

MODELS AND STANDARDS FOR PRODUCTION SYSTEMS INTEGRATION -TECHNOLOGICAL PROCESS AND DOCUMENTS

Danica LEČIĆ

*Faculty of Organizational Sciences, University of Belgrade
Serbia and Montenegro*

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Abstract: Electronic business demands from production companies to collaborate with customers, suppliers and end users and start electronic manufacturing. To achieve this goal companies have to integrate their subsystems (Application to Application-A2A) and they have to collaborate with their business partners (Business to Business - B2B). For this purpose models and unique standards for integration are necessary. In this paper, ebXML and OAGI specifications have been used to present metamodel process by UML class diagram and standardized model of document Working Order for technological process in the form of OAGI BOD XML document. Based on it, from an example, model of technological process is presented by activity diagram (DA) in XML form and an appearance of document Working Order. Just as well, rules of transformation DA to XML are presented.

Keywords: Electronic business, integration, process model, model of standardized document.

1. INTRODUCTION

In a few last decades information technologies have been developed very fast, and with their use practically no area of human life can not be discussed. Observing their development and influence on business in the last ten years, it can be concluded that Internet has the greatest influence. Internet influence is direct; it gives a huge number of information to users about products and services and enables new ways for sales and distribution. Business through the use of Internet is called electronic business.

Electronic business changes business of all companies including production companies as well. In production companies what is changed is the way of new product development or redesign of current products, the way of communication and business methods for suppliers and distributors, the way of service for customers and delivery of

products, etc. Electronic business demands from producers to become more ready, more flexible and to reply quickly on customers' demands. Producers must organize their production subsystems and integrate them tightly with other subsystems, and collaborate with their business partners. Electronic business for production companies means electronic manufacturing. Electronic manufacturing demands use of Internet technologies and electronic business in production systems.

Electronic manufacturing requires more than electronic exchange of data and execution of production processes. The essence of electronic manufacturing is the possibility to connect production processes, suppliers, distributors and customers in real-time cycle through Internet. Internet can also be used as a support to all aspects in production companies: marketing, sales, customer services, new products development, supply, connection with suppliers, logistic, development strategies and the production process itself.

Pre-conditions that production companies have to meet in order to be able to take part in electronic business are: first - complete internal integration of all its subsystems and information flows, second - in order to start business they have to find each other, then to decide which production processes and documents are necessary for its collaboration and they have to agree how to exchange information. With it, production companies make mutual integration and start business collaboration.

In the recent past EDI (Electronic Data Interchange) was the only way to integrate inside and outside of the company. Still, EDI was not flexible enough. Today, the use of traditional EDI is not enough itself; it is very complex, expensive and demands separate solution for each business partner. EDI is based on the integration of individual transaction. Integration is not initiated by transaction any more, but with business process that should be adapted to new market conditions. Approaches and methodologies based on XML buy better way of mutual exchange of data through Internet in neutral formats. They give power set of technologies as the substitute for EDI through building up on current EDI solutions. This language describes and enables exchange of structured data among applications in one company or between business partners. XML is a universal notation for data exchange.

The problem of integration that is discussed here, no matter it is about integration inside a business company or between few business partners, in a last few years attract attention of many organizations that are involved in problems related to integration and standards. There are few initiatives for integration problem solution, solutions for simplification, standardization and interoperability of companies in electronic business, just as there are few organizations occupied only with problems of standardization. Unfortunately in our country there are organizations involved in standardization in electronic data interchange, and they have no solutions that could be offered and recommended as standards for description of process or documents in any area of business, so in the production as well.

2. OAGI AND EBXML

In this chapter suggestions and solutions are briefly presented of the most important organizations in the world that, each in its specific way, contribute to a definition of unique standard for integration and interoperability. First, work of OAGI

(Open Application Group Inc.) was presented and their specifications of business documents BOD (Business Object Document) that are recommended as the standard way of business documents recording and exchanging. After it, work of ebXML (Electronic Business eXtensible Markup Language) was presented and its reference model for integration. ebXML, different from other developed standards, has made whole infrastructure necessary for electronic business performance. Each of ebXML modules can be implemented and used together or separately from complete infrastructure implementation. OAGI and ebXML groups offer complete solution for the integration and interoperability problem by the use of OAGI specification and ebXML implementation.

2.1. OAGI

Virtual object model is a conceptual approach to interoperability that uses OAGI. Object initiation is performed by sending a message with the name of the object, method and set of arguments. Object process requests and replies to message sender. [2]

OAGI virtual business object model, enables business application of a company to make sphere of virtual object, through the use of OAGI API. This interoperability is reached by advantages of object-oriented approach.

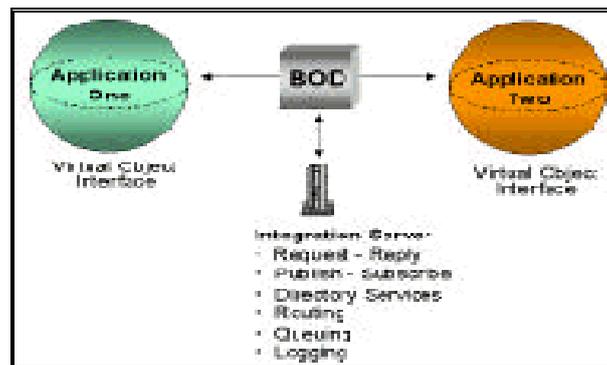


Figure 1: OAGI Virtual Business Object Model

For the purpose of communication with business software components in this model, events communicate through integration backbone by sending OAGI BOD to interface of virtual object (Figure 1).

Members of OAGI have designed mechanism for definition of API necessary for building up of their model through so-called self-describing mechanism called Business Object Document. BOD use concept of meta-data to describe itself to other software components. BOD itself is not an object. It has the architecture used to enable communication and data necessary to execute demanded business process. As BOD is a part of bigger model, it is understandable for receiving application and can be determined easily. Mechanism for receiving and processing of message is not of importance for sending application.

Meta-data that enable BOD to be self-describing are in fact data that both describe data and enable a flexible mechanism that allows their description to some other

component and with it ensures transfer of information only necessary for execution of task defined. This architecture gives model that can be developed faster and easier for support and ensure better performance for the end user.

BOD is architecture used for communication through messages or business documents among applications or components. Each BOD includes support of details that enable business application to which BOD is sent, to execute activity. In [2] there is a detailed description of BOD architecture.

2.2. ebXML

ebXML offers infrastructure for data exchange, semantic framework for commercial collaboration and mechanism that enable companies to find out and establish business relationship between each other.

Figure 2 presents ebXML technical architecture that consists of two basic components: Design Time and Run Time. Business process and Business information analyses are part of Design Time component. Design Time component is occupied with procedures for ebXML infrastructure creation, discovering and enabling ebXML resources necessary for business collaborations. Run Time component covers execution of ebXML scenario with adequate ebXML transactions. [19]

Elements of Design Time enable systems of Run Time to execute agreed business processes. Business process and business documents are defined in activities of Business processes and Business Information Analyses. Core components and Domain Components are reusable information that is used to specify content and structure of a document. Specification of business process for defined business process and business documents are stored and registered in Business Library that contains catalogues of business process and objects of business information. Catalogues are in ebXML Registers.

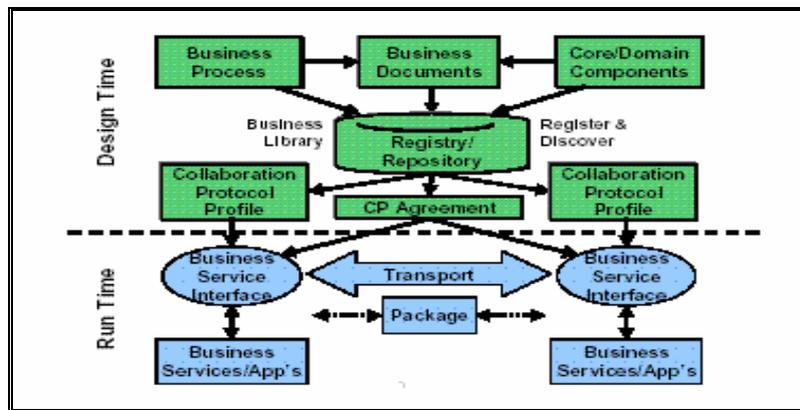


Figure 2: ebXML Reference Model

Business process modelling results in ebXML Business Process Specification referenced in the Collaboration Protocol Profile (CPP) and Collaboration Protocol Agreement (CPA) between business partners. Finally, business processes specified in CPA leads Business Service Interfaces toward execution of these processes and sends demanded documents.

Registry/Respiratory is a part of ebXML that companies usually first meet. It is a central server that stores different data, necessary for ebXML operations.. Information in Registry in XML formats are: Business Process and Information Meta-models, Business Library, Core Library, Collaboration Protocol Profiles, List of scenarios, Messaging Constraints and Security Constraints. Basically, when company wants to have ebXML collaboration with another company Registry needs to be searched in order to find adequate partner and find out information regarding demands and needs for business with that particular partner.

3. RELATED WORK

A number of industry groups are working to define and create common definitions for XML business integration standards. Zhao (2001)[21] has used a systematic approach to show how the integration standards (such as ebXML, OAGI, RosettaNet, and BizTalk) meet the requirements of e-commerce and verify the roles of XML-based standard. Kotinurmi and his colleagues (2002) [7] have studied economic theories for creating e-business standards.

A large number of benefits from the communication standards governed by the Internet and network communications have been realized. The implementation experiences of leading high-tech manufacturers and retailers provide evidence of integration standards benefits. The success at the Ford Motor Company is one of the success stories of implementing integration standards [16]. The author describes successful usage of XML-enabled integration standard (OAGI in particular) for real-time communications and collaboration triggered by business events.

The OAGIS BODs are widely used for B2B and A2A integrations. They are used as a formal basis for describing supply-chain management in the manufacturing sector [4]. The authors have used a linguistic approach to coordinate modeling and analyzing interactions in terms of linguistic primitives. They have evaluated their methodology in the context of several industrial scenarios.

To help manufacturers improve the integration standards, NIST (National Institute of Standard and Technology) has established a tested project. The tested project uses NIST-developed test methods and tools to verify that a specific software component copes with industry standards [5]. This project has on-going testing and experimental capabilities for generic XML standards as well as specific focuses on OAGIS and RossetaNet specifications. The test bed has participants from industries including major manufacturers such as Boeing, Lucent Technologies, Lockheed Martin, and more.

In this paper, we adopt those successful integration standards including the ebXML BPSS and the OAGIS BODs and demonstrate how they could be used together to formally describe workflows and for improving interoperability in systems integration.

4. PRODUCTION PROCESSES

Production as the organizational entity is an arranged group of organizational units that can be activated, under some circumstances, in the direction of establishing production process. Here it is started with a fact that production, as a functional part, includes such a production process that can be executed in a particular time framework and bring some amount of product of certain quality, and structure of this process is made of particular single, elementary production processes.

Processes in production company can be production, business and research-development. Production processes are separated to smaller, elementary processes: production working places (technological process), quality control, internal transport, stock, maintenance and energy and water supply. [17]

Because of the amount of production process and document models, in this paper only model of technological process and model of standardized document of technological process Working Order will be presented. Models of other process and their documents can be viewed in. [9]

4.1. Tehnological process

In production systems, production and technological processes are not the same. Under production processes we consider all operations under the object of work, from the entrance of materials in production until final products from production process. Technological process is a part of production process that relates to work on production working places, for separate products. In the framework of technological system there is a process of transformation of input elements in wanted shape. Technological process presents connection of technological operations for the purpose of transformation of lower into higher value by man acting.

Technological process contains indirect relation and moving of production element in their mutual acting at separate production working places and contains: work methods at the work place, work regime, time and complexity of work that is used for the production of a product. Technological process shows way of individual products making. In one production process one or more technological processes can be found, which depends on the production type.

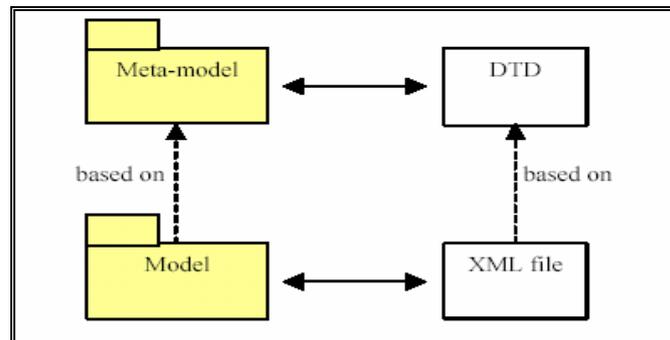


Figure 3: Relation between meta-model and XML file

4.2. Metamodel of the process

ebXML in [19] for UML process specification schema recommend meta-model process by UML class diagram, as a general model of all process description, so as for here observed production process. This model was taken from the mentioned analyzed source, after the possibilities of its use were approved for production process. In the chapter 6 its use is shown on the example of production process. In the figure 4 ebXML meta-model of the process is presented by UML class diagram.

Presented meta-model by production rules [19] is transformed in XML specification scheme. XML specification scheme can be DTD (Data Type Definition) or BPSS (Business Process Specification Schema) [1]. ebXML DTD specification scheme and ebXML BPSS specification scheme can be viewed in [19] or on the Internet, at: www.ebxml.org.

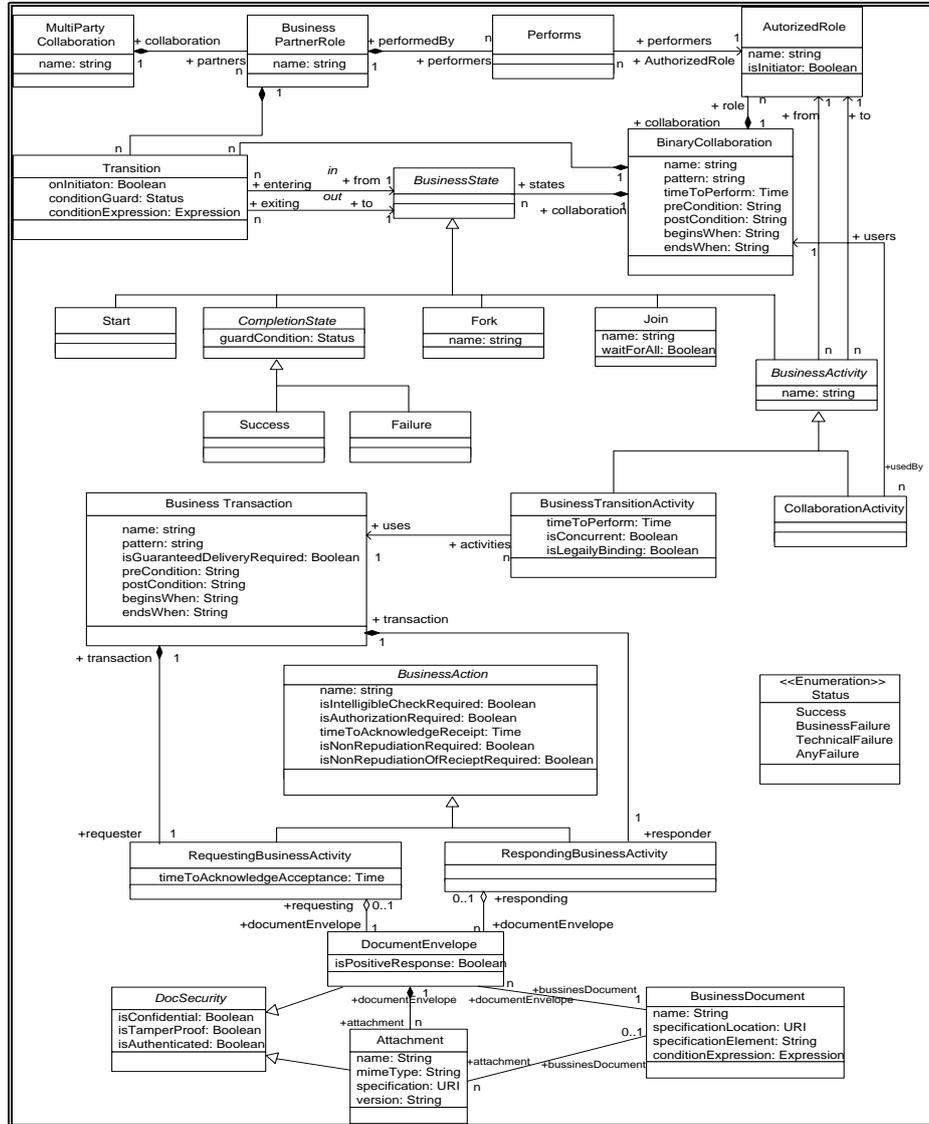


Figure 4: ebXML meta-model of the process

The process model is based on meta-model of the process that is made of group of tags where each tag responds to the entity in a meta-model. Meta-model is presented in

the frame of XML DTD or BPSS, and model of concrete process is presented by XML file based on DTD or BPSS meta-model (Figure 3).

5. PRODUCTION DOCUMENTS

In the model of production process there are two basic flows: flow of materials and flow of information e.g. documents to transform necessary information through production company. Each production process has a certain group of documents which are used and generalized during the business process, the way which they make exchange of information with other production system processes and how they communicate with an environment, e.g. do the exchange of information with an environment.

5.1. Documents in technological process

In domestic production companies technological documents include all documents that are necessary for production, monitoring and regulation of production of one type of products, and that are directly related to production process [18]. In production subsystem production documentation is up to its function and as a place of its initiation can be divided in three groups: construction, technological and working one.

Construction documents. Construction documents give all necessary information about a part or a product that has to be made. Construction documentation consists of all kinds of drawings, and consisting paper.

Technological documents. Technological documents contain all information necessary for complete definition of production process e.g. all necessary guide for production of one type of a product. Technological documents are formed based on construction documents and knowledge of state and possibility of production of observed company. Technological documents are: operational instruction paper, instruction paper, list of break down, procedure of technological control, technological procedure of making, tool specification, chart of machine location, scheduling chart.

Working documents. Working documents are formed based on construction and technological documents from one side and operation plans and current state of production, on the other side. Their function is three-dimensional. First, it has to enable instructions about way of production execution to all direct participants in production process. Second, it has to enable simpler and more efficient monitoring and regulation of production process. And the third, based on these documents direct costs in production are calculated. Content of production documents are precise data about resource amount, working machines and workers, data from operational instruction paper through which the whole production process is described, precisely defined dead-lines and duration of separate phases of production process, and the whole production process that are defined in the department for production scheduling and operational preparation of production. Working document can be: working order, material order, working paper, declaration, terms chart, and delivering chart.

These three groups of documents from the aspect of their move through the production process can be divided in two groups. First is the group of documents that goes through technological process together with the object of work. This group of documents is in technological process as a basic part of messages that are exchanged between activities together with the object of work. They are result of activities performed. This is a group consisted of Working documents. Second group of documents

in technological process is documented at the working place that means they do not move through technological process. With these documents, e.g. knowledge placed in them, certain activities at work place. In this group of documents are construction and technological documents.

5.2. Model of standardized technological document working order

In [9] for each production process one model of standard document in the form of OAGI BOD is presented. In order to define a standardized document model study from Mechanical Engineering Faculty is used, from group of authors from the Industrial Engineering Chair, based on survey at 34 production company and available references in the field. They have defined model of system of production documentation that takes into account standardization of each production document separately [18]. Beside it, Yugoslav standard JUS ISO 9004: 2001 [6] is used as the complete production documentation from a few production companies: ILR “LOLA” Corporation [12], “DMB” Rakovica [15], “IPM” Beograd [13], and from some private production companies. In this paper only model of standardize document of technology process named Working Order is presented.

Based on the suggested architecture OAGI BOD there is XML DTD for BOD with which suggested standardized form of document Working Order is presented.

```

<!--This is BOD for document WORKING ORDER -->
<!ELEMENT WORKING_ORDER (CNTROLAREA, DATAAREA+)>
<!ELEMENT CNTROLAREA (BSR, SENDER, DATETIME)>
<!ELEMENT BSR (VERB, NOUN, REVISION)>
<!ELEMENT VERB EMPTY>
<!ATTLIST VERB
  value CDATA #FIXED "PRODUCTION START"
>
<!ELEMENT NOUN EMPTY>
<!ATTLIST NOUN
  value CDATA #FIXED "PRODUCTION OF PRODUCT"
>
<!ELEMENT REVISION EMPTY>
<!ATTLIST REVISION
  value CDATA #FIXED "001"
>
<!ELEMENT SENDER (LOGICAL_ID, COMPONENT, TASK, REFERENCE_ID, CONFIRMATIO,
LANGUAGE, CODE_PAGE, AUTH_ID)>
<!ELEMENT LOGICAL_ID (#PCDATA)>
<!ELEMENT COMPONENT (#PCDATA)>
<!ELEMENT TASK (#PCDATA)>
<!ELEMENT REFERENCE_ID (#PCDATA)>
<!ELEMENT CONFIRMATIO (#PCDATA)>
<!ELEMENT LANGUAGE (#PCDATA)>
<!ELEMENT CODE_PAGE (#PCDATA)>
<!ELEMENT AUTH_ID (#PCDATA)>
<!ELEMENT DATETIME (YEAR, MONTH, DAY, HOUR, MINUTE)>
<!ATTLIST DATETIME
  qualifier CDATA #REQUIRED
>
<!ELEMENT YEAR (#PCDATA)>
<!ELEMENT MONTH (#PCDATA)>
<!ELEMENT DAY (#PCDATA)>
<!ELEMENT HOUR (#PCDATA)>

```

```

<!ELEMENT MINUTE (#PCDATA)>
<!ELEMENT DATAAREA (WORKINGORDER)>
<!ELEMENT WORKINGORDER (NUMBERWO, PRODUCT, ORDERER, TIME, MIDDLE +,
PROCESSED, APPROVED, VERIFIDE)>
<!ATTLIST WORKINGORDER
  value CDATA #FIXED "WORKING ORDER"
>
<!ELEMENT NUMBERWO (#PCDATA)>
<!ATTLIST NUMBERWO
  value CDATA #FIXED "WORKING ORDER NO:"
>
<!ELEMENT PRODUCT (NAME, CODE)>
<!ELEMENT NAME (#PCDATA)>
<!ATTLIST NAME
  value CDATA #FIXED "NAME OF PRODUCT:"
>
<!ELEMENT CODE (#PCDATA)>
<!ATTLIST CODE
  value CDATA #FIXED "CODE OF PRODUCT:"
>
<!ELEMENT ORDERER (CUSTOMER, ORDER)>
<!ELEMENT CUSTOMER (#PCDATA)>
<!ATTLIST CUSTOMER
  value CDATA #FIXED "CUSTOMER:"
>
<!ELEMENT ORDER (#PCDATA)>
<!ATTLIST ORDER
  value CDATA #FIXED "ORDER NO:"
>
<!ELEMENT TIME (START, DELIVER)>
<!ELEMENT START (#PCDATA)>
<!ATTLIST START
  value CDATA #FIXED "START TIME:"
>
<!ELEMENT DELIVER (#PCDATA)>
<!ATTLIST DELIVER
  value CDATA #FIXED "DELIVER TIME:"
>
<!ELEMENT MIDDLE (POSITION, DRAWINGNO, PIECE, PPRICE, FULLY)>
<!ATTLIST MIDDLE
  value CDATA #FIXED "JOB DESCRIPTION:"
>
<!ELEMENT POSITION (#PCDATA)>
<!ATTLIST POSITION
  value CDATA #FIXED "POSITION:"
>
<!ELEMENT DRAWINGNO (#PCDATA)>
<!ATTLIST DRAWINGNO
  value CDATA #FIXED "Drawing No:"
>
<!ELEMENT PIECES (#PCDATA)>
<!ATTLIST PIECES
  value CDATA #FIXED "Number of pieces:"
>
<!ELEMENT PPRICE (#PCDATA)>
<!ATTLIST PPRICE
  value CDATA #FIXED "Price of piece:"
>
<!ELEMENT FULLY (#PCDATA)>
<!ATTLIST FULLY

```

```

    value CDATA #FIXED "Fully:"
  >
  <!ELEMENT NAME (#PCDATA) >
  <!ATTLIST NAME
    value CDATA #FIXED "Name"
  >
  <!ELEMENT PROCESSED (NAME) >
  <!ATTLIST PROCESSED
    value CDATA #FIXED "PROCESSED:"
    DATE CDATA #REQUIRED
  >
  <!ELEMENT APPROVED (NAME) >
  <!ATTLIST APPROVED
    value CDATA #FIXED "Approved:"
    DATE CDATA #REQUIRED
  >
  <!ELEMENT VERIFIDE (NAME) >
  <!ATTLIST VERIFIDE
    value CDATA #FIXED "Verifide:"
    DATE CDATA #REQUIRED
  >

```

6. RULES FOR TRANSFORMATION DA INTO XML

In the modeling process of a technological process UML DA is used and then transformed in XML form by use of elements of metamodel of process presented at Figure 4 and XML DTD from [19]. In this chapter rules for transformation of DA into XML are described and are defined:

1. Every DA (which have more than two states) represent one *MultiPartyCollaboration*,
2. Activity state from *DA* is rendered as *XML* element *BusinessTransaction*
3. Transition from *DA* is rendered as *XML* element *Transition*,
4. Transition together with connected activity states represent one *BinaryCollaboration*,
5. Every complex activity is represented over separate description which are included in basic description of *DA* with *XML include*,
6. Start state from *DA* is rendered as *XML* element *Start*,
7. End state from *DA* is rendered as *XML* element *Success* or *Failure*,
8. Forking from *DA* is rendered as *XML* element *Fork*,
9. Joining (synchronization) from *DA* is rendered as *XML* element *Join*,
10. When transforming one state to more then one state by forking, the problem is solved through elements *CollaborationActivity* rendering to more *BinaryCollaboration*. In situation when several states are transformed in to one state by synchronization, problem is also solved through element *CollaborationActivity*,
11. Processors which are in *DA* represented as “swimming lines” are rendered as *XML* element *BusinessPartnerRole*,
12. For each *Binary Collaboration* must be defined *InitiatingRole* and *RespondingRole*. They suggest to processors that initiate or do that *Binary Collaboration*,
13. Document from *DA* is rendered as *BusinessDocument*,
14. Documents which are on activity input flow are defined in *XML* element *RequestingBusinessActivity*,
15. Documents which are on activity output flow are defined in *XML* element *RespondingBusinessActivity*.

7. EXAMPLE OF OAGI AND EBXML SPECIFICATION USE IN PRODUCTION SYSTEMS

Use of previously shown metamodel of process and model of document is presented here, based on OAGI and ebXML specification in domestic production companies, started with the existing processes and documents. At the example there is a production of cog-ged rivet in the production company ILR “Lola” Corporation from Belgrade, for “Magnitogorski” from Russia.

7.1. Technological process of production of cog-ged rivet

Technological process of production of cog-ged rivet is consisted of 14 operations [ILR_01]; three of them are complex. Operations are accomplished at three working places. In Table 1 technological operations are presented by they numbers, names, descriptions, machines and working places on which operations are accomplished.

Table 1: Technological process of production of cog-ged rivet

No	Op. No	Operation name	Operation description	Machine name and WP
1.	10	Inspection, cleaning and prepare for mounting	Inspect positions and products, clean and prepare for mounting	“MMOU” WP1
2.	20	Lubrication, installing bearings 13c and 14c	Lubricate bearing positions 13c and 14c and then build in bearings	“MMOU” WP 1
3.	30a	Measure of shames	Measure shames and then if necessary pass positions 19c and 20c to ragging	“MMOU” WP 1
	30b	Build in bearing 19c and 20c	Build in bearing positions 19c and 20c	“MMOU” WP 1
4.	35	Ragging	Ragging bearing positions 19c and 20c	Ragg WP 2
5.	40a	Drilling 3a	Through mounting of ring position 3a do drilling	“MMOU”
	40b	Engraving of 3xM6	Engraved screw 3xM6	Ragg WP 2
6.	50a	Engraving of 2xM6	Through mounting of ring position 4a do drilling	“MMOU”
	50b	Mounting 4a	Engrave screw 2xM6	Ragg RM2
7.	60	3a and 4a ensure with screws 5a	Position 3a and 4a ensure with screws 5a	“MMOU” WP 1
8.	70	Accomplish shame between 1 and 2	Accomplish shame between position 1 and 2, maintain elevation 2 and 2,5	“MMOU” WP 1
9.	80	Test turning, mounte 2c	Test turning and then mounte 2c	“MMOU” WP 1
10.	90	Fit in and adjust	Through mounting do all necessary fit in and adjustment of toothed positions	“MMOU” WP1
11.	100	Spread over with barsil, seal 1a and 5c	Area pointed on drawing which have to be seald between positions 1a and 5c spread over with barsil	“MMOU” WP1
12.	110	Mounting of cog-ged rivet	Mounte cog-ged rivet using measures on drawing	“MMOU” WP1
13.	120	Static balancing	Do static balancing reposing on position 1a and 2 without damaging	“MMOU” WP1
14.	130	Cleaning, painting with washprimer and basic colour	Cleane and paint one time with washprimer and one time with basic colour num. 301023	“MFR” WP3

From Table 1 you can see which three operations are complex. Operation 30 (measure of shames and build in bearing 19c and 20c) is consisted of two sub-operations:

30a (measure of shame) and 30b (build in bearing 19c and 20c), but the result of operation 30a may need passing to operation 35 (ragging), after which operation 30b is to be done. Operation 40 (drilling 3a and engraving of 3xM6) is consisted of two parallel sub-operations, that mean that after both of them are finished then next operation can start. The same situation is in operation 50 (engraving of 2xM6 and mounting 4a). In Figure 5 DA of this technological process is presented.

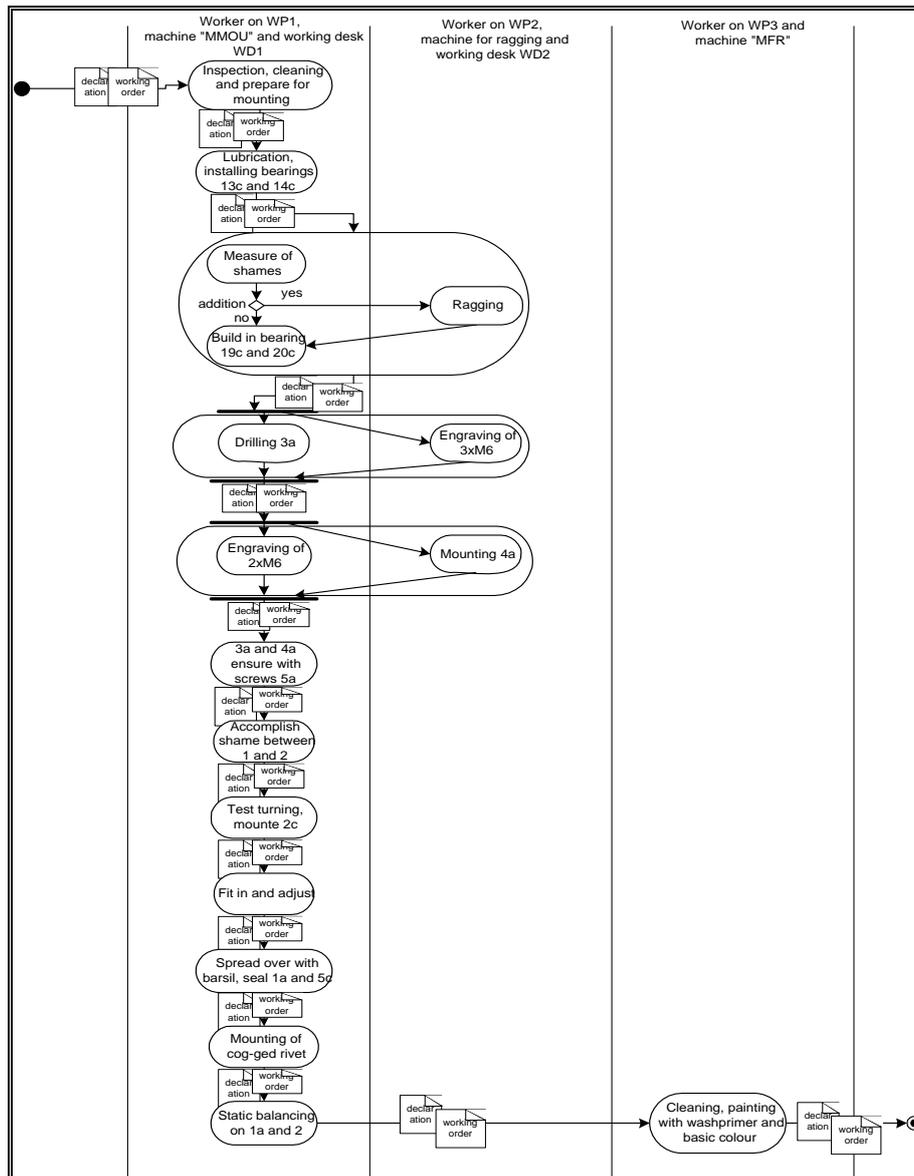


Figure 5: DA of technological process of production of cog-ged rivet

There is presented XML description of technological process of production of cog-ged rivet using ebXML metamodel and his XML DTD. Because this technological process is consisted of 14 operations and tree of them are complex, first we present main XML file of technological process, which include tree separated XML files. After that we present one separated XML files in which is description of one complex operation.

```

<!-- XML Technological process -->
<!DOCTYPE ProcessSpecification SYSTEM "ebBPSS.dtd">
<ProcessSpecification name="Technological" version="1.0" uuid="TEH000">
  <Include name="Teh-1" uuid="TEH001" uri="teh-1" version="1.0"/>
  <Include name="Teh-2" uuid="TEH002" uri="teh-2" version="1.0"/>
  <Include name="Teh-3" uuid="TEH003" uri="teh-3" version="1.0"/>
  <!-- Business Documents -->
  <BusinessDocument name="BOD working order"/>
  <BusinessDocument name="BOD declaration"/>
  <BusinessDocument name="BOD working sheet"/>
  <Package name="Technological">
    <!-- MultiParty Collaboration -->
    <MultiPartyCollaboration name=" Technological process">
      <BusinessPartnerRole name="Worker">
        <Performs initiatingRole="manager"/>
        <Performs respondingRole="workerWP1"/>
        <Performs respondingRole="workerWP2"/>
        <Performs respondingRole="workerWP3"/>
        <Transition fromBusinessState=" Inspection, cleaning and
prepare for mounting "
          toBusinessState=" Lubrication, installing bearings 13c and
14c "/>
          <Transition fromBusinessState=" Lubrication, installing
bearings 13c and 14c "
            toBusinessState=" Measure of shame and Build in bearing 19c
and 20c "/>
            <Transition fromBusinessState=" Measure of shameand Build in
bearing 19c and 20c"
              toBusinessState=" Drilling 3a and Engraving of 3xM6"/>
              <Transition fromBusinessState=" Drilling 3a and Engraving of
3xM6"
                toBusinessState=" Engraving of 2xM6 and Mounting 4a "/>
                <Transition fromBusinessState=" Engraving of 2xM6 and Mounting
4a"
                  toBusinessState="3a and 4a ensure with screws 5a "/>
                  <Transition fromBusinessState="3a and 4a ensure with screws
5a"
                    toBusinessState=" Accomplish shame between 1 and 2"/>
                    <Transition fromBusinessState=" Accomplish shame between 1 and
2"
                      toBusinessState=" Test turning, mounting 2c "/>
                      <Transition fromBusinessState=" Test turning, mounting 2c "
                        toBusinessState=" Fit in and adjust "/>
                        <Transition fromBusinessState=" Fit in and adjust "
                          toBusinessState=" Spread over with barsil, pugging 1a and
5c "/>
                          <Transition fromBusinessState=" Spread over with barsil,
pugging 1a and 5c"
                            toBusinessState=" Mounting of cog-ged rivet "/>
                            <Transition fromBusinessState=" Mounting of cog-ged rivet "
                              toBusinessState=" Static balancing on 1a and 2"/>
                              <Transition fromBusinessState=" Static balancing on 1a and 2"

```

```

        toBusinessState=" Cleaning, painting with washprimer and
basic colour "/>
    </BusinessPartnerRole>
</MultiPartyCollaboration>
<!-- Binary Collaborations -->
<BinaryCollaboration name=" Inspection, cleaning and prepare for
mounting "
    beginsWhen="after receive working order">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <BusinessTransactionActivity name="Prepare for mounting"
        businessTransaction=" Prepare for mounting "
        fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"/>
    <Start toBusinessState=" Inspection, cleaning and prepare for
mounting "/>
    <Transition fromBusinessState=" Inspection, cleaning and prepare
for mounting "
        toBusinessState=" Lubrication, installing bearings 13c and 14c
"/>
    </BinaryCollaboration>
<BinaryCollaboration name=" Lubrication, installing bearings 13c and
14c "
    timeToPerform="now">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <BusinessTransactionActivity name=" build in bearing 13c and 14c"
        businessTransaction=" build in bearing 13c and 14c "
        fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"/>
    <Transition fromBusinessState=" Lubrication, installing bearings
13c and 14c "
        toBusinessState="Teh1"/>
    </BinaryCollaboration>
<BinaryCollaboration name="3a and 4a ensure with screws 5a "
timeToPerform="now">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <Transition fromBusinessState="Teh3" toBusinessState="3a and 4a
ensure with screws 5a"/>
    <BusinessTransactionActivity name="3a and 4a ensure with screws
5a"
        businessTransaction="3a and 4a ensure with screws 5a "
        fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"/>
    <Transition fromBusinessState="3a and 4a ensure with screws 5a "
        toBusinessState=" Accomplish shame between 1 and 2"/>
    </BinaryCollaboration>
.
.
.
<BinaryCollaboration name=" Static balancing on 1a and 2"
    timeToPerform="now">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <BusinessTransactionActivity name=" Static balancing "
        businessTransaction=" Static balancing "
        fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"/>
    <Transition fromBusinessState=" Static balancing on 1a and 2"
        toBusinessState=" Cleaning, painting with washprimer and basic
colour "/>
    </BinaryCollaboration>

```

```

    <BinaryCollaboration name=" Cleaning, painting with washprimer and
basic colour "
    timeToPerform="now">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP3"/>
    <BusinessTransactionActivity name=" Cleaning and painting "
    businessTransaction=" Cleaning and painting "
    fromAuthorizedRole="manager" toAuthorizedRole="workerWP3"/>
    <Success fromBusinessState=" Cleaning, painting with washprimer
and basic colour "/>
    </BinaryCollaboration>
    <!-- Business Transactions -->
    <BusinessTransaction name=" Prepare for mounting ">
    <RequestingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
    businessDocument="BOD working order ">
    <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
    <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
    </DocumentEnvelope>
    </RequestingBusinessActivity>
    <RespondingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
    businessDocument="BOD working order ">
    <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
    <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
    </DocumentEnvelope>
    </RespondingBusinessActivity>
    </BusinessTransaction>
    <BusinessTransaction name=" build in bearing 13c and 14c ">
    <RequestingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
    businessDocument="BOD working order ">
    <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
    <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
    </DocumentEnvelope>
    </RequestingBusinessActivity>
    <RespondingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
    businessDocument="BOD working order ">
    <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
    <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
    </DocumentEnvelope>
    </RespondingBusinessActivity>
    </BusinessTransaction>
    <BusinessTransaction name="3a and 4a ensure with screws 5a ">
    <RequestingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
    businessDocument="BOD working order ">
    <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
    <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>

```

```

        </DocumentEnvelope>
    </RequestingBusinessActivity>
    <RespondingBusinessActivity name="">
        <DocumentEnvelope isPositiveResponse="true"
            businessDocument="BOD working order ">
            <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
            <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
        </DocumentEnvelope>
    </RespondingBusinessActivity>
</BusinessTransaction>
.
.
.
<BusinessTransaction name=" Static balancing ">
    <RequestingBusinessActivity name="">
        <DocumentEnvelope isPositiveResponse="true"
            businessDocument="BOD working order ">
            <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
            <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
        </DocumentEnvelope>
    </RequestingBusinessActivity>
    <RespondingBusinessActivity name="">
        <DocumentEnvelope isPositiveResponse="true"
            businessDocument="BOD working order ">
            <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
            <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
        </DocumentEnvelope>
    </RespondingBusinessActivity>
</BusinessTransaction>
<BusinessTransaction name=" Cleaning and painting ">
    <RequestingBusinessActivity name="">
        <DocumentEnvelope isPositiveResponse="true"
            businessDocument="BOD working order ">
            <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
            <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
        </DocumentEnvelope>
    </RequestingBusinessActivity>
    <RespondingBusinessActivity name="">
        <DocumentEnvelope isPositiveResponse="true"
            businessDocument="BOD working order ">
            <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
            <Attachment name="" mimeType="" businessDocument="BOD
working sheet "/>
        </DocumentEnvelope>
    </RespondingBusinessActivity>
</BusinessTransaction>
</Package>
</ProcessSpecification>

```

There is presented XML description of operation “Measure of shame, build in bearing 19c and 20c” and operation “Ragging” because accomplishing of operation

“Ragging” is conditioned by operation “measure of shame and build in bearing 19c and 20c”, see DA in Figure 5.

```

<!--XML Tehnological process of operation Measure of shame, Build in
bearing 19c and 20c and operation Ragging-->
<!DOCTYPE ProcessSpecification SYSTEM "ebBPSS.dtd">
<ProcessSpecification name="Teh1" version="1.0" uuid="TEH001">
  <BinaryCollaboration name=" Measure of shame - addition">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <BusinessTransactionActivity name=" Measure of shame "
      businessTransaction=" Measure of shame "
fromAuthorizedRole="manager"
      toAuthorizedRole="workerWP1" isConcurrent="false"/>
    <Transition fromBusinessState="Teh1" toBusinessState=" Measure of
shame "/>
    <Fork name="addition"/>
    <CollaborationActivity name=" Measure of shame - Build in bearing "
      binaryCollaboration=" Measure of shame, Build in bearing 19c and
20c "
      fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"/>
    <CollaborationActivity name=" Measure of shame - Ragging "
      binaryCollaboration=" Ragging " fromAuthorizedRole="manager"
      toAuthorizedRole="workerWP2"/
  </BinaryCollaboration>
  <BinaryCollaboration name=" Measure of shame, Build in bearing 19c and
20c "
      preCondition="Addition=NO">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <Transition fromBusinessState=" Measure of shame "
      toBusinessState=" Build in bearing 19c and 20c "/>
  </BinaryCollaboration>
  <BinaryCollaboration name="Ragging " preCondition="Addition=YES">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP2"/>
    <Transition fromBusinessState=" Measure of shame " toBusinessState="
Ragging "/>
  </BinaryCollaboration>
  <BinaryCollaboration name=" Ragging, Build in bearing 19c and 20c ">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <BusinessTransactionActivity name=" Ragging " businessTransaction="
Ragging "
      fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"
      isConcurrent="false"/>
    <Transition fromBusinessState=" Ragging " toBusinessState=" Build in
bearing 19c and 20c "/>
  </BinaryCollaboration>
  <BinaryCollaboration name=" build in bearing 13c and 14c "
timeToPerform="now">
    <InitiatingRole name="manager"/>
    <RespondingRole name="workerWP1"/>
    <BusinessTransactionActivity name=" build in bearing 13c and 14c "
      businessTransaction=" build in bearing 13c and 14c "
      fromAuthorizedRole="manager" toAuthorizedRole="workerWP1"/>
    <Transition fromBusinessState="Teh1" toBusinessState="Teh2"/>
  </BinaryCollaboration>
<!-- Business Transactions -->

```

```

<BusinessTransaction name=" Measure of shame ">
  <RequestingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
      businessDocument="BOD working order ">
      <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
      <Attachment name="" mimeType="" businessDocument="BOD working
sheet "/>
    </DocumentEnvelope>
  </RequestingBusinessActivity>
  <RespondingBusinessActivity name="">
    <DocumentEnvelope isPositiveResponse="true"
      businessDocument="BOD working order ">
      <Attachment name="" mimeType="" businessDocument="BOD
declaration "/>
      <Attachment name="" mimeType="" businessDocument="BOD working
sheet "/>
    </DocumentEnvelope>
  </RespondingBusinessActivity>
</BusinessTransaction>
.
.
.
</ProcessSpecification>

```

At the same way operations “Drilling 3a and engraving of 3xM6” and “Engraving of 2xM6 and mounting 4a” are described in separate XML files.

7.2. Working order in technological process of cog-ged rivet

Working Order is basic document of working documentation as it initiate and finish certain technological process. By its issue technological process starts and during it is moved from one to another working place and at the end is sent from the last working place, after last operation is finished it is marked that technological process is finished.

At Figure 5 that presents activities diagram of technology process of cog-ged rivet production document that circulate through technological process from working place can be seen which are Working Order and Declaration.

For the document Working Order model is presented in chapter 5.2 like BOD in the form of XML DTD. There is presentation of XML document, based on mentioned DTD, Working Order for technological process of cog-ged rivet, that would be exchanged in electronic form between working places.

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE WORKING_ORDER SYSTEM "C:\XML Spy 3.5\moje\WORKING ORDER.dtd">
<WORKING_ORDER>
  <CNTROLAREA>
    <BSR>
      <VERB value="PRODUCTION START"/>
      <NOUN value="PRODUCTION OF PRODUCT"/>
      <REVISION value="001"/>
    </BSR>
    <SENDER>
      <LOGICAL_ID>XX141HG09</LOGICAL_ID>
      <COMPONENT>PRODUCTION OF PRODUCT</COMPONENT>
      <TASK>PRODUCTION PROCESs</TASK>

```

```

<REFERENCE_ID>1111</REFERENCE_ID>
<CONFIRMATIO>1</CONFIRMATIO>
<LANGUAGE>ENG</LANGUAGE>
<CODE_PAGE>0000</CODE_PAGE>
<AUTH_ID>WP1</AUTH_ID>
</SENDER>
<DATETIME qualifier="CREATION">
  <YEAR>2001</YEAR>
  <MONTH>11</MONTH>
  <DAY>07</DAY>
  <HOUR>8</HOUR>
  <MINUTE>1</MINUTE>
</DATETIME>
</CNTROLAREA>
<DATAAREA>
  <WORKINGORDER value="WORKING ORDER">
    <NUMBERWO value="WORKING ORDER NO.:">301076</NUMBERWO>
    <PRODUCT>
      <NAME value="NAME OF PRODUCT:">COG-GED RIVET</NAME>
      <CODE value="CODE OF PRODUCT:">25146</CODE>
    </PRODUCT>
    <ORDERER>
      <CUSTUM value="CUSTOM:">MAGNITOGORSK-RUSSIA </CUSTUM>
      <ORDER value="ORDER NO.:">22-300-043</ORDER>
    </ORDERER>
    <TIME>
      <START value="START TIME:">07.12.2001</START>
      <DELIVER value="DELIVER TIME:">20.12.2001</DELIVER>
    </TIME>
    <MIDDLE value="JOB DESCRIPTION:">
      <POSITION value="POSITION:">COG-GED RIVET</POSITION>
      <DRAWINGNO value="Drawing No:">7-35-1-6</DRAWINGNO>
      <PIECES value="Pieces:">20</PIECES>
      <PPRICE value="Price of pieces:">2750</PPRICE>
      <FULLY value="Fully:">55000</FULLY>
    </MIDDLE>
    <PROCESSED value="PROCESSED:" DATE="07.11.2001">
      <NAME value="Name">S. Mandic</NAME>
    </PROCESSED>
    <APPROVED value="Approved:" DATE="13.11.2001">
      <NAME value="Name">M. Vlajic</NAME>
    </APPROVED>
    <VERIFIDE value="Verifide:" DATE="13.11.2001">
      <NAME value="Name">S. Stanojevic</NAME>
    </VERIFIDE>
  </WORKINGORDER>
</DATAAREA>
</WORKING_ORDER>

```

8. CONCLUSION

Problem of integration of production companies that is considered here, no matter it is spoken about integration in the frame of one production company or between company and other business partners, in the last few years attract attention of great number of organizations involved in integration and standards. All over the world there are initiatives for solutions of mentioned problem of integration, e.g. solutions for simplification, standardization and interoperability of a company in electronic business,

and there is certain number of organizations that are involved in the standard related problems. In our country there are organizations involved in the standards in the electronic data interchange, and they still have no solutions they could offer and recommend as the standard for the process or document description in any area of business, so in the production. With an aim to present possibilities of use of OAGI and ebXML, as the standard for integration recommended by the international community, in this paper model of technological process is presented, standard of technological document Working Order is suggested and one of its appearance is shown. Research done in this paper should be of help and faster process of national standard formation for electronic business and electronic manufacturing, like for world standards for integration and interoperability.

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