Eu Project No.: 287933

ARTISAN

Energy-aware enterprise systems for low-carbon intelligent operations

Strep Project - ICT for a Low Carbon Economy Program

Dissemination level[1]	
Type of Document[2]	Internal Deliverable
Contractual date of delivery	
Actual Date of Delivery	
Deliverable Number	
Deliverable Name	**Extract from Interoperability Data Exchange Model Definition**
Deliverable Leader	**ENEA**
Type	Internal Document
Work package(s)	WP 5
Status & version	Draft
Number of pages	
WP contributing to the deliverable	WP 5
WP / Task responsible	T5.2
Author (name / contact)	Angelo Frascella
Other Contributors	
EC Project Officer	Grazyna Wojcieszko
Keywords:	Interoperability, Data model, Standards
Abstract (few lines)	This report is an extract from ARTISAN architecture deliverable about use of B2MML for exchanging data between ARTISAN system and textile companies ERP/MES

[1] PU Public
PP Restricted to other programme participants (including the Commission Services)
RE Restricted to a group specified by the consortium (including the Commission Services)
CO Confidential, only for members of the consortium (including the Commission Services)

[2] Official Deliverable (D), Internal Deliverable (ID), Data Collection (DC)

Index

List of figures

List of tables

1. Introduction

This document starts from ARTISAN data model, from identification of collection of requirements about the energy consumption data exchange between ARTISAN and external devices/services/actors for mapping the ARTISAN data model towards these standardized B2MML format.

1.1. Dictionary of terms

Term	Meaning
Embodied Energy	Embodied Energy is the sum of all the energy required to produce goods or services, considered as if that energy was incorporated or 'embodied' in the product or service itself (Mourtos, 2012)
Resource List	The resources (name, id, quantity) used for the production of a specific piece/article. These resources could be planned, actual or normal. (Damigos, 2012)

Table 1- dictionary of terms

2. Mapping of the data

In the following paragraph the mapping between the reference standards and the ARTISAN data model will be examined.

In order to represent the XML root of a document:

- the level of nesting of the elements will be represented with a number of vertical dashes equal to the level of nesting (for example || for level 2 of nesting)
- the symbol @ for representing an XML attribute

For example, the following XML document:

```
<root>
      <firstChild @attributo=0>
            <secondChild>Child</secondChild>
      </fistChild>
</root>
```

will be represented as

```
root
|-firstChild
```

```
|-@attribute
||-secondChild
```

2.1. Exchange of data with ERP/MES

2.1.1. B2MML in details

B2MML is “an XML implementation of the ANSI/ISA 95 family of standards (ISA95), known internationally as IEC/ISO 62264. B2MML consists of a set of XML schemas written using the World Wide Web Consortium's XML Schema language (XSD) that implement the data models in the ISA-95 standard” (B2MML, 2013).

B2MML v0600 schema and documentation can be downloaded at:

https://services.mesa.org/Document/ResourceFile?resourceId=0f47758b-60f0-40c6-a71b-fa7b2363fb3a&documentId=a9d7c6b9-7805-4fb6-9ca4-d1190a2db835

The related page is: https://services.mesa.org/ResourceLibrary/ShowResource/0f47758b-60f0-40c6-a71b-fa7b2363fb3a

B2MML allows the exchange of the following pieces of information:

Resource definitions	Personnel / Equipment / Material
Production capability	What is available to use
Product definition	How to make a product
Product Schedule	What to make and use
Production performance	What was made and used

Table 2 - Information Exchanged with B2MML (Brandl, 2008)

B2MML involves:

- A **core component library** (*B2MML-V05-CoreComponents.xsd*), defining the common types;
- A **common library** (*B2MML-V05-Common.xsd*) including a set of elements re-used in different schemas;
- Schemas (B2MML-V05-CommonExtensions.xsd, B2MML-V05-AllExtensions.xsd and B2MML-V05-Extensions.xsd) that can be edited by the user **for extending B2MLL**.

- A schema for **defining the supported transaction actions** (*B2MML-V05-TransactionProfile.xsd*). It allows to get the information
  - about what are the 2B2MML transaction supported among the following: GET, PROCESS, CHANGE, CANCEL, CONFIRM, SYNC ADD, SYNC CHANGE, and SYNC DELETE
  - about the supported objects among the following: “PERSONNEL CLASS", “PERSON", “QUALIFICATION TEST", “EQUIPMENT CLASS", “EQUIPMENT", “CAPABILITY TEST", “MAINTENANCE REQUEST", “MAINTENANCE WORK ORDER", “MAINTENANCE RESPONSE", “MATERIAL CLASS", "MATERIAL DEFINITION", “MATERIAL LOT", “MATERIAL SUBLOT", "MATERIAL TEST", "PROCESS SEGMENT", "OPERATIONS CAPABILITY", “OPERATIONS DEFINITION", “OPERATIONS SCHEDULE", “OPERATIONS PERFORMANCE", "PRODUCTION CAPABILITY", “PRODUCT DEFINITION", “PRODUCTION SCHEDULE", “PRODUCTION PERFORMANCE", “TRANSACTION PROFILE", “CONFIRM BOD”, or “Other”
- A **confirmation message** (*B2MML-V0500-ConfirmBOD.xsd*) that is the message that is returned when the confirmation option is specified in a message
- Three messages implementing BatchML, an implementation of IEC 61512 standard for standardizing and normalizing recipe development and transfer
- A set of messages for definition of the objects (see Table 3)

Table 3 - List of messages (defining the objects) of B2MML

SCHEMA	aim
B2MML-V0600-Equipment.xsd	Define the information about equipment, grouping of equipment with similar characteristic, equipment capability test
B2MML-V0600-Material.xsd	Define the information about material definitions, material classes, material lots, material sub-lots, and Quality Assurance tests.
B2MML-V0600-OperationsCapability.xsd	Define the information of capability (intended as a set of information about, for example, if it is committee or available for a defined time) of operations, personnel, equipment, physical asset, material, process segment and resource identification
B2MML-V0600-OperationsDefinition.xsd	Define the information about operation. This involves Manufacturing Bill (a material or material class that is needed for operations), operations segment (what personnel, equipment, physical asset, or material resources are required for execution of the operations segment), personnel specification (personnel resources required for production of the product within an operations segment) and, similarly,

	equipment specifications, physical asset specifications and material specifications.
B2MML-V0600-OperationsPerformance.xsd	Defines the information about Operations Performance information (e.g. production unit cycle times, resource utilization, equipment utilization, equipment performance, procedure efficiencies, and production variability). It includes the definition of use of resources as electricity and steam.
B2MML-V0600-OperationsSchedule.xsd	Define the information about operation schedule
B2MML-V0600-Personnel.xsd	Define the information about operation schedule
B2MML-V0600-PhysicalAsset.xsd	Define the information about physical asset classes, physical assets, and physical asset capability tests
B2MML-V0600-ProcessSegment.xsd	Define the information about process segment. According to the documentation of the standard, "a process segment is a logical grouping of personnel resources, equipment resources, and material required to carry out a production step. Process segment usually define the needed classes of personnel, equipment, and material, but it may define specific resources, such as specific equipment needed. Process segment usually define the quantity of the resource needed"
B2MML-V0600-ProductDefinition.xsd	Define the "product definition" that is the object containing information about the product
B2MML-V0600-ProductionCapability.xsd	It is a "collection of information about all resources for production for selected times and within a selected site, area, process cell, production unit, or production line."
B2MML-V0600-ProductionPerformance.xsd	It defines the information about production performances, including information about energy consumption (within the consumable element).
B2MML-V0600-ProductionSchedule.xsd	It defines the production schedules (which include the availability of information about energy consumption)
B2MML-V0600-ResourceRelationshipNetwork.xsd	This element allows for the exchange of information about one or more resource network connection types (where the resource types are: Personnel, Personnel Class, Equipment, Equipment Class etc. and connection could be logical or physical)
B2MML-V0600-TransactionProfile.xsd	It defines the information about transaction profile definitions that may be exchanged between business systems and manufacturing operations systems. This profile contains a set of supported actions (that are GET, PROCESS, CHANGE, CANCEL, etc.)
B2MML-V0600-WorkAlert.xsd	It defines the information about the definition of work alert information that may be exchanged by manufacturing operations management systems
B2MML-V0600-WorkCapability.xsd	It defines the information about work capability by resource and by work master, where work capability is 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
B2MML-V0600-WorkDefinition.xsd	It defines the information about the work definition information that may be exchanged by manufacturing operations management systems
B2MML-V0600-WorkflowSpecification.xsd	It defines the information about the definition of operations information that may be exchanged by manufacturing operations management systems.
B2MML-V0600-WorkPerformance.xsd	It defines the information about Work Performance
B2MML-V0600-WorkSchedule.xsd	It defines the information about work schedules and job lists

In the following paragraphs the mapping about ARTISAN communications and B2MML messages will be defined. It is important to note that, even if, B2MML is not used at is full potentiality by ARTISAN, it is really a better way of working basing these communications on an existing standard, than inventing proprietary schemes for that purpose, since in this last case the interoperability of the system will be lost.

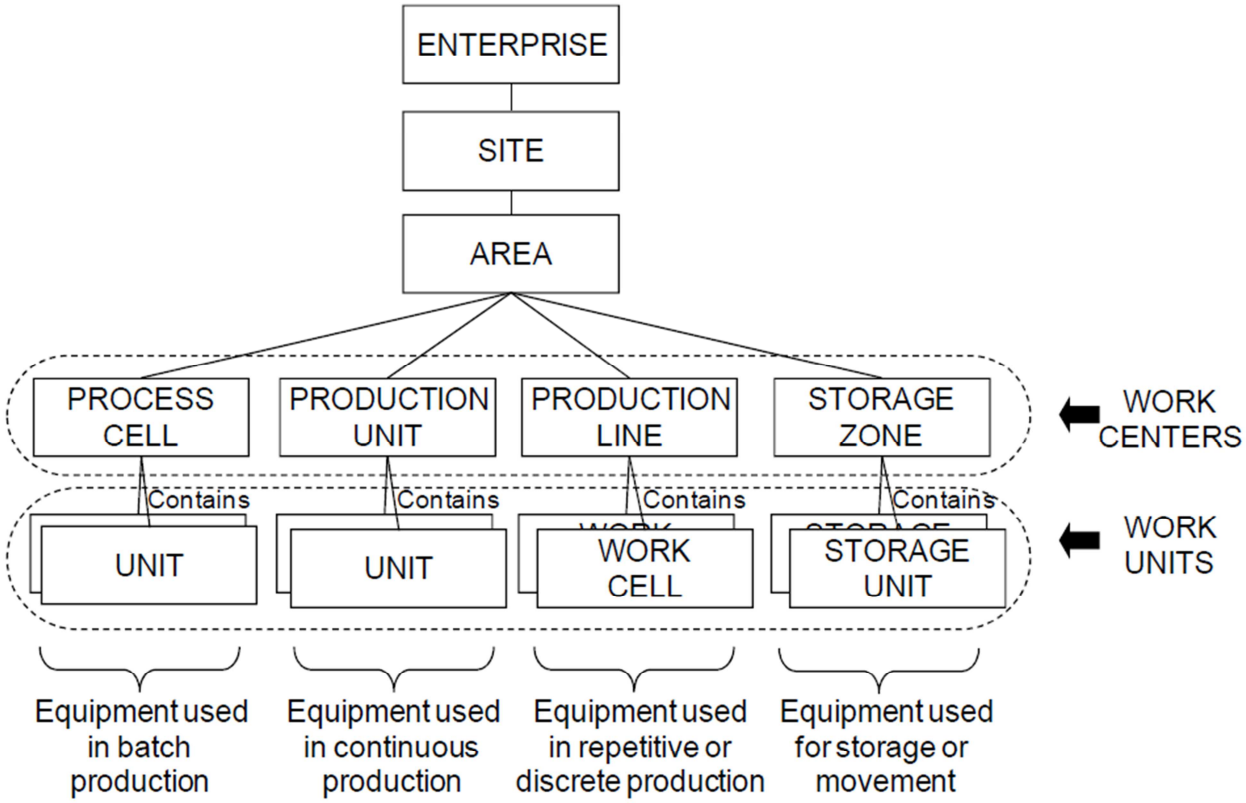

Figure 1 - Terminology used in naming the equipment levels in B2MML (B2MML, 2013)

2.1.2. Partners

The ARTISAN data model is the following:

Table 4 - data model for Partners

Data Model	Description	Type	Occurrence
List of partners			
|-Partner			1-N
||-ID	The ID of the partner.	String	1-1
||-Name	The unique name of the partner	String	1-1
||-Description	The description of the partner	String	0-1

There is not specific message for exchanging list of partners using B2MML, but the B2MML-V0600-Personnel.xsd schema can be easily adapted to this aim.

Starting from the data model documentation about the data that have to be exchanged about partners (see Table 4), the mapping will be defined as shown in Table 5.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-Personnel.xsd** schema, the second using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

The previous data can be mapped to the ***Personnel message*** of B2MML in the following way:

Table 5 - List of Partners mapped to B2MML-V0600-Personnel.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
PersonnelInformation			
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-Person	0-N	Partner	
||-ID	0-1	Partner/ID	The ID of the partner
||-Description	0-N	Partner/Description	The description of the partner
||-PersonName	0-1	Partner/Name	The unique name of the partner
||-PersonnelClassID	0-1		This has to be fixed to “Partner” and allows to understand that this message is for partners and not for employees
|- PersonnelClass	0-N		Here is defined the value for PersonnelClassID
||-ID	1		This has to be fixed to “Partner”
||-Description	0-1		If used, this has to be fixed to

		"Supply chain partner", and makes easier to understand the ID

An example of list of Partner message is shown in Figure 2.

```
<?xml version="1.0" encoding="UTF-8"?>
<PersonnelInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-Personnel.xsd">
    <ID>MESS151</ID> <!-- ID of the message -->
    <Description>Partners List</Description>
    <PublishedDate>2013-09-24T06:00:00</PublishedDate> <!-- Timestamp of the
message -->
    <Person>
        <ID>P1</ID>
        <Description>Marc Cain</Description>
        <PersonName>MarcCain</PersonName>
        <PersonnelClassID>Partner</PersonnelClassID>
    </Person>

    <Person>
        <ID>P2</ID>
        <Description>Piacenza</Description>
        <PersonName>Piacenza</PersonName>
        <PersonnelClassID>Partner</PersonnelClassID>
    </Person>

    <PersonnelClass> <!-- This identify that this message is for supply chain
partners -->
        <ID>Partner</ID>
        <Description>Supply chain partner</Description>
    </PersonnelClass>
</PersonnelInformation>
```

Figure 2 – Example of list of Partner message

2.1.3. Departments

The ARTISAN data model is the following:

Table 6 - data model for Departments

Data Model	Description	Type	Occurrence
List of departments			
|-Department			1-N
||-ID	The ID of the department.	String	1-1
||-Name	The unique name of the department	String	1-1
||-Description	The description of the department	String	0-1
||-Facility	The ID of the facility that owns the department	String	1-1

B2MML provide a schema for defining Process Segment, where a process segment is logical grouping of personnel resources, equipment resources, and material required to carry out a production step. This definition matches well with the department definition and so the schema B2MML-V0600-ProcessSegment.xsd can be used for mapping the list of Departments (ARTISAN Data model in Table 6 - data model for Departments)

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. As said above, the first message can be expressed using the **B2MML-V0600-ProcessSegment.xsd** schema, but some flexibility in its use is needed, since it does not contain the fields for inserting the unique name of the department and the related facility. For this aims the parameter field could be used as shown below (Table 7).

The confirmation can be sent using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 7 - List of departments mapped to B2MML-V0600-ConfirmBOD.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProcessSegmentInformation			
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-1	Value fixed to "List of Departments"	This would allow to understand the aim of this message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-ProcessSegment	0-N	Department	
||-ID	0-1	Department/ID	The ID of the department
||-Description	0-N	Department /Description	The description of the department
||- Parameter	0-N		
|||-ID	0-1	Value fixed to "Name"	
|||-Value	0-1		
|||-ValueString	1	Department/Name	The unique name of the department
||- Parameter	0-N		
|||-ID	0-1	Value fixed to "Facility"	
|||-Value	0-1		
|||-ValueString	1	Department/Facility	The ID of the facility that owns the department

An example of List of Partner message is shown in Figure 3

```
<?xml version="1.0" encoding="UTF-8"?>
<ProcessSegmentInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProcessSegment.xsd">
    <ID></ID>
    <Description>List of Departments</Description>
    <PublishedDate>2013-09-24T06:00:00</PublishedDate>
    <ProcessSegment>
        <ID>D1</ID>
        <Description>Department A</Description>
        <Parameter>
            <ID>Name</ID>
            <Value>
                <ValueString>Yarning department</ValueString>
            </Value>
        </Parameter>
        <Parameter>
            <ID>Facility</ID>
            <Value>
                <ValueString>F1</ValueString>
            </Value>
            <Description>ID of the facility that owns the
department</Description>
        </Parameter>
    </ProcessSegment>

    <ProcessSegment>
        <ID>D2</ID>
        <Description>Department B</Description>
        <Parameter>
            <ID>Name</ID>
            <Value>
                <ValueString>Dyeing department</ValueString>
            </Value>
        </Parameter>
        <Parameter>
            <ID>Facility</ID>
            <Value>
                <ValueString>F2</ValueString>
            </Value>
            <Description>ID of the facility that owns the
department</Description>
        </Parameter>
    </ProcessSegment>
</ProcessSegmentInformation>
```

Figure 3 – Example of List of Departments message

2.1.4. Facilities

The ARTISAN Data Model is the following

Table 8 - data model for List of Facilities

Data Model	Description	Type	Occurrence
List of facilities			
|-Facility			1-N
||-ID	The ID of the facility	String	1-1
||-Name	The unique name of the facility	String	1-1

||-Description	The description of the facility	String	0-1
||-Partner	The ID of the partner that owns the facility	String	1-1

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ProcessSegment.xsd** schema, but some flexibility in its use is needed, since it does not contain the fields for inserting the unique name of the related partner. For this aims the parameter field could be used as shown below (Table 9).

The confirmation can be sent using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 9 - List of Facilities mapped to B2MML-V0600-ProcessSegment.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProcessSegmentInformation		List of facilities	
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-1	Value fixed to "List of Facilities"	This would allow to understand the aim of this message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-ProcessSegment	0-N	Facility	
||-ID	0-1	Facility/ID	The ID of the facility
||-Description	0-N	Facility /Description	The description of the facility
||- Parameter	0-N		
|||-ID	0-1	Value fixed to "Name"	
|||-Value	0-1		
|||-ValueString	1	Department/Name	The unique name of the facility
||- Parameter	0-N		
|||-ID	0-1	Value fixed to "Partner"	
|||-Value	0-1		
|||-ValueString	1	Department/Partner	The ID of the partner that owns the department

An example of list of Facilities message is shown in Figure 4

```
<?xml version="1.0" encoding="UTF-8"?>
<ProcessSegmentInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProcessSegment.xsd">
```

```
    <ID>F12A</ID>
    <Description>List of Facilities</Description>
    <PublishedDate>2013-09-24T06:00:00</PublishedDate>
    <ProcessSegment>
        <ID>F1</ID>
        <Description>The main building</Description>
        <Parameter>
            <ID>Name</ID>
            <Value>
                <ValueString>Building  A</ValueString>
            </Value>
        </Parameter>
        <Parameter>
            <ID>Partner</ID>
            <Value>
                <ValueString>P1</ValueString>
            </Value>
            <Description>ID of the partner that owns the
department</Description>
        </Parameter>
    </ProcessSegment>

    <ProcessSegment>
        <ID>F2</ID>

        <Parameter>
            <ID>Name</ID>
            <Value>
                <ValueString>Building  B</ValueString>
            </Value>
        </Parameter>
        <Parameter>
            <ID>Partner</ID>
            <Value>
                <ValueString>P2</ValueString>
            </Value>
            <Description>ID of the partner that owns the
department</Description>
        </Parameter>
    </ProcessSegment>
</ProcessSegmentInformation>
```

Figure 4 – Example of List of Facilities message

2.1.5. Shifts

The ARTISAN Data Model is the following

Table 10 - data model for list of Shifts

Data Model	Description	Type	Occurrence
List of shifts			
|-Shifts			1-N
||-ID	The ID of the shift	String	1-1
||-Date	The date of the shift (FORMAT: yyyy-MM-dd)	String	1-1
||- Number	The number of the shift in that date	String	0-1

The "shift" entity is not directly represented in B2MML but it is referred in the Production Capability documentation. In particular, the production 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 and seems well suited for representing the list of shifts.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. As said above, the first message can be expressed using the **B2MML-V0600-ProductionCapability.xsd** schema, but some flexibility in its use is needed, since it does not contain the fields for inserting directly the shift entity (and so, for example its number), it has temporal reference that needs also time (while the ARTISAN one requires only date). For this aims the Personnel Capability Property field could be used as shown below (Table 11).

The confirmation can be sent using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 11 - List of shifts mapped to B2MML-V0600-ProductionCapability.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductionCapability		List of Shifts	
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-1		Value fixed to "List of shifts"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-CapabilityType	1		This is mandatory in B2MML message. It is suggested to give to it the value "Other"
|- PersonnelCapability	0-N	Shift	
|!-CapabilityType	1		This is mandatory in B2MML message. It is suggested to give to it the value "Other"
||-StartTime	0-N	Shift /Date	The Date of the shift. Since, in the B2MML document also a time is needed, it is suggested to set the time at 00:00:01
||-PersonnelCapabilityProperty	0-N		
|||-ID	0-1		Value fixed to "ID"
|||-Description			Value fixed to "The ID of the shift"
|||-Value	0-1		
|||-ValueString	1	Shift/ID	The ID the facility
||-PersonnelCapabilityProperty	0-N		
|||-ID	0-1	Value fixed to "Number"	

|||-Value	0-1		
|||-ValueString	1	Shift/Number	The Number of the shift

An example of List of Shifts message is shown in Figure 5.

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductionCapability xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProductionCapability.xsd">
    <ID>H12D</ID>
    <Description>List of shifts</Description>
    <CapabilityType>Other</CapabilityType>

    <PersonnelCapability>
        <CapabilityType>Other</CapabilityType>
        <StartTime>2013-01-01T00:00:00</StartTime>
        <PersonnelCapabilityProperty>
            <ID>ID</ID>
            <Description>The ID of the shift</Description>
            <Value>
                <ValueString>S1</ValueString>
            </Value>

        </PersonnelCapabilityProperty>
        <PersonnelCapabilityProperty>
            <ID>Number</ID>
            <Description>The Number of the shift</Description>
            <Value>
                <ValueString>1</ValueString>
            </Value>
        </PersonnelCapabilityProperty>
    </PersonnelCapability>

</ProductionCapability>
```

Figure 5 – Example of List of Shifts message

2.1.6. Shit assignments

The ARTISAN Data Model is the following

Table 12 - data model for Shifts Assignment

Data Model	Description	Type	Occurrence
Shift assignments			
|-Shift	The ID of the shift	String	1-N
|-Employee	The ID of the employee	String	1-N
|-Machine	The ID of the machine	String	1-N

The assignments of shifts to employees could be done using again the Production Capability document.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. As said above, the first message can be expressed using the **B2MML-V0600-ProductionCapability.xsd** schema, but some flexibility in its use is needed, since it does not contain the fields for inserting directly the shift entity. For this aims the Personnel Capability Property field could be used as shown below (Table 11).

The confirmation can be sent using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 13 - List of shifts mapped to B2MML-V0600-ProductionCapability.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductionCapability		List of Shift assignments	
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-1		Value fixed to "Shift Assignments"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-CapabilityType	1		This is mandatory in B2MML message. It is suggested to give to it the value "Used"
|-PersonnelCapability	0-N	Shift assignments	
||-CapabilityType	1		This is mandatory in B2MML message. It is suggested to give to it the value "Used"
||-HierarchyScope	0-1		
|||-EquipmentID	1	Shift assignments/Machine	The ID of the machine
|||-EquipmentElementLevel			This is mandatory in B2MML message. It is suggested to give to it the value "Enterprise"
||-PersonnelCapabilityProperty	0-N		
|||-ID	0-1		Value fixed to "Shift"
|||-Description	0-1		
|||-Value	0-1		Value fixed to "The ID of the shift"
|||-ValueString	1	Shift assignments/Shift	The ID the Shift
||-PersonnelCapabilityProperty	0-N		
|||-ID	0-1		Value fixed to "Number"
|||-Value	0-1		
|||-ValueString	1	Shift/Number	The Number of the shift

An example of Shift Assignment message is shown in Figure 6

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductionCapability xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProductionCapability.xsd">
    <ID>H12</ID>
    <Description>Shift Assignments</Description>
   <CapabilityType>Used</CapabilityType>

    <PersonnelCapability>
        <PersonID>E1</PersonID> <!-- ID of the Employee -->
        <CapabilityType>Used</CapabilityType>
        <HierarchyScope>
            <EquipmentID>M1</EquipmentID> <!-- ID of the Machine -->
            <EquipmentElementLevel>Enterprise</EquipmentElementLevel>
        </HierarchyScope>
        <PersonnelCapabilityProperty>
            <ID>Shift</ID>
            <Value>
                <ValueString>S1</ValueString>  <!-- ID of the Shift -->
            </Value>
        </PersonnelCapabilityProperty>
    </PersonnelCapability>

    <PersonnelCapability>
        <PersonID>E2</PersonID> <!-- ID of the Employee -->
        <CapabilityType>Used</CapabilityType>
        <HierarchyScope>
            <EquipmentID>M2</EquipmentID> <!-- ID of the Machine -->
            <EquipmentElementLevel>Enterprise</EquipmentElementLevel>
        </HierarchyScope>
        <PersonnelCapabilityProperty>
            <ID>ID of Shift</ID>
            <Value>
                <ValueString>S1</ValueString>  <!-- ID of the Shift -->
            </Value>
        </PersonnelCapabilityProperty>
    </PersonnelCapability>

</ProductionCapability>
```

Figure 6 – Example of Shift Assignment message

2.1.7. Machines

The ARTISAN Data Model is the following

Table 14 - data model for Machines

Data Model	Description	Type	Occurrence
List of machines			
|-Machine			1-N
||-ID	The ID of the machine	String	1-1
||-Name	The unique name of the machine	String	1-1
||-Description	The description of the machine	String	0-1

||-Priority	The priority of the machine	Integer	0-1
||-Department	The ID of the department, where the machine is located	String	1-1

The Production Capability B2MML document fit very well with the data model of the machine entity.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. As said above, the first message can be expressed using the **B2MML-V0600-ProcessCapability.xsd** schema (Table 15). The confirmation can be sent using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 15 - List of Machines mapped to B2MLL

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductionCapability		List of Machines	
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-1	Value fixed to "List of Machines"	This would allow to understand the aim of this message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-CapabilityType	1		This is mandatory in B2MML message. It is suggested to give to it the value "Used"
|-EquipmentCapability	0-N	Machine	
||-EquipmentID	0-1	Machine/ID	The ID of the machine
||-Description	0-1	Machine/Description	The Description of the machine
||-CapabilityType	1		This is mandatory in B2MML message. It is suggested to give to it the value "Used"
||-HierarchyScope	0-1		
|||-EquipmentID	1	Machine/Department	The ID of the Department where the machine is located
|||-EquipmentElementLevel	1		This is mandatory in B2MML message. It is suggested to give to it the value "Area"
||||- HierarchyScope	0-1		
|||||-EquipmentID	1	Machine/Name	The unique name of the machine
|||||-EquipmentElementLevel	1		This is mandatory in B2MML message. It is suggested to give to it the value "EquipmentModule"
||-	0-N		

EquipmentCapabilityProperty			
|||-ID	0-1	Value fixed to "Priority"	
|||-Value	0-1		
|||-ValueString	1	Machine/Priority	The priority of the Machine

An example of Machines message is shown in Figure 7

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductionCapability xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProductionCapability.xsd">
    <ID>H212</ID>
    <Description>List of Machines</Description>
    <CapabilityType>Used</CapabilityType>

    <EquipmentCapability>
        <EquipmentID>M1</EquipmentID> <!-- Machine ID  -->
        <Description>A sewing machine </Description>
        <CapabilityType>Used</CapabilityType>
        <HierarchyScope>
            <EquipmentID>D1</EquipmentID> <!-- Dipartiment ID -->
            <EquipmentElementLevel>Area</EquipmentElementLevel>
            <HierarchyScope>
                <EquipmentID>Sewing machine A</EquipmentID> <!-- Equipment Name
-->
                <EquipmentElementLevel>EquipmentModule</EquipmentElementLevel>
            </HierarchyScope>
        </HierarchyScope>
        <EquipmentCapabilityProperty>
            <ID>Priority</ID>
            <Value>
                <ValueString>3</ValueString>
            </Value>
        </EquipmentCapabilityProperty>
    </EquipmentCapability>

    <EquipmentCapability>
        <EquipmentID>M2</EquipmentID> <!-- Machine ID  -->
        <Description>A washing machine </Description>
        <CapabilityType>Used</CapabilityType>
        <HierarchyScope>
            <EquipmentID>D2</EquipmentID> <!-- Dipartiment ID -->
            <EquipmentElementLevel>Area</EquipmentElementLevel>
            <HierarchyScope>
                <EquipmentID>Washing machine A</EquipmentID> <!-- Equipment Name
-->
                <EquipmentElementLevel>EquipmentModule</EquipmentElementLevel>
            </HierarchyScope>
        </HierarchyScope>
        <EquipmentCapabilityProperty>
            <ID>Priority</ID>
            <Value>
                <ValueString>2</ValueString>
            </Value>
        </EquipmentCapabilityProperty>
```

```
    </EquipmentCapability>

</ProductionCapability>
```

Figure 7 – Example of list of Machines message

2.1.8. Employees

The ARTISAN Data Model is the following:

Table 16 - data model for Employees

Data Model	Description	Type	Occurrence
List of Employees			
|-Employee	An occurrence for each employee in the department		1-N
||-Id	The univocal Identifier of the employee (it could be the matriculation number)	String	1-1
||-Name	Name of the employee	String	1-1

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-Personnel.xsd** schema, the second using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

The previous data can be mapped to the ***Personnel message*** of B2MML in the following way:

Table 17 - List of employees and used machines mapped to B2MML-V0600-Personnel.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
PersonnelInformation			
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-N		Value fixed to "Employees"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-Person	0-N	Employees	
||-ID	0-1	Employees/ID	The ID of the employee
||- PersonName	0-1	Employees/Name	The Name of the employee

An example of Employees message is shown in Figure 8

```
<?xml version="1.0" encoding="UTF-8"?>
<PersonnelInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

```
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-Personnel.xsd">
<Description></Description>
    <PublishedDate>2013-09-24T06:00:00</PublishedDate>
   <Person>
        <ID>E1</ID>
        <PersonName>Isaac Blue</PersonName>
    </Person>

    <Person>
        <ID>E2</ID>
        <PersonName>John Black</PersonName>
    </Person>

</PersonnelInformation>
```

Figure 8 – Example of list of Employees message

2.1.9. Employee Qualifications

The ARTISAN Data Model is the following:

Table 18 - data model for Employee Qualifications

Data Model	Description	Type	Occurrence
Employee qualifications			
|-Employee	The ID of the employee		1
|-Machine	The ID of the machine		1-N

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-Personnel.xsd** schema, the second using the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

The previous data can be mapped to the ***Personnel message*** of B2MML in the following way:

Table 19 – Employee Qualifications mapped to B2MML-V0600-Personnel.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
PersonnelInformation			
|-ID	0-1		It could be used ad ID of the message in order to be able to refer univocally to it
|-Description	0-N		Value fixed to "Employee Qualifications"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-Person	0-N		
||-ID	0-1	Employee	The ID of the employee
||- HierarchyScope	0-1		

||||-EquipmentID	1	Machine	The ID of the Machine
||||-EquipmentElementLevel	1		It is suggested to use, for it, "Enterprise" as fixed value

An example of Employee Qualifications message is shown in Figure 9

```
<?xml version="1.0" encoding="UTF-8"?>
<PersonnelInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/B2MML-V0600-Personnel.xsd">
    <PublishedDate>2013-09-24T06:00:00</PublishedDate>     <!--Timestamp of the
message-->
    <Person>
        <ID>E1</ID>
        <HierarchyScope>
            <EquipmentID>M1</EquipmentID>
            <EquipmentElementLevel>Enterprise</EquipmentElementLevel>
        </HierarchyScope>
    </Person>

    <Person>
        <ID>E2</ID>
        <HierarchyScope>
            <EquipmentID>M2</EquipmentID>
            <EquipmentElementLevel>Enterprise</EquipmentElementLevel>
        </HierarchyScope>
    </Person>
</PersonnelInformation>
```

Figure 9 – Example of Employee Qualifications message

2.1.10. Planned / Produced Orders

The ARTISAN Data Model is the following:

Table 20 - data model for Orders

Data Model	Description	Type	Occurrence
List of Orders			
|-Order			1-N
||-ID	The ID of the order	String	1
||-Name	The unique name of the order	String	1
||-Description	The description of the order	String	0-1
||-Article	The ID of the Article	String	1
||-Quantity	The quantity of the article produced	Float	1
||-Release date	The date and time, when the production order was released (FORMAT: yyyy-MM-dd HH:mm:ss).	String	0-1
||-Due date	The date and time, when the production date is due (FORMAT: yyyy-MM-dd HH:mm:ss).	String	0-1
||-Completion date	The date and time, when the production date was completed	String	0-1

(FORMAT: yyyy-MM-dd HH:mm:ss).

The more suited B2MLL documents seem to be the Production Schedule and the Working Schedule. The second one seems more oriented to the job that have to be fulfilled for producing a product, the first one more on the features of the product. So the use of the first one is suggested. Some adaptation in the use of the scheme is needed for the definition of the three date required by ARTISAN data model

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ProductionSchedule.xsd** schema. Some flexibility in its use is needed, since in the B2MML message there are not the three kinds of dates required by the ARTISAN data model neither the double identification data (ID and Name).

The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

The previous data can be mapped to the ***Production Schedule*** of B2MML in the following way:

Table 21 – Planned/Produced orders mapped to B2MML-V0600-ProductionSchedule.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductionSchedule		List of Orders	
|-ID	0-1		The ID of the message
|-Description	0-N		It could be set to "Planned orders" or to "Produced Orders"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProductionRequest	0-N	Order	
|||-ID	0-1	Order/ID	The ID of the Order
|||-Description	0-1	Order/Description	The description of the Order
|||-ProductProductionRuleID	0-1	Order/Name	The unique name of the Order
|||-EndTime	0-1	Order/Due date	
|||-SegmentRequirement	0-N	Order/Article	
||||- ID	0-1	Order/Article/ID	The ID of the Article
||||- LatestEndTime	0-1	Order/Completion date	
||||-ProductionParameter	0-N		
|||||-ID	1		Value fixed to "Release Date"
|||||-Value	0-1		
||||||-ValueString	0-1	Order/Release Date	This is a String type and not a Date type, so some problems could arise
||||-MaterialRequirement	0-N		

|||||-Quantity	0-N		
||||||-QuantityString	0-1	Order/Quantity	The quantity of the article produced. This is a string in B2MML and a float in ARTISAN
||||||-UnitOfMeasure	0-1		The unit of measure of the quantity

An example of Order message is shown in Figure 10

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductionSchedule xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-
ProductionSchedule.xsd">
    <ID>AS12</ID>
    <Description>Planned Order</Description>
    <ProductionRequest>
        <ID>PO-1</ID>  <!-- Order  ID -->
        <Description>Production order for 100 black dresses</Description>
        <ProductProductionRuleID>PO1</ProductProductionRuleID> <!-- Unique name
-->
        <EndTime>2013-01-24T00:00:00</EndTime>  <!-- Due date -->
        <SegmentRequirement>
            <ID>A1</ID> <!-- Article ID -->
            <LatestEndTime>2013-01-13T13:45:00</LatestEndTime> <!-- Completion
Date -->
            <ProductionParameter>
                <Parameter>
                    <ID> Release date</ID>
                    <Value>
                        <ValueString>2013-01-01T00:00:00</ValueString>
                    </Value>
                </Parameter>
            </ProductionParameter>
            <MaterialRequirement>
                <Quantity>
                    <QuantityString>100</QuantityString>
                    <UnitOfMeasure>units</UnitOfMeasure>
                </Quantity>
            </MaterialRequirement>
        </SegmentRequirement>
     </ProductionRequest>
</ProductionSchedule>
```

Figure 10 – Example of Order message

2.1.11. Resource Vector

The ARTISAN Data Model is following:

Table 22 - data model for Resource Vectors

Data Model	Description	Type	Occurrence
Resource vectors			

|-Resource vector			1-N
||-ID	The ID of the resource vector	String	1
||-Name	The unique name of the resource	String	1
||-Production order	The ID of the production order	String	1
||-Article step	The ID of the article step	String	1
||-Resource	The ID of the resource.	String	1
||-Coefficient	The coefficient	Float	1

The Resource Vector can be expressed using the Production Performance document. The B2MML message does not map directly the Resource Vector concept, but it contains elements for expressing the Consumable data. Some fields has to be used in a flexible way for mapping the ARTISAN data model. In particular the sons of Process Segment Information do not allow expressing all the ID required by ARTISAN.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ProductionPerformance.xsd** schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 23 – Resource vector mapped to B2MML-V0600-ProductionPerformance.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductionPerformance		Resource Vectors	
|-ID	0-1		The ID of the message
|-Description	0-N		Value fixed to "Resource Vector"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProductionResponse	0-N	Resource Vector	
|||-ProductProductionRuleID	0-1	Resource Vector/Production Order	The ID of the Order
|||-SegmentResponse	0-N		
||||-ProductSegmentID	0-1	Resource Vector /Article step	The ID of the Article step
||||- ConsumableActual	0-N		
|||||- MaterialClassID	0-1	Resource Vector/ID	The ID of the resource vector
|||||-MaterialDefinitionID	0-1	Resource Vector/Name	The unique name of the resource
|||||-Quantity	0-N		
||||||-QuantityString	0-1	Resource Vector/Coefficient	The coefficient

An example of the resource vector message expressed by B2MML is in

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductionPerformance xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProductionPerformance.xsd">
    <ID>AA12</ID>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ProductionResponse>
        <ProductProductionRuleID>PO1</ProductProductionRuleID> <!-- Production
Order ID -->
        <SegmentResponse>
            <ProductSegmentID>AS1</ProductSegmentID> <!-- Article Step ID -->
            <ConsumableActual>
                <MaterialClassID>RV1</MaterialClassID> <!-- Resource Vector ID -
->
                <MaterialDefinitionID>Electricity for step 1 in PO-
1</MaterialDefinitionID> <!--  Unique
                    nName of the resource vector -->
                <Quantity>
                    <QuantityString>4</QuantityString> <!-- The coefficient -->
                </Quantity>
            </ConsumableActual>
        </SegmentResponse>
    </ProductionResponse>
</ProductionPerformance>
```

Figure 11 – Example of Resource Vector message

2.1.12. Article

The ARTISAN Data Model is following:

Table 24 - data model for Article

Data Model	Description	Type	Occurrence
List of Articles			
|-Article			1-N
||-ID	The ID of the article	String	1
||-Code	The unique code of the article	String	1
||-Description	The description of the article	String	0-1
||-Reference unit	The ID of the reference unit for the article	String	1
||- Weight	The ID of the reference unit for the article	String	1

B2MLL provides a message for Product Definition. It seems more suited for productive details, but can be adapted to send the ARTISAN data model.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-**

ProductDefinition.xsd schema. Some flexibility is needed in this use, since the sons of Product Definition do not allow to express the double identification data required by ARTISAN (ID and Code).The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 25 – Article mapped to B2MML-V0600-ProductDefinition.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductDefinition		List of Articles	
|-ID	0-1		The ID of the message
|-Description	0-1		Its value could be fixed to "Articles" in order to identify clearly the meaning of the message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProductSegment	0-N	Article	
|||-ID	0-1	Article/ID	The ID of the article
|||-Description	0-N	Article/Description	Article description
|||-Parameter	0-N		
||||-ID	0-1		Value fixed to "Reference Unit"
||||-Value	0-1		
|||||-ValueString	0-1	Article/Reference unit	
|||||- MaterialClassID	0-1	Article /Code	The unique code of the Article
|||-Parameter	0-1		
||||-ID	0-1		Value fixed to "Weight"
||||-Value	0-1		
|||||-ValueString	0-1	Article/Weight	The ID of the reference unit for the article

An example of Articles messages is shown In Figure 12.

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-
ProductDefinition.xsd">
    <ID>A112</ID>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ProductDefinition>
        <ID>A1</ID> <!-- Article ID -->
        <Description>Black dress</Description> <!--  Article description -->
        <ProductSegment>
```

```
            <ID>BD</ID> <!-- The unique code of the article -->
            <Description>Code</Description>
            <Parameter>
                <ID>Reference Unit</ID>
                <Value>
                    <ValueString>RU2</ValueString>
                </Value>
            </Parameter>
            <Parameter>
                <ID>Weight</ID>
                <Value>
                    <ValueString>1.5</ValueString>
                </Value>
            </Parameter>
        </ProductSegment>
    </ProductDefinition>

    <ProductDefinition>
    <ID>A2</ID> <!-- Article ID -->
     <Description>Red socks</Description> <!--  Article description -->
    <ProductSegment>
        <ID>RS</ID> <!-- The unique code of the article -->
        <Description>Code</Description>
        <Parameter>
            <ID>Reference Unit</ID>
            <Value>
                <ValueString>RU2</ValueString>
            </Value>
        </Parameter>
        <Parameter>
            <ID>Weight</ID>
            <Value>
                <ValueString>0.2</ValueString>
            </Value>
        </Parameter>
    </ProductSegment>
    </ProductDefinition>

</ProductInformation>
```

Figure 12 – Example of Articles message

2.1.13. Process

The ARTISAN Data Model is following:

Table 26 - data model for Process

Data Model	Description	Type	Occurrence
List of Processes			
|-Process			1-N
||-ID	The ID of the article	String	1
||-Name	The unique code of the process	String	1
||-Description	The description of the process	String	0-1

The data about the process in ARTISAN can be sent using the B2MLL Process Segment document, since there is not a Process Document available.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ProcessSegment.xsd** schema: some flexibility is needed in this use, since the field son of Process Segment Information do not allow to express the double identification data required by ARTISAN (ID and Name). The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 27 – Process mapped to B2MML

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProcessSegmentInformation		List of Processes	
|-ID	0-1		The ID of the message
|-Description	0-1		Its value could be fixed to "Processes" in order to identify clearly the meaning of the message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProcessSegment	0-N	Process	
|||-ID	0-1	Process/ID	The ID of the Process
|||-Description	0-N	Process /Description	Process description
|||-HierarchyScope	0-N		
||||-EquipmentID	0-1	Process/Name	The unique name of the process
||||-EquipmentElementLevel	0-1		It is mandatory. It is suggested to use the value "ProcessCell"

An example of List of Processes message is shown in Figure 13

```
<?xml version="1.0" encoding="UTF-8"?>
<ProcessSegmentInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:/[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ProcessSegment.xsd">
    <ID>AS12</ID>
    <Description>Processes</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ProcessSegment>
        <ID>P1</ID> <!-- ID of the process -->
        <Description>Sewing of clothing</Description>
        <HierarchyScope>
            <EquipmentID>Sewing</EquipmentID>
            <EquipmentElementLevel>ProcessCell</EquipmentElementLevel>
```

```
        </HierarchyScope>
    </ProcessSegment>
    <ProcessSegment>
        <ID>P2</ID> <!-- ID of the process -->
        <Description>Finishing of fabrics</Description>
        <HierarchyScope>
            <EquipmentID>Finishing</EquipmentID>
            <EquipmentElementLevel>ProcessCell</EquipmentElementLevel>
        </HierarchyScope>
    </ProcessSegment>
</ProcessSegmentInformation>
```

Figure 13 – Example of Processes message

2.1.14. Process steps

The ARTISAN Data Model is following:

Table 28 - data model for Process Steps

Data Model	Description	Type	Occurrence
List of Process steps			
|-Process step			1-N
||-ID	The ID of the process step	String	1
||-Name	The unique code of the process step	String	1
||-Description	The description of the process	String	0-1
||-Process	The ID of the process, part of which this process step is.	string	1

The data about the process in ARTISAN can be sent using the B2MLL Process Segment document, since a process segment is a logical grouping of personnel resources, equipment resources, and material required to carry out a production step.

The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ProcessSegment.xsd** schema. Some flexibility is needed in this use, since the field son of Process Segment Information do not allow to express the double identification data required by ARTISAN (ID and Name). Moreover it seems to be lacking the reference to the "parent" process. To this aim the Segment Dependency will be used, with "Other" fixed for the kind of dependency. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 29 – Process Steps mapped to B2MML-V0600-ProcessSegment.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
`ProcessSegmentInformation`		List of Process Steps	

|-ID	0-1		The ID of the message
|-Description	0-1		Its value could be fixed to "Process Steps" in order to identify clearly the meaning of the message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProcessSegment	0-N	Process Step	
|||-ID	0-1	Process Step/ID	The ID of the Process Step
|||-Description	0-N	Process Step/Description	Process Step description

An example of List of Process Steps message is shown in Figure 14

```
<?xml version="1.0" encoding="UTF-8"?>
<ProcessSegmentInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-ProcessSegment.xsd">
    <ID>PS12</ID>
    <Description>Process Steps</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ProcessSegment>
        <ID>PS1</ID>
        <Description>Sewing</Description>

        <HierarchyScope>
            <EquipmentID>Sewing</EquipmentID>
            <EquipmentElementLevel>ProcessCell</EquipmentElementLevel>
        </HierarchyScope>

        <SegmentDependency>
            <ID>P1</ID> <!--  ID of process, part of which this process step is
-->
            <Dependency>Other</Dependency>
         </SegmentDependency>
    </ProcessSegment>
</ProcessSegmentInformation>
```

Figure 14 – Example of Processes Steps message

2.1.15. Production phases

The ARTISAN Data Model is following:

Table 30 - data model for Production Phases

Data Model	Description	Type	Occurrence
List of Production phase			
|-Production phase			1-N
||-ID	The ID of the process step	String	1

||-Name	The unique code of the process step	String	1

This entity is still representable by the Production Segment concept and in this case there are no problems in the mapping. The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ProcessSegment.xsd** schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 2.1.11)

Table 31 – Production Phases mapped to B2MML-V0600-ProcessSegment.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProcessSegmentInformation		List of Production Phases	
|-ID	0-1		The ID of the message
|-Description	0-1		Its value could be fixed to "Production Phases" in order to identify clearly the meaning of the message
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProcessSegment	0-N	Production Phase	
|||-ID	0-1	Production Phases/ID	The ID of the Production Phases
|||-Description	0-N	Production Phases/Name	Production Phasesdescription

An example of Production Phases message is shown in Figure 17

```
<?xml version="1.0" encoding="UTF-8"?>
<ProcessSegmentInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-ProcessSegment.xsd">
    <ID>PPA213</ID>
    <Description>Production Phases</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ProcessSegment>
        <ID>PP1</ID>
        <Description>Setup</Description>
    </ProcessSegment>
    <ProcessSegment>
        <ID>PP2</ID>
        <Description>Production</Description>
    </ProcessSegment>
    <ProcessSegment>
```

```
        <ID>PP3</ID>
        <Description>Cleaning</Description>
    </ProcessSegment>
</ProcessSegmentInformation>
```

Figure 15 – Example of Production Phases message

2.1.16. Articles steps

The ARTISAN Data Model is following:

Table 32 - data model for Article Steps

Data Model	Description	Type	Occurrence
List of Article Steps			
|-Article Step			1-N
||-ID	The ID of the article step	String	1
||-Number	The number of the article step in the sequence	Integer	1
||-Article	The ID of the article.	String	1
||- Process step	The ID of the process step	String	1
||-Production phase	The ID of the production phase	String	1
||- Duration	The duration of the article step (in minutes).	Integer	1

The B2MML Product Definition matches very well with this ARTISAN entity. The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the B2MML-V0600-ProductDefinitio.xsd schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11)

Table 33 – Production Phases mapped to B2MML-V0600-ProductDefinition.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductInformation		List of Article Steps	
|-ID	0-1		The ID of the message
|-Description			Value fixed to “Article Steps”
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-ProductDefinition	0-N		
||-ID	0-1	Article Step/Article	The ID of the Article
||-ProductSegment	0-N	Article Step	
|||-ID	0-1	Article Step/ID	The ID of the Article Step
|||-Duration	0-1	Article Step/Duration	This is a XSD duration data type. In order to express the durate in minutes it has to be

			formatted as: PT[number of minutes]M. For example 10 minutes become PT10M
|||-ProcessSegmentID	0-1	Article Step/Production Phase	The ID of the production phase
|||-Parameter	0-N		
||||-ID	0-1		Value fixed to “Number”
||||-Value	0-1	Article Step/Number	The number of the Article Step. In ARTISAN it is an Integer. Here it has to be expressed has string
|||||-ValueString	0-1		
|||- ProductSegment	0-1		
||||-ID	0-1	Article Step/Process Step	ID of Process Step

An example of Article Steps message mapped in B2MML is shown in Figure 16

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-
ProductDefinition.xsd">
    <ID>MESSAGE12</ID>
    <Description>Article Step</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ProductDefinition>
        <ID>A1</ID> <!-- ID of the Article  -->
            <ProductSegment>
                <ID>AS1</ID> <!-- ID of the Article Step -->
                <Duration>PT10M</Duration>
                <ProcessSegmentID>PP1</ProcessSegmentID> <!-- ID of the
Production Phase -->
                <Parameter>
                    <ID>Number</ID>
                    <Value>
                        <ValueString>1</ValueString> <!--Number -->
                    </Value>
                </Parameter>
                <ProductSegment>
                    <ID>PS1</ID>  <!-- ID of Process Step -->
                </ProductSegment>
            </ProductSegment>

            <ProductSegment>
                <ID>AS2</ID> <!-- ID of the Article Step -->
                <Duration>PT20M</Duration>
                <ProcessSegmentID>PP2</ProcessSegmentID> <!-- ID of the
Production Phase -->
                <Parameter>
```

```
                    <ID>Number</ID>
                    <Value>
                        <ValueString>2</ValueString> <!--Number -->
                    </Value>
                </Parameter>
                <ProductSegment>
                    <ID>PS2</ID>  <!-- ID of Process Step -->
                </ProductSegment>
            </ProductSegment>
    </ProductDefinition>
</ProductInformation>
```

Figure 16 – Example of Article Steps message

2.1.17. Article tracking information

The ARTISAN Data Model is following:

Table 34 - data model for Article Tracking Information

Data Model	Description	Type	Occurrence
List of Article Tracking			
|-Article Tracking			1-N
||-Production order	The ID of the production order.	String	1
||-Article step	The ID of the article step.	String	1
||-Machine	The ID of the machine.	String	1
||-Start date	The date and time, when the article entered the machine (FORMAT: yyyy-MM-dd HH:mm:ss).	String	1
||-End date	The date and time, when the article left the machine (FORMAT: yyyy-MM-dd HH:mm:ss).	String	1

The B2MML Production Schedule matches very well with this ARTISAN entity, a part the usual degrees of flexibility for mapping correctly the ID (of process step and of production order) in the ARTISAN data model. The transaction is made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the B2MML-V0600-ProductionSchedule.xsd schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11)

Table 35 – Article Tracking mapped to B2MML

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ProductionSchedule		List of Article Tracking	
|-ID	0-1		The ID of the message

|-Description	0-N		It could be set to "Article Tracking"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
||-ProductionRequest	0-N	Article Tracking	
|||-ID	0-1	Article Tracking/ Production order	The ID of the Production Order
|||-ProductProductionRuleID	0-1	Article Tracking/Article step	The ID of the Article Step. Usually the Product Production Rule ID refers to information that are used within manufacturing to manufacture the product, such as assembly instructions, flow sheets, or recipes, in B2MML, to
|||-HierarchyScope			
||||-EquipmentID	0-1	Article Tracking/Machine	The ID of the Machine
||||-EquipmentElementLevel	1		It is mandatory. It is suggested to set it to "EquipmentModule"
|||-StartTime	0-1	Article Tracking/Start Date	It is formatted according to Format: ISO 8601
|||-EndTime	0-1	Article Tracking/End date	It is formatted according to Format: ISO 8601

An example of Article Steps message mapped in B2MML is shown in Figure 17.

```
<?xml version="1.0" encoding="UTF-8"?>
<ProductionSchedule xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-
ProductionSchedule.xsd">
    <ID>MSG12</ID>
    <Description>Article Tracking</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>

    <ProductionRequest>
        <ID>PO1</ID> <!-- Production Oder -->
        <ProductProductionRuleID>AS1</ProductProductionRuleID> <!-- Article Step
-->
        <HierarchyScope>
            <EquipmentID>M1</EquipmentID> <!-- Machine -->
            <EquipmentElementLevel>EquipmentModule</EquipmentElementLevel>
        </HierarchyScope>
        <StartTime>2013-01-13T10:00:00</StartTime>
        <EndTime>2013-01-13T10:10:00</EndTime>
    </ProductionRequest>

    <ProductionRequest>
        <ID>PO1</ID> <!-- Production Oder -->
```

```
        <ProductProductionRuleID>AS2</ProductProductionRuleID> <!-- Article Step
-->
        <HierarchyScope>
            <EquipmentID>M1</EquipmentID> <!-- Machine -->
            <EquipmentElementLevel>EquipmentModule</EquipmentElementLevel>
        </HierarchyScope>
        <StartTime>2013-01-13T10:10:00</StartTime>
        <EndTime>2013-01-13T10:50:00</EndTime>
    </ProductionRequest>

</ProductionSchedule>
```

Figure 17 – Example of Article Tracking message

2.1.18. Machine-to-process-step mappings

The ARTISAN Data Model is following:

Table 36 - data model for Machine-to-Process-Step mappings

Data Model	Description	Type	Occurrence
Mapping between Machine and Process Steps			
|-Machine	ID of the Machine		1
|-Process Step	The ID of the Process Step	String	1

B2MML provide a really interesting message for this kind of mapping: it is called Resource Relationship Network and can be used, in ARTISAN, for Mapping machines on process steps. The transaction will be made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the **B2MML-V0600-ResourceRelationshipNetwork.xsd** schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11)

The mapping is the following:

Table 37 – Article Tracking mapped to B2MML-V0600-ResourceRelationshipNetwork.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ResourceRelationshipNetwork		List of Machine to Process Step mappings	
|-ID	0-1		The ID of the message
|-Description	0-N		It could be set to "Machine-To-Process-Step Mappings"

|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-ResourceNetworkConnection	0-N	Mapping between Machine and Process Steps	
||-FromResourceReference	0-1		
|||-ResourceID	0-1	Mapping between Machine and Process Steps/Machine	The ID of the Machine
|||-ResourceType	0-1		It has to be fixed to "Equipment"
||-ToResourceReference			
|||-ResourceID	0-1	Mapping between Machine and Process Steps/Process Step	The ID of the Process Step
|||-ResourceType	0-1		It has to be fixed to "Prcess Segment"

An example of Article Steps message mapped in B2MML is shown in Figure 18

```
<?xml version="1.0" encoding="UTF-8"?>
<ResourceRelationshipNetwork xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600 file:[PATH ON THE
COMPUTER]/Schema/B2MML-V0600-ResourceRelationshipNetwork.xsd">
    <ID>MSG112</ID>
    <Description>Machine-To-Process-Step Mappings</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ResourceNetworkConnection>
        <FromResourceReference>
            <ResourceID>M1</ResourceID>
            <ResourceType>Equipment</ResourceType>
        </FromResourceReference>
        <ToResourceReference>
            <ResourceID>PS1</ResourceID>
            <ResourceType>Process Segment</ResourceType>
        </ToResourceReference>
    </ResourceNetworkConnection>
    <ResourceNetworkConnection>
        <FromResourceReference>
            <ResourceID>M2</ResourceID>
            <ResourceType>Equipment</ResourceType>
        </FromResourceReference>
        <ToResourceReference>
            <ResourceID>PS2</ResourceID>
            <ResourceType>Process Segment</ResourceType>
        </ToResourceReference>
    </ResourceNetworkConnection>
</ResourceRelationshipNetwork>
```

Figure 18 – Example of Machine to Process Step Mapping message

2.1.19. Sensors

The ARTISAN Data Model is following:

Table 38 - data model for Sensors

Data Model	Description	Type	Occurrence
Sensor list			
|-Sensor			1-N
||-ID	The ID of the sensor	String	1
||-Name	The unique name of the sensor	String	1
||-Description	The description of the sensor	String	0-1
||-Resource	The ID of the resource that the sensor measures	String	1

The sensor can be considered as a particular kind of equipment and so the B2MML Equipment message can be used. The transaction will be made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the B2MML-V0600-Equipment.xsd schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11)

The mapping is the following:

Table 39 – Sensors mapped to B2MML-V0600-Equipment.xsd

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
EquipmentInformation		List of Sensors	
|-ID	0-1		The ID of the message
|-Description	0-N		It could be set to "Article Tracking"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-Equipment	0-N	Sensor	
||-ID	0-1	Sensor/ID	The ID of the Sensor
||-Description	0-1	Sensor/Description	The description of the Sensor
||-HierarchyScope			
|||-EquipmentID	0-1	Sensor/Name	The unique name of the Sensor
|||- EquipmentElementLevel	1		It is mandatory. It is suggested to set it to "Unit"
||-EquipmentAssetMapping	0-N		
|||-EquipmentID	1	Sensor/ID	The description of the Sensor, It has to be repeated here
|||-PhysicalAssetID	1	Sensor/Resource	The ID of the resource that the sensor measures

An example of Article Steps message mapped in B2MML is shown in Figure 19:

```
<?xml version="1.0" encoding="UTF-8"?>
<EquipmentInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-Equipment.xsd">
    <ID>SRS234</ID>
    <Description>Sensors</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>

    <Equipment>
        <ID>s1</ID> <!-- The ID of the sensor -->
        <Description>A sensor that measures oil</Description> <!-- Description
of the sensor -->
        <HierarchyScope>
            <EquipmentID>Oil sensor</EquipmentID> <!-- Unique name of the sensor
-->
            <EquipmentElementLevel>Unit</EquipmentElementLevel>
        </HierarchyScope>
        <EquipmentAssetMapping>
            <EquipmentID>s1</EquipmentID>  <!-- The ID of the sensor -->
            <PhysicalAssetID>R1</PhysicalAssetID> <!--  ID of the resource that
the sensor measures -->
        </EquipmentAssetMapping> <
    </Equipment>

    <Equipment>
        <ID>s2</ID>
        <HierarchyScope>
            <EquipmentID>Electricity sensor B</EquipmentID>
            <EquipmentElementLevel>Unit</EquipmentElementLevel>
        </HierarchyScope>
        <EquipmentAssetMapping>
            <EquipmentID>s2</EquipmentID>
            <PhysicalAssetID>R2</PhysicalAssetID>
        </EquipmentAssetMapping>
    </Equipment>
</EquipmentInformation>
```

Figure 19 – Example of Sensors Message

2.1.20. Resources

The ARTISAN Data Model is following:

Table 40 - data model for Resources

Data Model	Description	Type	Occurrence
Resource list			
|-Resource			1-N
||-ID	The ID of the resource	String	1
||-Name	The unique name of the resource	String	1
||-Description	The description of the resource	String	0-1
||-CO2 per unit	The CO2 (in Kg) that corresponds to	Float	1

	one unit of the resource		
||-Measuring unit	The ID of the measuring unit of the resource	String	1

Even if there is no specific message for resources in B2MML, the resources can be assimilated to materials and the B2MML Material message fit well with ARTISAN data model. The transaction will be made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the B2MML-V0600-Material.xsd schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11)

Table 41 – Resources mapped to B2MML-V0600-Material.xsd schema

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
MaterialInformation		List of Resources	
|-ID	0-1		The ID of the message
|-Description	0-N		It could be set to "Resources"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-MaterialClass	0-N	Resource	
||-ID	0-1	Resource/ID	The ID of the Resource
||-Description	0-1	Resource/Description	The description of the resource
||- MaterialClassProperty	0-N		
|||-ID	0-1		Fixed to "Measure Unit"
|||-Value	0-1		
||||-ValueString	0-1	Resource/Measuring unit	ID of the measuring unit of the resource
||- MaterialClassProperty	0-N		
|||-ID	0-1		Fixed to "CO2 per unit"
|||-Value	0-1		
||||-ValueString	0-1	Resource/CO2 per unit	
||||-UnitOfMeasure	0-1		Fixed to "kg"
||-MaterialDefinitionID	0-1	Resource/Name	The unique name of the resource

An example of Resources message mapped in B2MML is shown in Figure 20.

```
<?xml version="1.0" encoding="UTF-8"?>
<MaterialInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
```

```
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-Material.xsd">
    <ID>RES131</ID>
    <Description>Resource</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>

    <MaterialClass>
         <ID>R1</ID>
         <Description>Oil.</Description>
         <MaterialClassProperty>
             <ID>Measure Unit</ID>
             <Value>
                 <ValueString>MU1</ValueString>
             </Value>
         </MaterialClassProperty>
         <MaterialClassProperty>
             <ID>CO2 per unit</ID>
             <Value>
                 <ValueString>10,7</ValueString>
                 <UnitOfMeasure>kg</UnitOfMeasure>
             </Value>
         </MaterialClassProperty>
         <MaterialDefinitionID>Oil</MaterialDefinitionID>
    </MaterialClass>

    <MaterialClass>
        <ID>R2</ID>
        <Description>Electricity.</Description>
        <MaterialClassProperty>
            <ID>Measur Unit</ID>
            <Value>
                <ValueString>MU2</ValueString>
            </Value>
        </MaterialClassProperty>
        <MaterialClassProperty>
            <ID>CO2 per unit</ID>
            <Value>
                <ValueString>20</ValueString>
                <UnitOfMeasure>kg</UnitOfMeasure>
            </Value>
        </MaterialClassProperty>
        <MaterialDefinitionID>Electricity</MaterialDefinitionID>
    </MaterialClass>

</MaterialInformation>
```

Figure 20 – Example of Resource Message

2.1.21. Sensors to machines mapping

The ARTISAN Data Model is following:

Table 42 - data model for Sensors to Machines mapping

Data Model	Description	Type	Occurrence
Sensor to Machine			1-N
|-Sensor	The ID of the Sensor		1
|-Machine	The ID of the Machine	String	1
|-Creation date	The date and time, when the mapping was created (FORMAT: yyyy-MM-dd	String	1

	HH:mm:ss)		
|- Deletion date	The date and time, when the mapping was deleted (FORMAT: yyyy-MM-dd HH:mm:ss).	String	0-1

For this kind of mapping, as for the Machine to Process Steps one, the B2MML Resource Relationship Network message fits very well. The transaction will be made of a message (with all the previous data) and an answer about the correct execution of the operation. The first message can be expressed using the B2MML-V0600-ResourceRelationshipNetwork.xsd schema. The second message can be expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11)

The mapping is the following:

Table 43 – Sensor to Machine mapped to B2MML-V0600-ResourceRelationshipNetwork.xsd schema

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ResourceRelationshipNetwork		List of Sensor to Machine mappings	
|-ID	0-1		The ID of the message
|-Description	0-N		It could be set to "Sensor-to-Machine-mapping"
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-ResourceNetworkConnection	0-N	Sensor to Machine	
||-FromResourceReference	0-1		
|||-ID	0-1		Fixed to "Sensor"
|||-ResourceID	0-1	Sensor to Machine/Sensor	The ID of the Sensor
|||-ResourceType	0-1		It has to be fixed to "Equipment"
||-ToResourceReference			
|||-ID	0-1		Fixed to "Machine"
|||-ResourceID	0-1	Sensor to Machine/Machine	The ID of the Machine
|||-ResourceType	0-1		It has to be fixed to "Machine"
||- ConnectionProperty	0-N		
|||-ID	0-N		Fixed to "Creation Date" or "Deletion Date"
|||-Value	0-1		
||||-ValueString		Sensor to Machine/Creation(Deletion)Date	The date of creation (or of deletion) of the mapping. Being a string it can use the same format of the ARTISAN field
||||-DataType	0-1		Fixed to "DateTime"

An example of Sensor to Machine mapping message mapped in B2MML is shown in Figure 21.

```
<?xml version="1.0" encoding="UTF-8"?>
<ResourceRelationshipNetwork xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-
ResourceRelationshipNetwork.xsd">
    <ID>STM223</ID>
    <Description>Sensor-to-Machine-mapping</Description>
    <RelationshipType>Physical</RelationshipType>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <ResourceNetworkConnection>

        <FromResourceReference>
            <ID>Sensor</ID>
            <ResourceID>S1</ResourceID>
            <ResourceType>Equipment</ResourceType>
        </FromResourceReference>

        <ToResourceReference>
            <ID>Machine</ID>
            <ResourceID>M1</ResourceID>
            <ResourceType>Equipment</ResourceType>
        </ToResourceReference>

        <ConnectionProperty>
            <ID>Creation Date</ID>
            <Value>
                <ValueString>2013-05-31 00:00:00</ValueString>
                <DataType>DateTime</DataType>
            </Value>
        </ConnectionProperty>

    </ResourceNetworkConnection>

    <ResourceNetworkConnection>

        <FromResourceReference>
            <ID>Sensor</ID>
            <ResourceID>S2</ResourceID>
            <ResourceType>Equipment</ResourceType>
        </FromResourceReference>

        <ToResourceReference>
            <ID>Machine</ID>
            <ResourceID>M2</ResourceID>
            <ResourceType>Equipment</ResourceType>
        </ToResourceReference>

        <ConnectionProperty>
            <ID>Creation Date</ID>
            <Value>
                <ValueString>2013-05-31 00:00:00</ValueString>
                <DataType>DateTime</DataType>
```

```
            </Value>
        </ConnectionProperty>

        <ConnectionProperty>
            <ID>Deletion  Date</ID>
            <Value>
                <ValueString>2013-06-30 00:00:00</ValueString>
                <DataType>DateTime</DataType>
            </Value>
        </ConnectionProperty>

    </ResourceNetworkConnection>
</ResourceRelationshipNetwork>
```

Figure 21 – Example of Sensor-to-Machine Message

2.1.22. Alert

The ARTISAN Data Model is following:

Table 44 - data model for Sensors

Data Model	Description	Type	Occurrence
Alerts			1-N
|-ID	The ID of the Alert		1
|-Machine	The ID of the Machine	String	1
|-Resource	The ID of the Resource	String	1
|-Level	The level of the alert.	Float	1
|-Enabled	Whether the alert is enabled (1) or disabled (0).	Integer	1

B2MML provides a document called Work Alert that matches well with ARTSIAN requirements. The transaction will be made of a message (with all the previous data), expressed using the B2MML-V0600-WorkAlert.xsd schema, and an answer about the correct execution of the operation, expressed by the B2MML-V0600-ConfirmBOD.xsd message (see 7.2.11).

The mapping is the following:

Table 45 – Alerts mapped to B2MML-V0600-WorkAlert.xsd schema

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
WorkAlertInformation		List of Alerts	
|-ID	0-1		The ID of the message
|-Description	0-N		It could be set to “Alerts”
|-PublishedDate	0-1		Timestamp of the message. Format: ISO 8601
|-WorkAlert	0-N	Alert	
||-ID	0-1	Alert/ID	The ID of the Alert
||-HierarchyScope	0-1		

|||-EquipmentID	0-1	Alert/Machine	The ID of the Machine
|||-EquipmentElementLevel	1		It is Mandatory. It is suggested to fix it to “EquipmentModule”
||-Priority	0-1	Alert/Level	According to the documentation the priority field provides “a priority of the work alert definition that acts as a guide to the relative level of importance of a work alert”. So it matches with Level field of ARTISAN data model
||-Property	0-N		
|||-ID	0-1		Fixed to “Enabled”
|||-Value	0-1		It has to be fixed to “Machine”
||||-Value String	0-1	Alert/Enabled	0 if disabled / 1 if enabled
||||-DataType	0-1		Fixed to “BinaryObject”

An example of Alerts message mapped in B2MML is shown in.

```
<?xml version="1.0" encoding="UTF-8"?>
<WorkAlertInformation xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-WorkAlert.xsd">
    <ID>AM123</ID>
    <Description>Alert</Description>
    <PublishedDate>2013-01-13T13:45:00</PublishedDate>
    <WorkAlert>
        <ID>A1</ID>
        <HierarchyScope>
            <EquipmentID>M1</EquipmentID>
            <EquipmentElementLevel>EquipmentModule</EquipmentElementLevel>
        </HierarchyScope>
        <Priority>40</Priority>
        <Property>
            <ID>Enabled</ID>
            <Value>
                <ValueString>1</ValueString>
                <DataType>BinaryObject</DataType>
            </Value>
        </Property>
    </WorkAlert>
</WorkAlertInformation>
```

Figure 22 – Example of Alerts Message

2.1.23. Confirmation (acknowledgment) of data

For all the messages is foreseen a simple response, with acknowledgment of acceptation of data or of their rejection because of error condition. It is important to have in the confirmation, the ID of the input message, in order to be sure of what is the message to which this is answering.

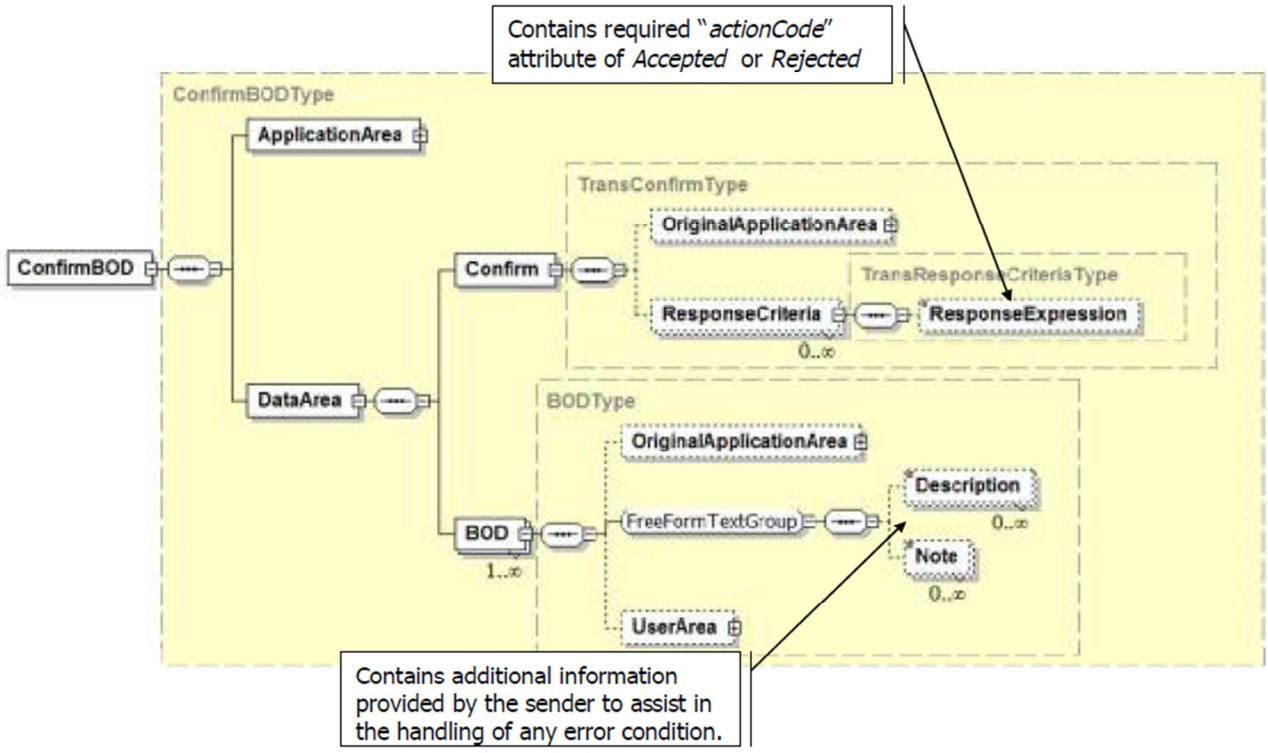

Figure 23 - Main element of the schema for Confirmation BOB

For all the cases the ConfirmationBOD schema can be used (B2MML-V0600-ConfirmBOD.xsd) in this way:

Table 46 - General answer from ARTISAN to the ERP/MES

Tree of the B2MML message	Occurrence	Corresponding ARTISAN data fields	Notes
ConfirmBOD		Confirmation	
|-ApplicationArea	0-1		
||-Sender	0-1		The ID of the message
|||-ReferenceID	0-1		The ID of the input message
||-CreationDateTime	0-1		Timestamp of the confirmation message. Format: ISO 8601
||-BODID	0-1		The ID of the answer message
|-DataArea	0-1		
||-Confirm	0-1		

|||-ResponseCriteria			
||||- ResponseExpression	0-N		
||||-@actionCode	0-1		"Accepted" is the input message was correct, "Rejected" if it was wrong
||-BOD	1		
|||-Descroption	0-1	Error (if any)	Here the error message, if any, can be inserted

An example of this confirmation message is shown in

```
<?xml version="1.0" encoding="UTF-8"?>
<ConfirmBOD xmlns="http://www.mesa.org/xml/B2MML-V0600"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.mesa.org/xml/B2MML-V0600
file:/C:/Users/Angelo/Documents/X-
lab%20Progetti/ARTISAN/WP5/Task%205.2%20Interoperability%20Data%20Exchange%20Mod
el%20Definition/B2MML%20versione%20600/Schema/B2MML-V0600-ConfirmBOD.xsd">
    <ApplicationArea>
        <Sender>
            <ReferenceID>MSG122</ReferenceID>
        </Sender>
        <CreationDateTime>2013-09-24T06:00:00</CreationDateTime>
        <BODID>CONF123</BODID>
    </ApplicationArea>

    <DataArea>
        <Confirm>
            <ResponseCriteria>
                <ResponseExpression actionCode="Rejected"/> <!-- or Accepted -->
            </ResponseCriteria>
        </Confirm>
        <BOD>
            <Description>Error in line 59</Description>
        </BOD>
    </DataArea>

</ConfirmBOD>
```

Figure 24 - Example of general answer from ARTISAN to the ERP/MES

2.2. Summarizing table of mapping between ARTISAN and reference standards

In the table below the mapping between ARTISAN data models and suggested standard SML Schema and needed adaptation in their use are summarized.

Table 47 - summarized mappings between ARTISAN data models and reference standards

Message	Schema	Notes
Partners	B2MML-V0600-Personnel.xsd	The original use of the B2MML message is for internal personnel information, so this is used here with some flexibility
Departments	B2MML-V0600-	ARTISAN data model requires unique name of

	ProcessSegment.xsd	Department and the ID of the facility that own the department. These fields do not compare in B2MML. For both of them, it is proposed to use the "Parameter" element.
Facilities	B2MML-V0600-ProcessSegment.xsd	ARTISAN data model requires unique name of Facility and the ID of the partner that own the department. These fields do not compare in B2MML. For both of them, it is proposed to use the "Parameter" element
Shifts	B2MML-V0600-ProductionCapability.xsd	It is not a direct representation of shifts, so this is used with some flexibility, in particular for representing the ID of the shift and its number
Shift Assignments	B2MML-V0600-ProductionCapability.xsd	It is not a direct representation of shifts, so this is used with some flexibility, in particular for representing the shift entity
Machines	B2MML-V0600-ProductionCapability.xsd	
Employees	B2MML-V0600-Personnel.xsd	
Employee Qualifications	B2MML-V0600-Personnel.xsd	
Planned/Produced Orders	B2MML-V0600-ProductionSchedule.xsd	ARTISAN data model requires three date fields that do not have a direct mapping in the B2MML message. So, some other fields has to be used for these aims
Resource Vector	B2MML-V0600-ProductionPerformance.xsd	The B2MML message does not map directly the Resource Vector concept, but it contains elements for expressing the Consumable data. Some fields has to be used in a flexible way for mapping the ARTISAN data model
Article	B2MML-V0600-ProductDefinition.xsd	
Process	B2MML-V0600-ProcessSegment.xsd	B2MML does not provide a "Process" document, so the Process Segment one was used, with some degrees of flexibility in its use
Process Steps	B2MML-V0600-ProcessSegment.xsd	In the B2MML is lacking a reference to the Parent Process, so it has to be mapped with some degrees of flexibility
Production Phases	B2MML-V0600-ProcessSegment.xsd	
Article Steps	B2MML-V0600-ProductDefinition.xsd	
Article Tracking	B2MML-V0600-ProductionSchedule.xsd	The ARTISAN Article Step ID has been mapped in the B2MML schema in a field that more correctly should indicate the information that used within manufacturing to manufacture the product, such as assembly instructions, flow sheets, or recipes
Machine-to-process-step mappings	B2MML-V0600-ResourceRelationshipNetwork.xsd	
Sensors	B2MML-V0600-Equipment.xsd	The sensor has been considered as a particular kind of equipment and so the B2MML message for equipment was used
Resources	B2MML-V0600-Material.xsd	There is no specific message for resources in B2MML. The resources can be assimilated to materials and the B2MML Material schema.
Sensors to machines	B2MML-V0600-	

mapping	ResourceRelationshipNetwork .xsd
Alert	B2MML-V0600-WorkAlert.xsd

In general, in the suggested ARTISAN usage:

- In the header of the B2MML message:
  - The description field is used for inserting the name of the ARTISAN message that is being sent (e.g. “List of Partners”) since some B2MML schema are used for more than one ARTISAN message
  - The “Published Data” is suggested as timestamp of the message
- In the body of the B2MML message:
  - The most of ARTISAN data models use an ID and, at the same time, a unique name. This does not match directly with B2MML and some other B2MML field has to be used for this aim.

3. Bibliography

B2MML. (2013, 03 11). Retrieved from ISA-95.com: http://www.isa-95.com/subpages/technology/techdes/b2mml.php?PHPSESSID=c2578f826498b94051c9a43ce30f6864

B2MML. (2013). *Equipment - Version 6.0.* MESA.

Bill of Materials. (n.d.). Retrieved 02 18, 2013, from Wikipedia: http://en.wikipedia.org/wiki/Bill_of_materials

Brandl, D. (2008, 05 19). *What is ISA-95? Industrial Best Practices of Manufacturing Information Technologies with ISA-95 Models.* Retrieved from http://www.apsom.org/docs/T061_isa95-04.pdf

Business-to-shop integration realized through B2MML. (2012). Retrieved from ISA: http://www.isa.org/InTechTemplate.cfm?ContentID=90132&template=/ContentManagement/ContentDisplay.cfm

Damigos, M. a. (2012). *ARTISAN D5.1 Architecture & Collaboration Infrastructure (Interim Version).* ARTISAN.

Mourtos, Y. a. (2012). *ARTISAN D1.3 Services and Tools Definition.* ARTISAN.