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A theoretical comparison upon the use of UML or BPMN in the modelling of logistic processes and the management of logistical operations

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Abstract. Although the use of UML and BPMN is widely spread among many domains, it has not yet been analysed which of the two approaches favours the modelling of logistical process. In a world in which all actions have become more constricted by the time factor and everything needs to arrive "just in time", a successful logistical model can influence the success or the failure of many projects that are linked to logistical services. As such, it is important to compare the best possible tools that favour the correct and efficient modelling of logistical businesses and approaches. The article will shortly try to present an overview of the advantages and disadvantages of using either UML (Unified Modelling Language) or BPMN (Business Process Modelling Notation) in modelling the logistical process. In comparing these two languages, the article will analyse some characteristics that can be applied to make the logistical models more efficient, structured and most important applicable. It is highly advisable, when choosing one of the two languages to have a clear choice from the start in order to not switch back to the other language during the modelling process or even in the implementation phase, upon realising that there some features that are not favourable for this domain-specific modelling.

1. Introduction

In the newly developed world, where all activities need to be organized, just to manage to have an overview of what is happening in an organization, there are many efforts being made to standardize this organizational process. In order to understand this process, businesses have to define their core activities and focus on establishing general guidelines that can be followed in any situation.
From a simplistic perspective, the business process is the sum of tasks or related activates, having clearly defined inputs and outputs and have a starting point and an end

In general, the business process is divided into other sub processes. Each of these sub processes are contributing to the main goals of the process. The **Figure *1*** developed by Vaisman [1] describes the life cycle of a business process.

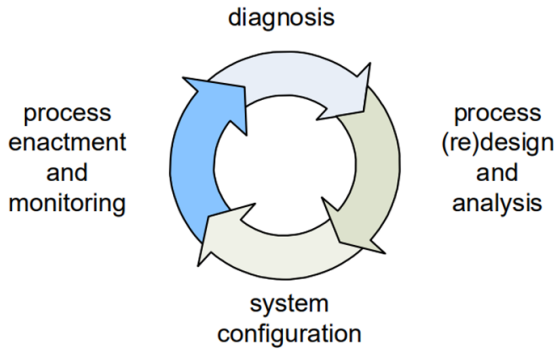

Figure 1 Life cycle of a business process [1]

There are four steps:

1. The process design or redesign and analysis in which the process is divided and all aspects theorised and analysed
2. The system configuration of the process which applies the theory developed in step 1
3. The process enactment and monitoring tests and monitors the way the business process is designed
4. The diagnosis step takes into account the results of the monitoring phase of step 3 and passes over these results to step 1 for a process redesign. (if necessary)
5. The cycle is redone

In order to keep track of this life cycle and the changes over time, there was a lot of effort over the last decades to represent them graphically. In the initial phase, it was done using Workflow Diagrams. These diagrams were only concentrated on the activities of each department of the organization. Afterwards, realising that such Diagrams are only applicable in the respective department, Business Process Models were developed, trying to synergize the activities of the entire organization and intertwine them. The big difference between Workflow Diagrams and Business Process Models was that Workflow Diagrams were designed taken into account only the processes realized by people, whist the Business Process Models are structured around both system processes and people related processes

Also considering the complexity of the above mentioned life cycle, in the last decades there were organizations (like OMG – Object Management Group, OASIS , BPMI –Business Process Management Initiative) that set forth to design standards that could solve all of the steps required to design and implement a business process. Two standards are known to set the pace of the Business Process Management. One of them is Business Process Languages Notation (BPMN) [2] and the other one is UML Activity Diagram (UML AD) [3].

This article tries to compare these two languages considering the necessities that arise from designing logistical processes. Although they werer compared from a general point of view, these two languages have never been compared from the point of view of solving the unique challenges that arise from managing a logistical process.

2. The current state in the analysis of the use of BPMN versus UML

There are many researches that have studied the application and suitability of using BPMN and UML AD in general business process. In one of the researches Dumas and ter Hofstede [4]analysed the capabilities of UML AD to represent the desired workflow patterns and workflow specifications. In another research Sarshar and Loos [5] regarded the resource components of business process modelling and also compared this aspect to Petri nets.

There were also researches designed to asses the capacities of BPML and UML languages to map the business processes. As an example the research of Mazanek and Hanus [6] described the possibility to transform in both directions a BPMN workflow pattern into a BPEL workflow pattern and the other way around. In order to have also an empirical overview, such type of researches have also been

conducted. In the empirical study of Birkmeier [7] the result was that the languages have equal degrees of complexity, since the ergonomics with the user and the efficiency, as well as the effectiveness were approximately the same.

The objective of this research is to check if part of the goals of the logistic process can be fulfilled by using the BPMN and UML languages. Furthermore, if possible to shortly evaluate which of the two languages is more suited to represent these types of processes.

3. Research methods

In this research the main goal and objectives of implementing logistical processes will be presented, based on literature review. Afterwards, these goals will be shortly analysed from the perspective of the utility of using either the BPMN language and the UML language by implementing a short logistical model. The purpose of the study is to show some aspects of using these languages and to compare them. If possible, at the end of this research some short initial conclusions can be presented regarding the language than has more utility in analysing logistical processes

4. The logistical processes

Logistics is considered one of the most important functions of the economy. The goal of logistics is to create a bridge between the dimension of time and space by planning, organizing, coordinating and implementing the delivery of goods or services.

The European Committee for Standardization CEN (Comite´ Europe´en Normalisation) stipulates the following definition for logistics : :". . . *the planning, execution and control of the movement and placement of people and/or goods and of the supporting activities related to such movement and placement, within an system organized to achieve specific objectives*." [8]

Logistics have the following goal clusters:

- Cost reduction of the logistical processes and of the total process
- Adaptability needs to be increased due to constant changes in demand and supply
- Added values needs to be taken into consideration as logistics can improve the quality of the goods

Logistical processes are one of the base elements for manufacturing companies and especially the service sector. These processes vary in complexity and structure depending on the companies sector, the services or goods it provides or the size. For the services providers these process are of great importance. The environment for these companies are changing constantly and usually these processes are considered core processes that can give an edge to the companies or even make them fail. [9]

4.1. Short description of BPMN and UML

BPMN is the result of the agreement between software companies to standardize notations. That is why this language is used in many instances and there are many instruments that adopt this notation. BPMN supplies a graphical notation that describes the business processes, is intuitive and can represent complex process structures. BPMN has also the possibility to be implemented in later stages into a BPEL language (Business Process Execution Language)

The primary goal of BPMN *is "to provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes*."BPMN was created in order to have multiple uses, in multiple domains in order to design "end-to-end" business processes.

"Unified Modelling Language (UML) is a standardized general-purpose modelling language in the field of object-oriented software engineering. UML includes a set of graphic notation techniques to create visual models of object-oriented software systems. UML combines techniques from data modelling, business modelling, object modelling, and component modelling and can be used throughout the software development life-cycle and across different implementation technologies." [10]

The activity diagram is the main modelling tool of the UML language. "*The focus of activity modelling is the sequence and conditions for coordinating lower-level behaviours […]. The behaviours coordinated by these models can be initiated because other behaviours finish executing, because objects and data become available, or because events occur external to the flow*." [3]

Both languages have the same structure of elements or building blocks. These elements are: workflow elements, organizing elements, readability elements and behavioral elements. Both languages have a hierarchical structure. These languages try and show the general layout of the model and break down to the more detailed form.

5. Modelling of logistic processes with BPML and UML

If the languages would be regarded from a general point of view, these would seem very similar. But, in the following chapter, based on a practical self-designed sales and logistics example, it can be showed that there are some differences that can determine the selection of one language instead of the other. The example shown will try to present an incoming order for a greenhouse project or for greenhouse parts. Although in theory this process can be viewed as simple, there are a lot of actors and resources involved. And as stipulated in the beginning of this article there are three main objectives that need to be followed in order to have at least a first impression upon which language would be better suited to represent logistical process. First of all the cost reduction (which is anyway hard to prove, but can be evaluated), adaptability and the added value that these languages can supply. The following two diagrams will present a simple example of a sales and logistics process.

The structure of the processes is the following:

1. The client decides to order parts or a project for the greenhouse industry
2. The account and the project requirements are checked using databases or information related to the client or the parts and project
3. Management or an authorized entity validates the order and the database of the order is updated.
4. One very important question has to be answered: Is the production capacity of the project/ parts available for this specific inquiry?
5. There are two possible answers:
    a) If the answer is no, then there will be a proposition to the client to move the date of production and of the order. The client is informed and he can decide if he likes to order taking into account the new date proposed, or if the new date is not good for his needs. Upon accepting the date, the process restart from point 2 and the order can be produced. If the date is refused the order is ended.
    b) If the answer is yes the inventory is checked for all the parts using the inventory database. Afterwards the question arises if the parts are on stock. If this is the case the order can be shipped. If the question is no, then other parts need to be ordered and manufactured in order to complete the order.

In order to design this process some processes were shortened and have more sub processes. In the following two Figures (**Error! Reference source not found.** and Figure 3) the same logistic ordering and delivering process is shown as described in the paragraph above.

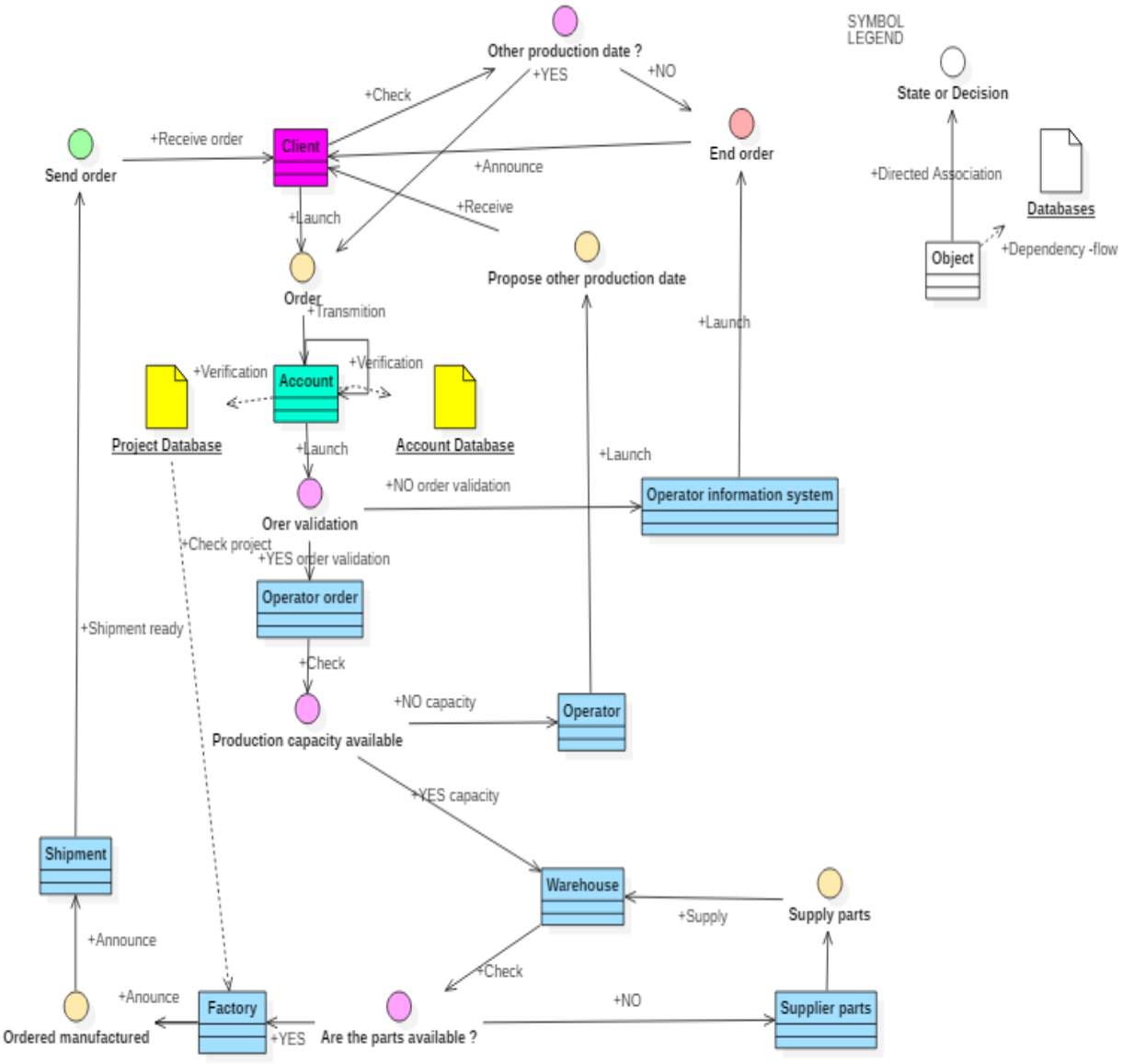

Figure 2 UML logistic process modelling diagram

The UML modelling diagram is structured around states and objects. Each state needs to be displayed and decisions like XOR or AND need to be connected to objects. It is also required to close the compete circuit, otherwise the UML model is not correct. This can affect the adaptability of such a process, which needs to have the posssibility to add, shorten or change some of the workflow patterns or the objects in the Diagram.

Furthermore, regarding the added value factor of the UML modelling, there is clearly a good overview of the entire process. This means that the entity can follow the workflow patterns and always decide upon the next step that needs to be taken. The cost efficiency is hard to evaluate, as mentioned hereabove. Still the possiblity to have such a step-by- step guide shortens decision times and reduces error in strategy and decision making. This translates into faster delivery periods, higher volume of shipping and with less errors, less costs for errors made during the logistic process. At the same time,

the rigidity of the model can block some possibilities to analyze easier solutions for the chalenges that can occur during such a process

Error! Reference source not found. presents the same cases and logistic processes using BPMN modelling.

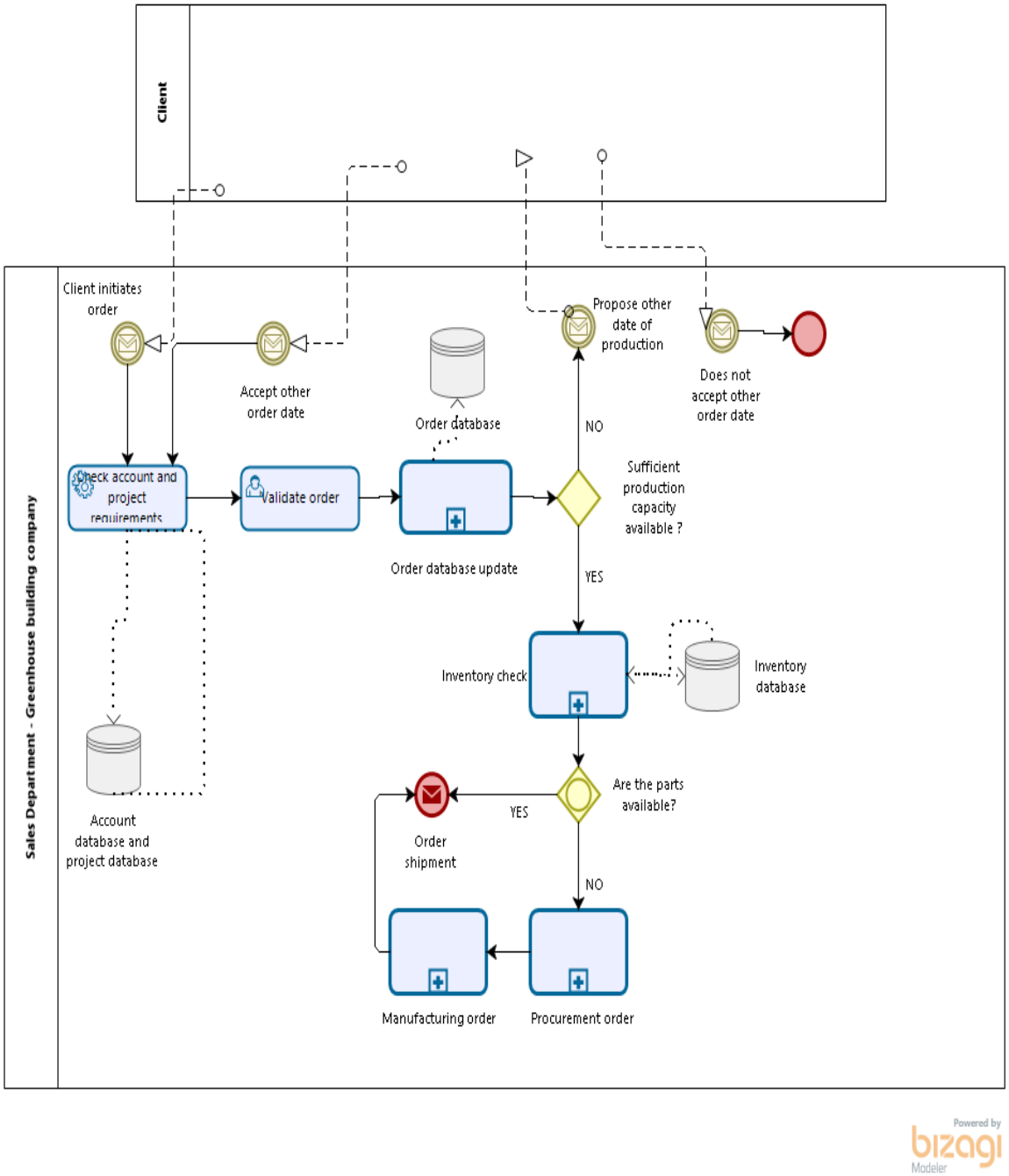

Figure 3 BPMN logistic process modelling diagram

The BPMN language modelling diagram has layers describing different actors. As such, this modelling structure makes the overview clearer in the layers of responsibility. Also the messages blocks are differently defined than the processes blocks. The color scheme is predefined and with a general

map of the blocks, explaining each role, it is easy to follow what each block is assigned to do. Also, the possibility to leave open ends, gives the opportunity for fast adaptability. As in the case of the UML modelling, costs can be reduced by having this overview of the processes reducing the time resource and reducing the errors that might occur. But, due to the open ends, there are possibilities to adapt solutions that come up during the implementation of this process and can be easily added on. The added value of the BPMN modelling is the same as in the UML modelling case. A clear overview of all the steps in the logistical processes creates security regarding all the resources needed.

Both languages can depict the logistical processes in a logical way. The difference is in the complexity in how these languages are shown, the adaptability of the model and the cost efficiency that it can create by using them.

6. Conclusions

This article has tried to research from a theoretical point of view, which of the two languages UML and BPMN are more suited for modelling logistical processes. Based on a simple example, it is shown that both languages have their advantages and disadvantages. Both UML and BPMN models show a clear overview of the processes, which clearly adds values to the companies that use it. However, in the case of BPMN it is easier to recognize the layer of responsibilities.

UML has a more rigid structure, in which a state may only be connected to an object and has to be a closed circuit. BPMN offers more flexibility in this respect and allows open ends. This leads to the second factor, which is adaptability. Open ends can absorb easier the changes that can occur during operation or implementation of this model. This means, that other solutions which were not assessed at the creation of the model, can be added on to the model. UML permits no open ends, which means that it is more time consuming to adapt the model based on new approaches. Still, this can also be an advantage, due to the fact that not all theoretical solutions can be implemented in real time operations and this can be recognized more easily in the UML model. Cost efficiency is also a factor and both models can help in reducing the time it takes to deliver the parts or project and the model can also reduce errors in operations.

In conclusion, taking into account that logistical processes are very dynamic processes and need to be adapted continuously, due to the constant changes in the market, the adaptability factor takes lead in this case. BPMN model have more advantages regarding this factor and can absorb these changes in a simpler, more cost efficient use. While both languages can be used, UML is better suited for the manufacturing processes, which have strict and rigid rules and also the update cycle is longer. Therefore, in the logistical process in order to have added value, cost efficiency and adaptability, the better model language to be used is the BPMN language model, by a very slight difference.

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