LANGUAGES OF PROCESS MODELING

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Abstract The article discusses issues related with process modeling. Process modeling is supposed to help to describe, analyze and document processes within the discussed organization. Processes can be modeled with use various tools, some as simple as a sheet of paper and a pen, some sophisticated as specialized notations. It is crucial that the selected method (language) of modeling is understandable to all people participating in the process. Currently, there are over 70 modeling languages in use. The choice of a modeling language depends on peculiarity of a process as well as the determined objective. The present work provides a list of the most commonly used languages and a description of some of them (e.g. BPMN notation, SwimLane method, UML).

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1. INTRODUCTION

The idea of process modeling is to construct a model, i.e. a formal representation of a process that can subjected to an analysis (evaluating coherence, simulating action, estimating costs etc.) (Damelio, 1996), (Cobb, 2005). To perform this task, modeling languages are used. In the present work, anassumption has been made that a map of a process is its model; therefore the terms modeling and mapping of a process are synonymous. Yet, it should be noted that usually a map is considered as model of a real existing process. Modeling languages can be both graphical and/or textual. Most formalisms for modeling production systems are graphical formalisms. Frequently, a small graphical symbol is more comprehensible and meaningful than a long text. The initial works on the issue of modeling formalism were conducted in the USA (Chen, 1995), and they resulted in the creation of the family of IDEF methods. Until now, over 70 modeling languages have been developed. However, this huge number brings some difficulties with selecting a language.

With use of languages of modeling business processes, it is possible to model either the whole process or a certain part of it. Appropriate tools enable efficient designing of systems and processes. What is more, the created maps can be also used in the course of constructing technical architecture that supports processes.

2. REVIEW OF LANGUAGES OF PROCESS MODELING

There are a few dozen languages of process modeling. In the period from 2002-2006, within the EU Sixth Framework Program, a project was implemented whose objective was to compare the languages of process modeling (Lucas, Hommerson, Galan, Marcos, Coltell, Mouzon, Polo, Rosenbrand, Wittenberg & Van Croonenborg, 2005). Seventy languages were selected for the comparison: ADELE-TEMPO, ALF, AMBER, APPEL, APPL/A, ARIS, Articulator, BAM, BPEL4WS, BPML, Chou-UML, CIMOSA, Converstion Builder, CSP, CSPL, E3, EAI, ebXML, EDOC, EEML, ENVI12204, EPC, EPOS, EVPL, FUNSOFT, GEM, GRAI, GRAPPLE, Hakoniwa, HFSP, IDEF, IEM, ITM, JIL, LATIN, LOTOS, LSPL, MARVEL, Melmac, Merlin, MVP-L, OIKOS, OORAM, PADM, PEACE+, Petri Net, PMDB+, Process Weaver, Promenade, PSL, RAD, REA, Rosetta Net, SDL, SLANG, Socca, SPADE, SPELL, SPM, STATEMENT, System Dynamics, TEMPO, UEML, UML, UML2, UPM, Woflan, WPDL, XPDL, YAWL. In the project 18 criteria were defined:
- formality,
- expressiveness-information,
- expressiveness-actors,
- expressiveness-dynamics,

- expressiveness-process,
- expressiveness-real time,
- graphical,
- textual,
- abstraction and modularization,
- extendibility,
- executability,
- analyzability,
- evolutionability,
- multiple conceptual perspectives/views,
- computer support,
- availability,
- maintainability,
- standardization.

Based on these criteria the comparison was made and IDEF0 was chosen as the best language. However, reviewers suggested making a more detailed comparison between IDEF0 and UML (Unified Modeling Language); therefore, an additional evaluation of the two languages was made. The findings were published in a report (Galan, Marcos, Reif, Balser & Schmitt, 2005). It should be emphasized that UML is acknowledged by IT specialists and it is considered a standard tool for designing IT systems. Yet, IDEF0 was selected as the best option due to its user-friendliness in terms of constructing and comprehending a model. Authors of the report (Galan, Marcos, Reif, Balser & Schmitt, 2005, p. 18) draw the conclusion the UML definitely is not the best choice unless software development is the main objective. These findings are similar those presented by the author of the present work at the conferences OiE2007 (Pawlewski, Szafrański & Wrembel, 2007) and MOSIM2008 (Pawlewski & Fertsch, 2008).

The description of IDEF0 can be found inter alia in (Palacz, 2000) and its full definition is provided by the standard (Announcing, 1993), (U.S. Air Force, 1981). One of its qualities is the possibility of hierarchical absorption and decomposition depending on the point of view (Santarek, 1998). Figure 1 illustrates this quality.

The possibility of hierarchical absorption in IDEF0 may correspond (Pawlewski, Trujillo, Golińska, Pasek & Fertsch, 2008) with the complexity of production units, expressed by their classification (Głowacka-Fertsch & Fertsch, 2004). This method has many strengths. Relying on Grzybowska, the primary advantage of IDEF0 is: "(…) that the method has proven effective in detailing the system activities for function modelling, the original structured analysis communication goal for IDEF0. Activities can be described by their inputs, outputs, controls, and mechanisms (ICOMs). Additionally, the description of the activities of a system can be easily refined into greater and greater detail until the model is as descriptive as necessary for the decision-making task at hand" (Grzybowska & Kovács, 2014).
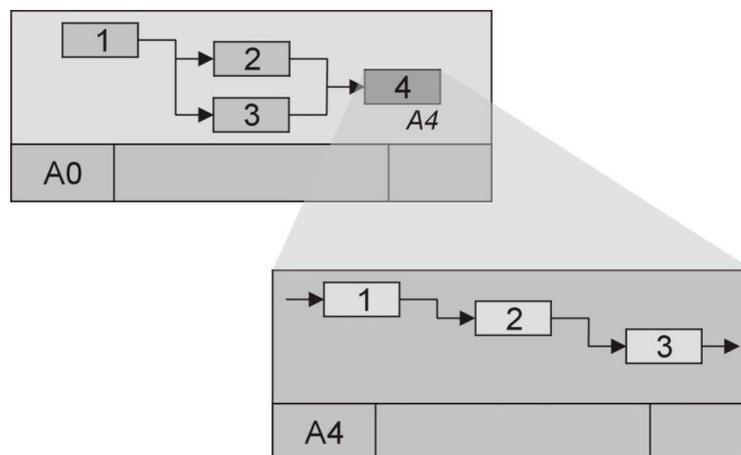
Fig. 1 Hierarchical decomposition in IDEF0, (U.S. Air Force, 1981)

In Poland, an Internet service procesowcy.pl (www.procesowcy.pl, 2010) published a report titled "Process maturity of Polish enterprises". The report presents results of 480 questionnaires correctly completed by representatives of various organizations and branches of business performing different functions in organizations, both dealing with process management or not related to it. This is the first report of this kind in Poland. The data were collected in the period from October 2009 to January 2010, and the report was published at the beginning of April 2010. The data collected in the course of the study was analyzed on the basis of the following issues:

- subjective evaluation of process maturity,
- process ownership,
- process management vs. organization management,
- relation between IT and process management,
- standards and tools used for process management,
- process management vs. communication.

Among numerous findings and conclusions presented in the report, there are results of analyses of the applied standards and tools. Figure 2 presents a summary of notations used in the process mapping.

The presented results prove that the most frequently used notation is BPMN standard (30.6%). The relatively high participation of SwimLane (15.6%) and UML (8.1%) is a surprising fact.
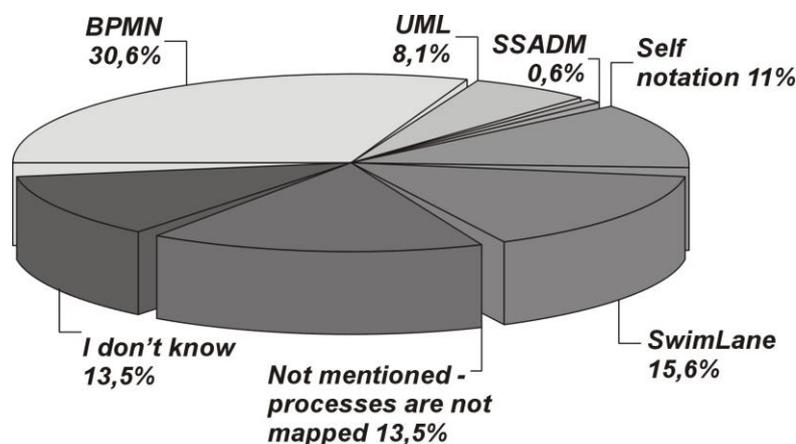
Fig. 2 Notations used in the process mapping, (www.procesowcy.pl, 2010)

BPMN (Business Process Modeling Notation) is a graphical standard of modeling descriptions directed at business processes and a standard describing Web services (Lasek & Otmianowski, 2007). It is a notation that assumes meeting the following requirements stated by designers of systems (White, 2004):

- assuring efficient management of changes in the course of modeling and designing IT systems,
- modeling business processes of various complexity levels,
- modeling the exchange of information in Web services,
- supporting the generation of executable programming languages BPEL (Business Process Execution Languages) owing to full formalization,
- providing a standard for modeling business processes and elements of web services,
- reducing the costs of implementing new solutions by means of integrating the existing IT solutions.

The SwimLane method describes the way processes pass between departments of an organization. It is relatively simple and not much formalized. Since actions, documents and stages can be incorporated into it, SwimLane can be used to describe processes from different points of view. It can be used to describe the circulation of documents for the needs of Workflow or ABD (Activity Based Costing) analyses, i.e. the cost calculating of actions for accounting analyses (www.conceptdraw.com, 2010).

UML (Unified Modeling Language) is a method used mostly for planning IT systems. It operates several diagrams showing a business process from different perspectives, depending on an observer. Currently, it is developed by Object Management Group – OMG (www.omg.org, 2010). In Poland, the Internet service designed for those interested in this standard is the website www.uml.com.pl.

The analysis of the presented findings and the description of the used notations show that the results attained for the Polish organizations are not correspondent with the results of the European project discussed above. The popularity of BPMN and UML in Poland probably stem from the fact they are used by qualified IT specialists. According to the authors of the Polish report, the fact that works connected with processes result from projects aimed at implementing IT systems is a worrying issue. The processes are described by consultants implementing IT systems and, consequently, the documentation is prepared with use of the notation and tool prepared by the provider. It should be emphasized that the simple notation SwimLane is a part of the notations BPMN and UML. The European report states clearly that UML definitely is not the best solution unless software development is the primary objective (Galan, Marcos, Reif, Balser & Schmitt, 2005, p. 18).

The IDEF0 model is a graphical representation of the hierarchical structure of a system that clearly illustrates he relations between all elements of functions of a system. The model is structuralized in such a manner that it gradually reveals more and more details. The structure of the language is based on the so called ICOM (I – Input, C – Control, O – Output, M – Mechanism), which takes into consideration all the elements that are necessary to show the process. The notation used in CIMOSA and GRAI is based on IDEF, being its modification. Further in the work, IDEF0 is considered as the standard notation. The presentation of processes in the form of a map reflects the statics of a process.
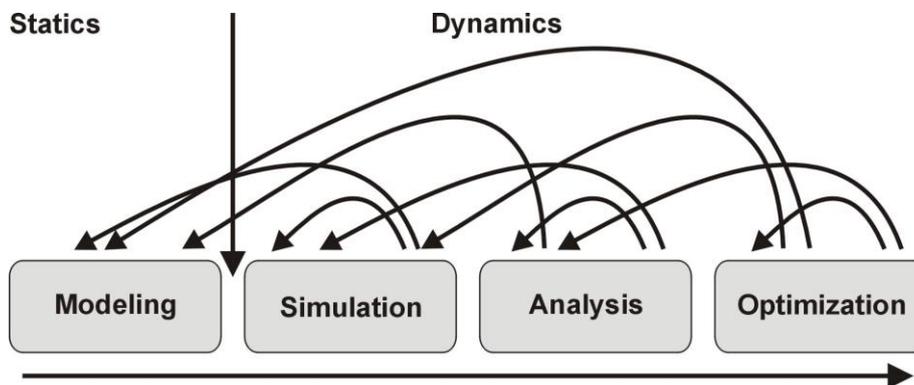
Fig. 3 The place of simulation in the process analysis and borders of static and dynamic analysis of processes, (Pawlewski, 2011)

The undertaken action related with designing and analyzing processes should be coherent and based on the following steps:
 • modeling (mapping),
 • simulation,
 • analysis,

- optimization.

In each step, as well as between them, there may occur a retain and a repeated implementation of a step (Fig. 3) depending on the partial effects attained in every particular step. From this perspective, modeling (mapping) is considered as the first step, as an element of a wider strategy aiming at finding an optimum solution. Modeling (mapping) is a part of the static analysis of a process: the time and dynamics of changes in a process are not taken into consideration. Simulation provides an opportunity for a dynamic analysis, as it takes the time into account and makes it possible to observe changes in time.

4. CONCLUSIONS

In the times of a constant effort to enhance their performance, enterprises continuously search for methods of improving the efficiency of particular processes, as such actions lead to the increased competitiveness. In order to achieve this goal, processes are subjected to modeling, i.e. their formalized representation is constructed and, therefore, a more profound analysis can be made. It is crucial to properly and comprehensively analyze and model the processes as it makes it possible to analyze various scenarios of introducing changes and rationalizations.

Processes are modeled with use of certain modeling languages. The languages can be either graphic and/or textual. A language is selected in dependence on the type of the analyzed process as well as the determined objectives and the skills (knowledge of a language) of a person making a representation of a process. However, the most important thing, after selecting a language, is to show the process in a precise manner that truly reflects the reality. When modeling the course of a process it is also significant to consider the needs, possibilities and constraints defined from the viewpoint of various participants of the system.

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BIOGRAPHICAL NOTES

Paweł Pawlewski is an assistant professor at the Faculty of Engineering Management at Poznan University of Technology. His research interests include

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Patrycja Hoffa – a graduate with distinction of the Poznań University of Technology, she studied Logistics at the Faculty of Engineering Management. In the academic year 2012/2013 she received a scholarship from the Minister of Science and Higher Education for outstanding achievement. She participated in conferences, such as 6th Conference of the OIE (2011), Winter Simulation Conference (2012), 10th National Conference of Students and Young Scholars (2013). She is a co-author of articles such as: "Airport Logistics - using simulation for new communication configuration" (2011), "Eksperyment symulacyjny w usprawnianiu dostaw sekwencyjnych w przemyśle samochodowym" (2013). Since 2010 she has been a member of the SOCILAPP – Simulation and Optimization Center in Logistic and Production Processes.