



# Business To Manufacturing Markup Language

## Work Capability

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B2MML-WorkCapability





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**CHANGE HISTORY**

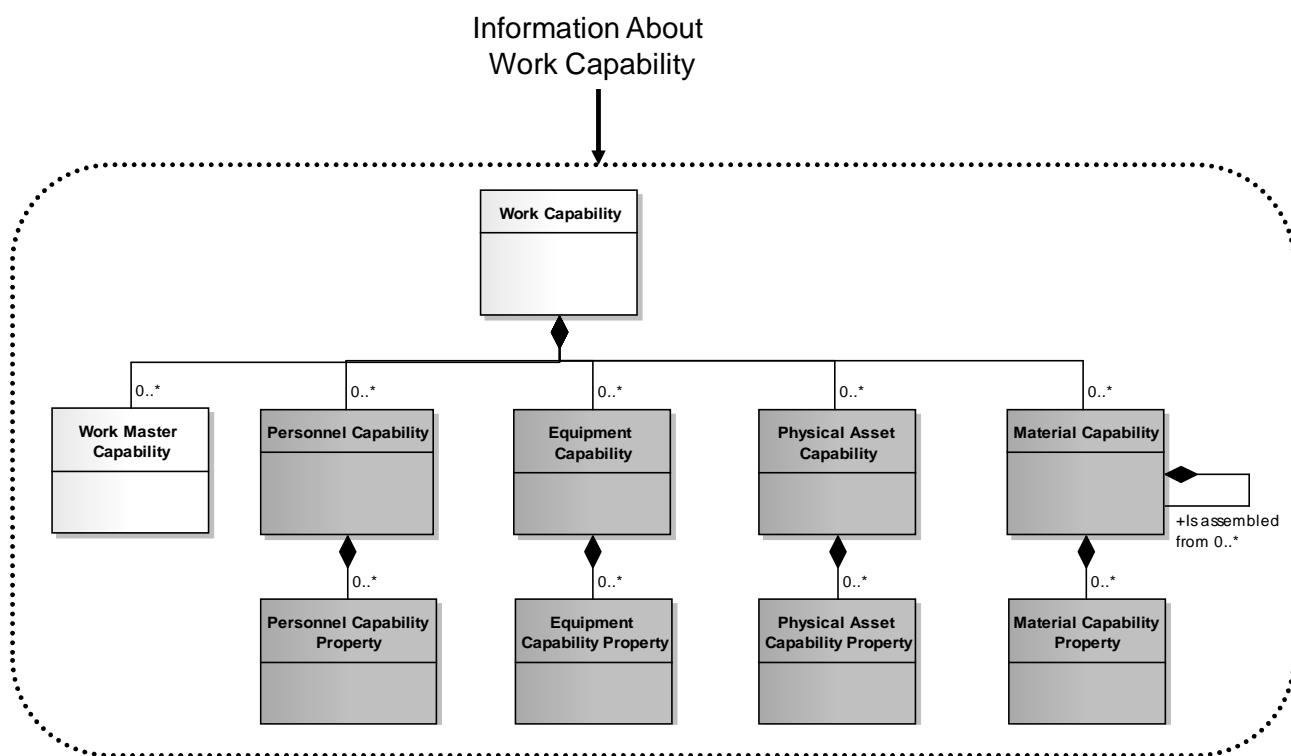
Change	Date	Person	Description
V0600	Aug 2012	D. Brandl	Initial Version

## SCHEMA SCOPE

This document defines the information about work capability by resource and by work master. This information is based on the data models and attributes defined in the ANSI/ISA 95.00.04 Enterprise/Control System Integration standard. Contact ISA (The Instrumentation, System, and Automation Society) for copies of the standard. Additional information on the standard is available at [www.isa.org](http://www.isa.org).

## Key Information Assumptions

The data represented in these schemas is derived from the UML model below. This model is defined in the ANSI/ISA 95.00.04 standard. The information model in the figure below is hierarchical, and the assumption is that any Work Capability information will always be within a contained Work Capability object.



Model of Exchanged Work Capability Information

This schema uses a common schema for definition of elements that are used in multiple schemas, such as ID, Description, and Value. See the document defining the Common schema for definition of the common elements.

## Type Definitions

The XML schema uses a model that defines simple and complex data types for each element. The data types all follow the convention of a suffix of “Type” added to the element name. Elements that have the same name in other B2MML schemas are also prefixed with “Op” to uniquely identify the extension group.

### Schema definition:

```
<xsd:element name = "OpPersonnelCapability" type = " OpPersonnelCapabilityType" />

<xsd:complexType name = "OpPersonnelCapabilityType">
  <xsd:sequence>
    <xsd:element name = "PersonnelClassID" type = "PersonnelClassIDType"
                  minOccurs = "0" />
    ...
  </xsd:sequence>
</xsd:complexType>
```

The method is a modification of the “Venetian Blind Model”, defined in the book Professional XML Schemas, 2001, published by WROX (ISBN 1-861005-47-4). It makes all of the type names global and usable in user derived works, without a loss of context or additional information required to identify the element as of being of the same type as related B2MML elements

## WorkCapabilityInformation

An operations information element is a collection of WorkCapability elements.

## WorkCapability

A Work Capability is the collection of information about all resources for production for selected times and within a selected site, area, process cell, production unit, or production line. This is made up of capability information about equipment, physical assets, material, personnel, and work masters. Work Capability also defines the available capability, committed capability, and unattainable capability of each resource, and each resource within a work master.

## Personnel Capability

Personnel capability is defined as a set of references to persons or personnel classes which were used or unused, or are committed, available or unattainable, for a defined time. Personnel capability contains references to persons or personnel classes. Personnel capability identifies the capability type (available, unattainable, committed), and the time associated with the capability (e.g. third shift on a specific date).

Specific personnel capabilities are defined in personnel capability properties. The personnel capability property may include the quantity of the resource referenced, such as 3 horizontal drill press operators available for the third shift on February 29, 2012.

## EquipmentCapability

Equipment capability is defined as a set of references to equipment or equipment classes which were used or unused, or are committed, available or unattainable, for a defined time. Equipment capability contains references to equipment or equipment classes. Equipment capability will usually identify the capability type (available, unattainable, and committed) and the time associated with the capability (e.g. third shift on a specific date).

Specific equipment capabilities are defined in equipment capability properties. The equipment capability properties may include the quantity of the resource referenced, such as 3 horizontal drill presses currently available.

## PhysicalAssetCapability

Physical asset capability is defined as a set of references to physical assets or physical asset classes which were used or unused, or are committed, available or unattainable, for a defined time. Physical asset capability contains references to physical assets or physical asset classes. Physical asset capability will usually identify the capability type (available, unattainable, and committed) and the time associated with the capability (e.g. third shift on a specific date).

Specific physical asset capabilities are defined in physical asset capability properties. The equipment capability properties may include the quantity of the resource referenced.

## MaterialCapability

Material capability is defined as a set of references to material lots or sublots which were used or unused, or are committed, available or unattainable, for a defined time. Material capability identifies the capability type (available, unattainable, and committed) and the time associated with the capability (e.g. third shift on a specific date).

Specific material capabilities are defined in material capability properties. The material capability properties may include the quantity of the material referenced.

## WorkMasterCapability

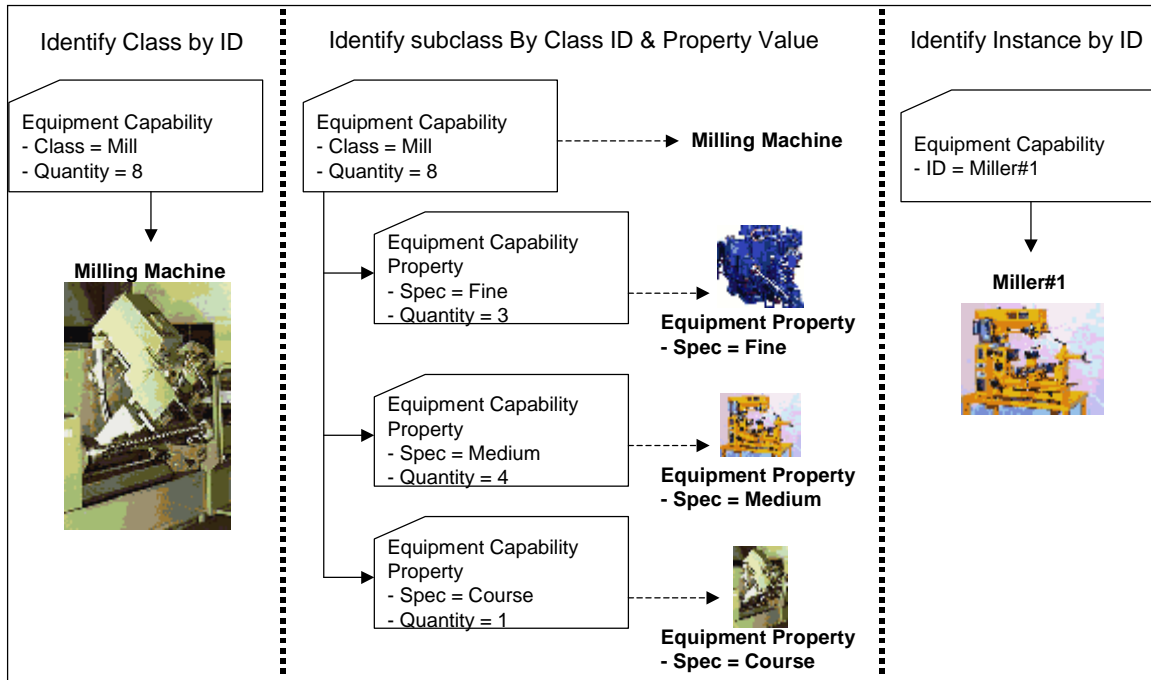
A work master capability is defined as a logical grouping of personnel resources, equipment resources, physical asset resources and material which were used or unused, or are committed, available or unattainable, for a defined time for a specific Work Master.

A work master capability identifies the capability type (available, unattainable, and committed), the time associated with the capability (e.g. third shift on a specific date).

## Resource Identification

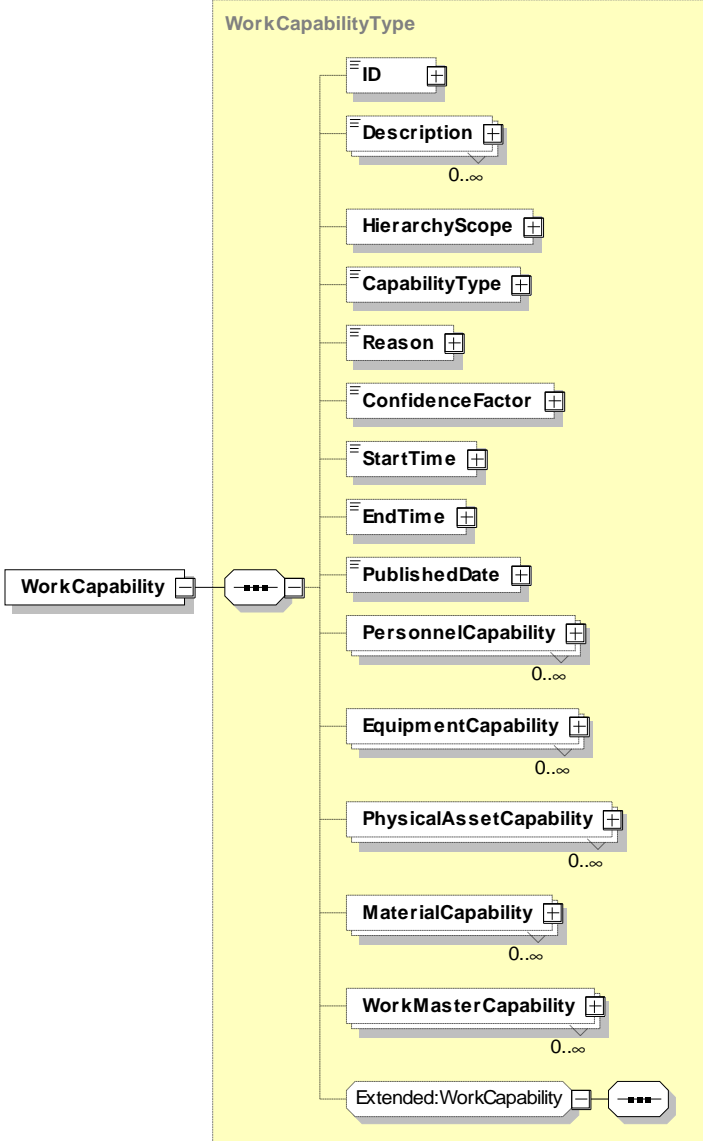
The schemas follow the ANSI/ISA-95 standard by defining resources by class ID or instance ID, or by defining them by class ID and a property value that is used to define a subset of the resource. For example, the figure below illustrates that a segment may require a certain number of milling machine, an equipment class. Other segments may require a subset of milling machine, such as "Fine" milling machines only. In the first case the class name, "Mill", is sufficient to identify the resource required. In the second case the class name, "Mill", and property name and value, "Spec" and "Fine", define the required resource. Alternately a specific resource may be specified for a Work Capability, such as specifying milling machine with ID="Miller#1".



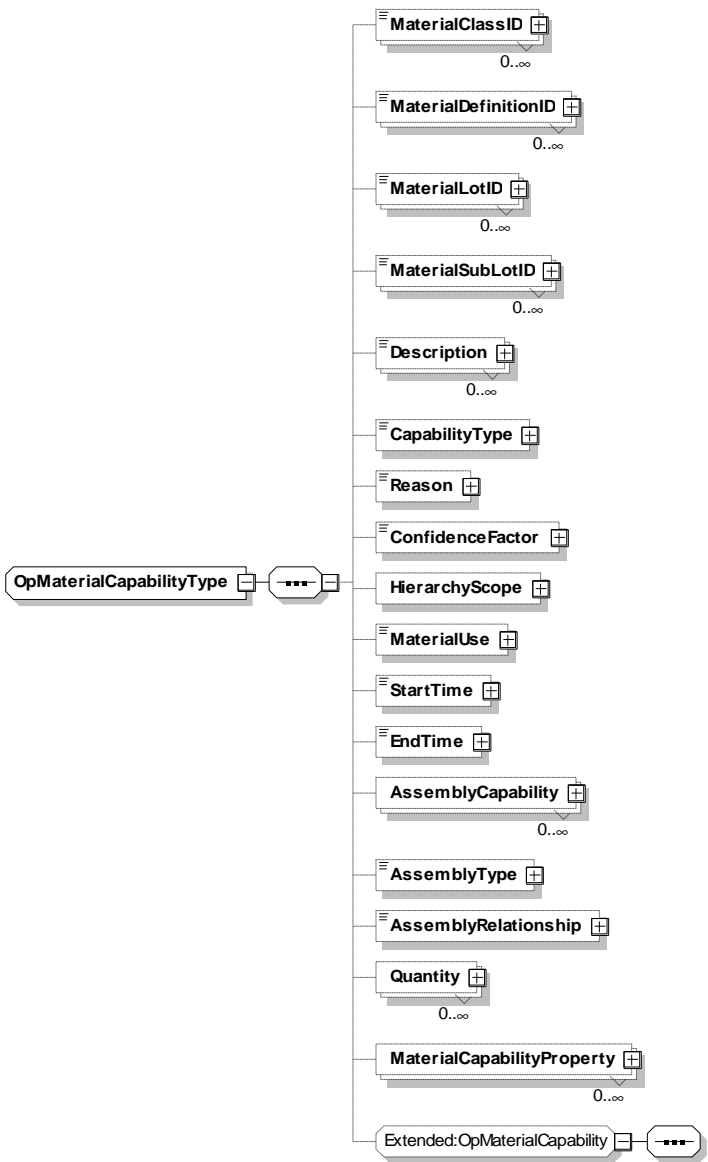



ELEMENT DEFINITIONS

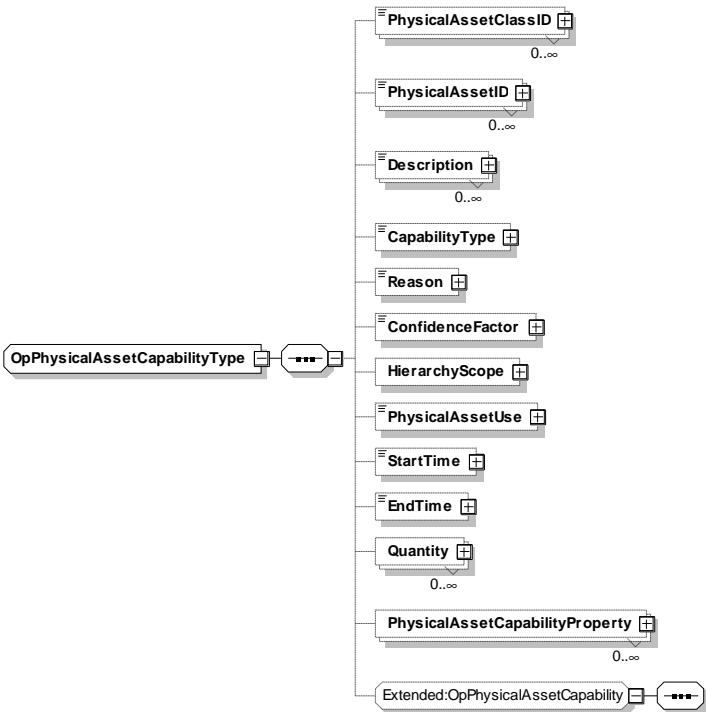
Element/Type	Description
WorkCapabilityInformation <i>WorkCapabilityInformationType</i>	<p>Contains a collection of WorkCapability elements. Contains an identification of the capability information, a description, and the hierarchy scope in the role based equipment hierarchy, the published date of the information and a set of Work Capability definitions.</p> <pre>classDiagram     class WorkCapabilityInformationType {         ID         Description 0..∞         HierarchyScope         PublishedDate         WorkCapability 0..∞         Extended:WorkCapabilityInformation     }     note for WorkCapabilityInformationType "WorkCapabilityInformation"</pre>

Element/Type	Description
WorkCapability <b>WorkCapabilityType</b>	<p data-bbox="634 226 1369 363">Contains a description of a Work Capability, including the hierarchy scope of the capability, the published date of the capability, the reason for the capability, the time range of the capability, the equipment, physical assets, material, and personnel resources for the capability, and work master capabilities within the Work Capability.</p>  <pre> classDiagram     class WorkCapabilityType {         ID         Description         HierarchyScope         CapabilityType         Reason         ConfidenceFactor         StartTime         EndTime         PublishedDate         PersonnelCapability         EquipmentCapability         PhysicalAssetCapability         MaterialCapability         WorkMasterCapability         ExtendedWorkCapability     }     class WorkCapability {     }     WorkCapabilityType "1" -- "0..*" WorkCapability     WorkCapabilityType --&gt; "0..*" Description     WorkCapabilityType --&gt; "0..*" PersonnelCapability     WorkCapabilityType --&gt; "0..*" EquipmentCapability     WorkCapabilityType --&gt; "0..*" PhysicalAssetCapability     WorkCapabilityType --&gt; "0..*" MaterialCapability     WorkCapabilityType --&gt; "0..*" WorkMasterCapability     WorkCapabilityType --&gt; "0..*" ExtendedWorkCapability   </pre> <p>The diagram illustrates the structure of the <b>WorkCapabilityType</b> class. It is associated with a <b>WorkCapability</b> class via a one-to-many relationship (indicated by a solid line with an open circle at the <b>WorkCapability</b> end and a crow's foot notation at the <b>WorkCapabilityType</b> end). The <b>WorkCapabilityType</b> class contains the following attributes and associations:</p> <ul style="list-style-type: none"> <li><b>ID</b>: A primary key attribute.</li> <li><b>Description</b>: An association to a class, with a multiplicity of 0..∞.</li> <li><b>HierarchyScope</b>: An attribute.</li> <li><b>CapabilityType</b>: An attribute.</li> <li><b>Reason</b>: An attribute.</li> <li><b>ConfidenceFactor</b>: An attribute.</li> <li><b>StartTime</b>: An attribute.</li> <li><b>EndTime</b>: An attribute.</li> <li><b>PublishedDate</b>: An attribute.</li> <li><b>PersonnelCapability</b>: An association to a class, with a multiplicity of 0..∞.</li> <li><b>EquipmentCapability</b>: An association to a class, with a multiplicity of 0..∞.</li> <li><b>PhysicalAssetCapability</b>: An association to a class, with a multiplicity of 0..∞.</li> <li><b>MaterialCapability</b>: An association to a class, with a multiplicity of 0..∞.</li> <li><b>WorkMasterCapability</b>: An association to a class, with a multiplicity of 0..∞.</li> <li><b>Extended:WorkCapability</b>: An association to a class, with a multiplicity of 0..∞.</li> </ul>

Element/Type	Description
EquipmentCapability <b>OpEquipmentCapabilityType</b>	<p>Contains a definition of an equipment capability. Including the type of the capability, the hierarchy scope of the capability, the time duration of the capability, the quantity of the capability, and the properties that may be required to identify capabilities of subsets of the class.</p> <pre> classDiagram     class OpEquipmentCapabilityType {         EquipmentClassID 0..∞         EquipmentID 0..∞         Description 0..∞         CapabilityType         Reason         ConfidenceFactor         HierarchyScope         EquipmentUse         StartTime         EndTime         Quantity 0..∞         EquipmentCapabilityProperty 0..∞     }     OpEquipmentCapabilityType .. &gt; OpEquipmentCapability : Extended   </pre>
EquipmentCapabilityProperty <b>OpEquipmentCapabilityPropertyType</b>	<p>Contains a definition of the quantity of an equipment property, including the value used to identify the class subset of the capability, and the quantity of the capability.</p>

Element/Type	Description
MaterialCapability <b>OpMaterialCapabilityType</b>	<p>Contains a definition of a material capability. Including the type of the capability, the hierarchy scope of the capability, the time duration of the capability, the quantity of the capability, the use of the material (consumed or produced), any contained material assembly capability definitions, and the properties that may be required to identify capabilities of subsets of the class.</p> 
MaterialCapabilityProperty <b>OpMaterialCapabilityPropertyType</b>	<p>Contains a definition of the quantity of a material property, including the value used to identify the class subset of the capability, the use of the material in the capability, and the quantity of the capability.</p>

Element/Type	Description
PersonnelCapability <b>OpPersonnelCapabilityType</b>	<p data-bbox="634 226 1365 338">Contains a definition of a personnel capability. Including the type of the capability, the hierarchy scope of the capability, the time duration of the capability, the quantity of the capability, and the properties that may be required to identify capabilities of subsets of the class.</p>  <pre> classDiagram     class OpPersonnelCapabilityType {         PersonnelClassID         PersonID         Description         CapabilityType         Reason         ConfidenceFactor         HierarchyScope         PersonnelUse         StartTime         EndTime         Quantity         PersonnelCapabilityProperty     }     class PersonnelClassID {         &lt;&lt;enumeration&gt;&gt;     }     class PersonID {         &lt;&lt;enumeration&gt;&gt;     }     class Description {         &lt;&lt;enumeration&gt;&gt;     }     class CapabilityType {         &lt;&lt;enumeration&gt;&gt;     }     class Reason {         &lt;&lt;enumeration&gt;&gt;     }     class ConfidenceFactor {         &lt;&lt;enumeration&gt;&gt;     }     class HierarchyScope {         &lt;&lt;enumeration&gt;&gt;     }     class PersonnelUse {         &lt;&lt;enumeration&gt;&gt;     }     class StartTime {         &lt;&lt;enumeration&gt;&gt;     }     class EndTime {         &lt;&lt;enumeration&gt;&gt;     }     class Quantity {         &lt;&lt;enumeration&gt;&gt;     }     class PersonnelCapabilityProperty {         &lt;&lt;enumeration&gt;&gt;     }     OpPersonnelCapabilityType "0..∞" -- "0..∞" PersonnelClassID     OpPersonnelCapabilityType "0..∞" -- "0..∞" PersonID     OpPersonnelCapabilityType "0..∞" -- "0..∞" Description     OpPersonnelCapabilityType "0..∞" -- "0..∞" CapabilityType     OpPersonnelCapabilityType "0..∞" -- "0..∞" Reason     OpPersonnelCapabilityType "0..∞" -- "0..∞" ConfidenceFactor     OpPersonnelCapabilityType "0..∞" -- "0..∞" HierarchyScope     OpPersonnelCapabilityType "0..∞" -- "0..∞" PersonnelUse     OpPersonnelCapabilityType "0..∞" -- "0..∞" StartTime     OpPersonnelCapabilityType "0..∞" -- "0..∞" EndTime     OpPersonnelCapabilityType "0..∞" -- "0..∞" Quantity     OpPersonnelCapabilityType "0..∞" -- "0..∞" PersonnelCapabilityProperty     OpPersonnelCapabilityType "0..∞" -- "0..∞" ExtendedOpPersonnelCapability   </pre> <p>The diagram illustrates the structure of the <b>OpPersonnelCapabilityType</b> class. It is a generalization of the <b>ExtendedOpPersonnelCapability</b> class. The <b>OpPersonnelCapabilityType</b> class has the following attributes: <b>PersonnelClassID</b>, <b>PersonID</b>, <b>Description</b>, <b>CapabilityType</b>, <b>Reason</b>, <b>ConfidenceFactor</b>, <b>HierarchyScope</b>, <b>PersonnelUse</b>, <b>StartTime</b>, <b>EndTime</b>, <b>Quantity</b>, and <b>PersonnelCapabilityProperty</b>. Each attribute is represented by a box with a plus sign and a multiplicity of 0..∞. The <b>ExtendedOpPersonnelCapability</b> class is shown as a generalization of <b>OpPersonnelCapabilityType</b>, indicated by a dashed line with an open arrow pointing from the generalization to the general.</p>

Element/Type	Description
PersonnelCapabilityProperty <b>OpPersonnelCapabilityPropertyType</b>	Contains a definition of the quantity of a personnel property, including the value used to identify the class subset of the capability, and the quantity of the capability.
PhysicalAssetCapability <b>OpPhysicalAssetCapabilityType</b>	Contains a definition of a physical asset capability. Including the type of the capability, the hierarchy scope of the capability, the time duration of the capability, the quantity of the capability, and the properties that may be required to identify capabilities of subsets of the class. 

Element/Type	Description
PhysicalAssetCapabilityProperty <b>OpPhysicalAssetCapabilityPropertyType</b>	Contains a definition of the quantity of a physical asset property, including the value used to identify the class subset of the capability, and the quantity of the capability.
WorkMasterCapability <b>WorkMasterCapabilityType</b>	<p>Contains a definition of a capability for a work master, includes the identification of the associated work master, the capability type, the reason for the capability, the location of the capability, the duration of the capability, the personnel, equipment, and material capability definitions.</p> <pre> classDiagram     class WorkMasterCapabilityType {         ID         Description 0..∞         WorkMasterID 0..∞         CapabilityType         Reason 0..∞         HierarchyScope 0..∞         StartTime         EndTime         PersonnelCapability 0..∞         EquipmentCapability 0..∞         PhysicalAssetCapability 0..∞         MaterialCapability 0..∞     }     class ExtendedWorkMasterCapability {     }     WorkMasterCapabilityType .. &gt; ExtendedWorkMasterCapability : Extended:WorkMasterCapability   </pre>



## TRANSACTION ELEMENTS

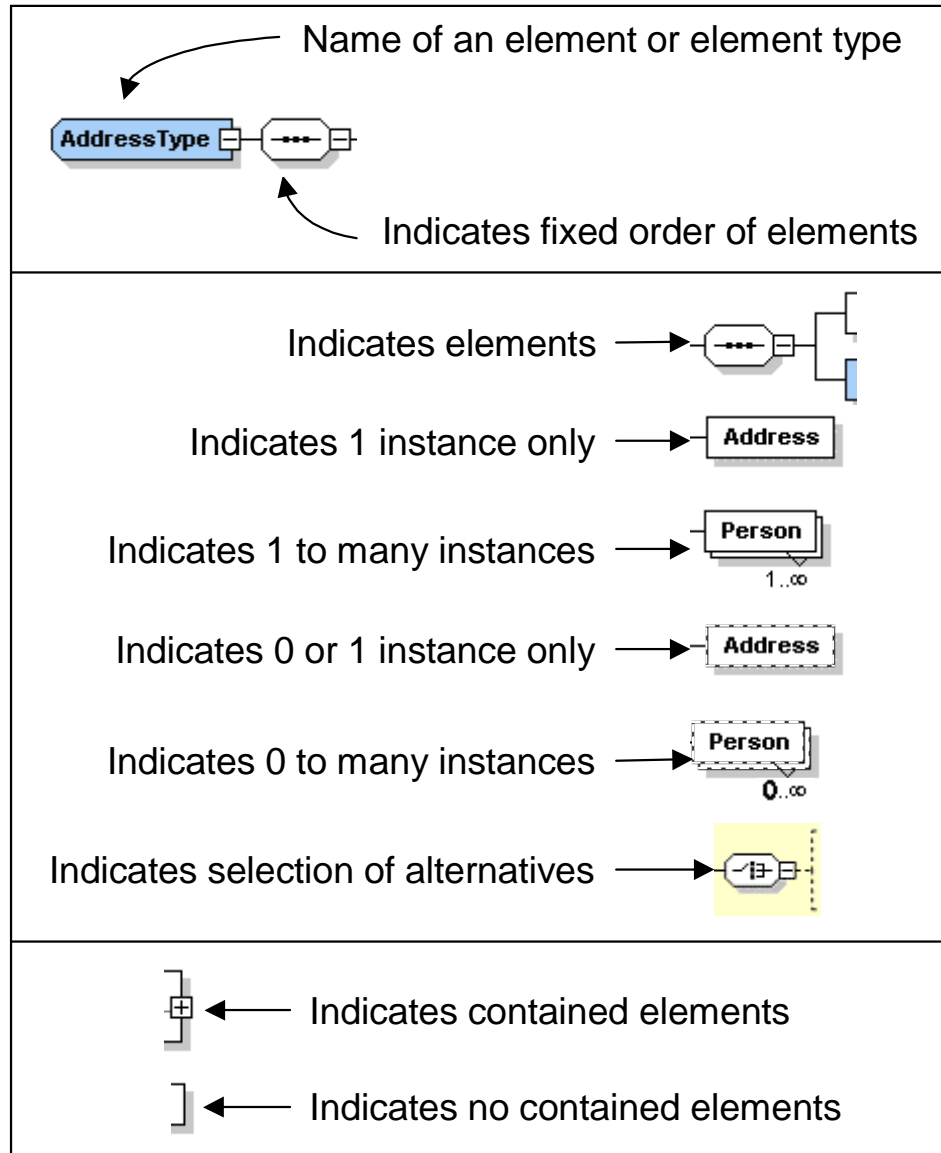
The following elements are defined to support the ISA 95 Part 5 transactions, using the transaction data types defined in the B2MML-Common.xsd schema.

Work Capability Information Elements	Description
GetWorkCapabilityInformation	Get a <i>WorkCapabilityInformation</i> definition.
ShowWorkCapabilityInformation	Returned information from the <i>GetWorkCapabilityInformation</i> message.
ProcessWorkCapabilityInformation	Process a <i>WorkCapabilityInformation</i> definition.
AcknowledgeWorkCapabilityInformation	Returned status from the <i>ProcessWorkCapabilityInformation</i> message.
ChangeWorkCapabilityInformation	Change a <i>WorkCapabilityInformation</i> definition.
RespondWorkCapabilityInformation	Returned status from the <i>ChangeWorkCapabilityInformation</i> message.
CancelWorkCapabilityInformation	Cancel a <i>WorkCapabilityInformation</i> definition.
SyncWorkCapabilityInformation	Published <i>WorkCapabilityInformation</i> definition.

Work Capability Elements	Description
GetWorkCapability	Get a <i>WorkCapability</i> definition.
ShowWorkCapability	Returned information from the <i>GetWorkCapability</i> message.
ProcessWorkCapability	Process a <i>WorkCapability</i> definition.
AcknowledgeWorkCapability	Returned status from the <i>ProcessWorkCapability</i> message.
ChangeWorkCapability	Change a <i>WorkCapability</i> definition.
RespondWorkCapability	Returned status from the <i>ChangeWorkCapability</i> message.
CancelWorkCapability	Cancel a <i>WorkCapability</i> definition.
SyncWorkCapability	Published <i>WorkCapability</i> definition.

## DIAGRAM CONVENTION

The schema diagrams using the following convention to illustrate the structure of the schema elements, the type of the elements and attributes, and the rules for optional elements and repetition.





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