OBA and BORM Approach in the Organizational Modeling and Simulation of Local Government Processes and Country Planing

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Abstract

This paper presents BORM approach as the tool for business process analysis, design and simulation of local government processes and country planing. The first part of this paper discusses the motivation for the application of the finite-state-machines and object-oriented based paradigm to this area of business process modelling. We practically experienced, that this approach saves time and improves the validity and correctness of the business process model of the built information system in specific conditions of agriculture and country planning management of socio-technical systems. In this paper, we plead the idea of necessary specific textual-based formal steps being performed before assembling process diagrams in order to assure better results. The second part describes the pre-diagramming text-based techniques being used before the subsequent modeling, which presented the thirs part on the example of the living situations among citizens and other participating subjects from small settlements with an emphasis on local government activities and country planning.

Keywords: business process modeling, organizational modeling and simulation, BORM, text-based techniques, diagramming techniques, country planning, urban sprawl

1. Introduction

Business process models show and animate (when they are simulated) the collaboration of more participants within the solved system. We need this approach for simulation, validation and verification the real world problems. This issue is stressed in specific areas of technical systems analysis and design in area

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of agriculture, landscape management and also, as it is used in this paper, in the visualization of law-based processes of country planning. A very important purpose of such a business model is to create and simulate an interconnected complex system where local actors, citizens, regional government, various interested organizations and partners and other participants mutually communicate. In addition to that, business process models are also the foundation of subsequent system modeling activities of software engineering, organizational design and management consulting. Typical way of performing these activities is to start directly with drawing process diagrams just during the intial interviews. But in this paper, we present the idea, that for better modeling, we need to use a specific textual technique, which helps us to recognize, define and refine our initial set of business process participants and their properties before the graphical business process model is assembled.

2. Motivation

Expected output of the business process modeling and simulation activities is information or data in a form that can be directly used as an input for implementation of the system in the spirit of software engineering and organizational modeling and management consulting. However, this is not the easy case; there are following issues described by Ilgen & Hulin [11] and Aalst [1]:

1. *oversimplification* - while trying to at least finish business and organizational model we are forced simplify the problem being modeled and
2. *inability* - some important details cannot be recorded because of the method being poorly used.

A perennial problem with the development of business systems is the communication gap that exists between analysist and domain experts; each live in their own well defined and complex cultures. One place where this gap manifests itself is in the constant failure of simulation model designers to fully capture the requirements of any proposed business system. In our experience, gathered during the last ten years working on major projects, not all system requirements are known at the start of the project, and the customer expects that their discovery and refinement will form part of the project. This problem is complicated further, since the function of any major system developed has a significant impact on the very organizational and management structure of the company or organization where the system is to be implemented. Examples include the creation of new or the modification of existing job positions, significant changes in the management structure, creation of new departments, etc.

Software application development for regional management, agriculture and country planning and similar domain-specific areas shifts the attention at the requirement analysis and design activities, e. g. from the programming level to the modeling level. MDA (Model-Driven Architecture) MDA [13] is the recent approach based on strategy of the application development based on requirements, conceptual and design modeling. The typical tool used in this area is the UML - the Unified Modeling Language UML [21].

Our idea of "pre-diagramming" activities aims to improve our requirement capture process. This is to maximize the correctness of simulation model through the OBA technique before the process models in visual form of diagrams are built.

3. Our Approach

Business Object Relation Modelling (BORM) is an approach to both process modelling and the subsequent development of information systems. It provides an approach that facilitates the description of how real business systems evolve, change and behave. BORM - Business Object Relation Modelling was originally developed in 1993 and was intended to provide seamless support for the building of object oriented software systems based on pure object-oriented languages, databases and distributed environments. Subsequently, it has been realised that this method has significant potential in business process modelling and other related business issues. BORM has been used in last 15 years (1998 - 2012) for a number of business consulting and software engineering projects including the modeling of properties necessary for the general agricultural commodities wholesale sector requested by the Agrarian Chamber, as a tool for business process reengineering in the electricity supply, gas supply industry and telecommunication network management, several business process simulation projects in area of simulation of marketing food and agricultural products for Metro&Makro supply chain, and in organizational modeling and simulation of regional management project concerning the analysis of the legislation and local officials' knowledge such as living situations, law, country planning etc.

In our experience, any modeling and simulation tool and any diagramming technique used at this kind of business projects should be comprehensible to the stakeholders, many of whom are not software engineering literate. Moreover, these diagrams must not deform or inadequately simplify requirement information. It is our experience that the correct mapping of the problem into the model and subsequent visualization and possible simulation is very hard task with standard diagramming techniques. We believe that the business community needs a simple yet expressive tool for process modeling; able to play an equivalent role to that played by Entity-Relation Diagrams, Data-Flows Diagrams or Flow-Charts over the past decades. One of the strengths of these diagrams was that they contained only a limited set of concepts (about 5) and were comprehensible by problem domain experts after few minutes of study. Unfortunately UML approach (as well as BPMN) lost this power of simplicity and clarity.

Currently there is not a 'standard solution' to the problem of gathering and representing knowledge. That is reason why we developed and successfully used our own UML-based BORM process diagraming technique Knott et al. [12] and our own way to start business system analysis and combined it with the OBA technique. The initial work on BORM (Business-Object Relation Modeling) was carried out in 1993 under the support of the Czech Academic

Link Programme (CZALP) of the British Council, as part of the VAPPIENS[1] research project; further development and recent practical projects in the last decade has been carried out with the support of Craft.CASE Ltd. - the British software consulting company supporting innovative technologies. (*VAPPIENS was funded by the British Governments CZALP, administered by the British Council. The authors acknowledge the support they received from this source, which enabled them to meet and carry out the initial work, out of which BORM grew.*)

BORM innovation is based on the reuse of old thoughts from the beginning of 1990s regarding the description of object properties and behavior using finite state machines (FSM). The first work expressing the possible merge of OOP (Object-Oriented Paradigm) and FSM was the book by . One of the best books speaking about the applicability of OOP to the business modeling was written by Taylor [20]. These works together with our practical experience is why we believe that the business requirement modeling and simulation and software modeling could be unified on the platform of OOP and FSM.

The object-oriented approach has its origins in the researching of operating systems, graphic user interfaces, and particularly in programming languages, that took place in the 1970s. It differs from other software engineering approaches by incorporating non-traditional ways of thinking into the field of informatics. We look at systems by abstracting the real world in the same way as in ontological, philosophical streams. The basic element is an object that describes data structures and their behavior. In most other modeling approaches, data and behavior are described separately, and, to a certain extent, independently. OOP has been and still is explained in many books, but we think that this one Rubin & Goldberg [15] written by OOP pioneers belong to the best.

In the field of theoretical informatics, the theory of automata is a study of abstract automatons and the problems they can save. An automaton is a mathematical model for a device that reacts to its surroundings, gets input, and provides output. Automatons can be configured in a way that the output from one of them becomes input for another. An automaton's behavior is defined by a combination of its inner structure and its newly - accepted input. The automata theory is a basis for language and translation theory, and for system behavior descriptions. Its usage for modeling and simulation in software engineering activities has been described in Shlaer & Mellor [16] and many newer publications. The idea of automata also inspired behavioral aspects of the UML standard.

The BORM development methodology starts from an informal problem specification and provides both methods and techniques, to enable this informal specification to be transformed into an initial set of interacting objects. The main technique used here is modified form of Object Behaviour Analysis (OBA) being firstly published in Rubin & Goldberg [15]. BORM modified Object Behavioural Analysis (OBA) is a step-by-step iterative approach to analysis. Tools

[1] Visual Application Programming Paradigms for Integrated ENvironmentS

Table 1: Five OBA steps.

step	*action*	*result*
1.	Understand the application, perform interviews, identify the system processes.	Initial behaviours of the system as the list of recognised system processes and scenarios.
2.	Derive initial objects in the system using behavioural perspective.	Objects and object behaviours as the list of modelling cards.
3.	Start classifying objects.	Secondary recognised objects and all objects classified with behaviours and visible properties.
4.	Identify relationships among objects.	Object associations and communications expressed via tables.
5.	Model and evaluate object processes.	Object lifecycles and interactions within processes.

of OBA are structured texts, various lists and tables and so-called modeling cards (textual forms). It is a only text-based method and uses a large set of form sheets, modelling cards and tables for storing and manipulating the information being processed. The result of any OBA procedure is a description of a model for the analysed problem, expressed in natural language terms. OBA procedure consists of five stages. Each of these has its appropriate set of tools such as tables or modelling cards. Each OBA stages may consist of several steps, which will be described later. The five stages of OBA in BORM are explained in the table 1.

Stage 1. - Identify the System Behaviours

This stage consists of a number of steps, which have the goal of understanding the problem, recognising and describing the main *system behaviours*. (These behaviours are often called the *processes* (or *use-cases*) in other methodologies). A process of interviewing relevant parties in the problem domain next determines a list of required system functions. This list represents a textual inventory of all the identified functions, desired or necessary, for the system. Each function has its identification number and about one line of plain text description.

The next step is the formation of *system scenarios*, which refines (e.g. are derived from) the notion of *system processes*. (These are referred to as methods or system scripts in other development methods) There often exists a sequence hierarchy among such scripts. OBA scripts are written in a specific tabular form, that always includes at least the four following columns:

- *Initiator*, which is a brief and accurate verbal description of the beginning of the scenario and includes any inputs or entry conditions. It also describes the first event or first activity of some element within the process.
- *Action*, which is a verbal description of the process itself.

Table 2: business process scenario example

initiation	*action*	*participants*	*result*
A settlement council is invited to build a country plan.	A settlement council assembles an assignment of a country plan, the project assignment is discussed and approved by a project supervisor, government bodies and inhabitants of the village.	settlement council, inhabitants of a village, government bodies, projectant, country plan supervisor.	A country plan is assigned to the designer, the project is discussed with the inhabitants of the village and higher authorities and other parties.

- *Set of participants*, which is the set of those subjects (e.g. participants) of the system, which are required for the action. It is often the case that the same participants may be present in several processes of the modelled system.
- *Result*, which is a brief and accurate verbal description of the end and outputs of the scenario.

These columns represent the four most important attributes of each scenario. The complete set of scenarios is capable of determine system behaviours, as well as determining the objects that perform these behaviours. In addition to those four attributes each scenario must also refer to the required system function it realises. Scenarios may be viewed as structured answers to the „What happens when ..." questions. Scenarios illustrate the expected use of the system. It is good idea, once scenarios have been determined, to evaluate them via an interview-driven simulation. This normally results in further iterations and refinement of the scenario. There is a typical number of 10-20 *system processes* and 30-80 *system scenarios* in our projects.

Stage 2. - Modelling Cards

The goal of the second stage of OBA is the creation of the initial set of objects within the modelled system. The existence of each recognised object in this stage must be rigorously based on some system behaviour specified earlier. That is the reason why the object specification was not performed earlier. This approach ensures that each object created is relevant to and needed for the system. It is useful idea to consider this stage of object creation as being similar to the process of casting a play in the theatre. We have a description of the parts of the whole play (the processes), and know the roles needed in each scene. However we do not yet know who will perform each role. Hence we must find an appropriate actors for each role. Objects are modelled with the help of modelling cards. Each modelled object has its own modelling card. It

Table 3: modeling card example

name	**concerned government body**
attributes	address, contact person, dates, documents, ...
behaviors	receives a request for assessment, provide information, approves or rejects, initiates changes

is a special kind of small table describing in three boxes *participant's name*, *attributes* and *behaviours*. This layout is inspired by the classical class-symbol in the UML standard. There is a typical number of 50-200 *modeling cards* in our projects.

Stage 3. - Classification of Objects

No new form or table is used in this stage. The goal of this stage is to refine the set of objects through the possible introduction of new object into the set.

We determine which object to introduce by studying the behaviours of the known objects. Certain behavioural aspects will suggest the presence of other objects, yet undiscovered. The tool that facilitates this process is classification performed via interviews with domain experts. Classification is the grouping of objects according to several common aspects such as similar or same behaviours, common visible properties and shared collaborators.

Stage 4. - Modelling Object Relationships

In this stage, we bring together the information relating to the newly discovered objects. This information, which is stored in modelling cards, is subsequently distributed over various tables and matrices. The reason for this stage is to aggregate all the discovered information together and view it from several different aspects (e.g. tables of behaviours, object interaction matrices, tables of visible properties, ...). In this way, we can more easily identify errors of omission, duplication, irrelevancy, etc. These tables also prove extremely useful in interviews with the domain experts and provide a method where by their expertise can be used to validate the current model.

The stages 2, 3 and 4 of OBA can be skipped during the first iteration and the team may go directly from textually described *scenarios* to the draft form of *process diagrams*. This approach preserves the attention and interest of target staff and quickly produces first visible and attractive results. *Modelling cards* and other textual table-based documentation is easy generated in CASE tool within consequent iterations. MetaCase [14] Typical number of these iterations is 2 or 3.

Stage 5. - Model Processes

This final stage of OBA has two objectives. Firstly, we walk through the various scenarios using only the behavioural information contained on the mod-

elling cards. This walk through is ideally performed with the active participation of domain experts. "Players" take on the role of an object and their actions are exactly specified by what is on the card. Consequently, we may discover behaviour required for the scenario, which is not present on any modelling card. In which case it must be added and all other information repositories updated. On the other hard, we may discover object behaviour which is not required for any of the specified scenarios. In which case the details of the scenarios may need careful checking to see if they are complete. Because of this first step of the final stage, we obtain via a process of iteration, a consistent set of scenarios and object descriptions. The BORM approach is to concentrate only on information, which is essential for the proposed system. In our experience we have often found "extra behaviour" to be present on the modelling cards. This information, is often in the form of extra visible properties or behaviours for some objects, is introduced into the process by users, who tend to feel everything they can think of as being relevant. The information appears reasonable and necessary but the outcome of applying this process reveals it redundant. The main idea here is that we need to model system that will save and optimise human work, not the opposite.

The second objective is the production of *business process diagrams*. There is a typical number of 30-80 *business process diagrams* in our projects.

4. Our Experience

OBA technique when performed with domain experts as the first step of organizational modeling nad simulation project requires some additional practical skills and experiences. Workshops that put together teams and experts are the best tools how to facilitate and speed up the modelling. Consulting team members should precisely perform three independent roles:

1. *Problem domain expert*, who is responsible for querying and best practices knowledge.
2. *Methodology expert*, who is responsible for functions, scenarios and diagram consistency because of problem domain people often tend to confuse modelling concepts, do not respect the scenario borders and cross from one process to another.
3. *Project-Relationship Manager*, who knows personal names and personalities of all target staff team members, who watches them, who is able to initiate the particular discussions or countdown some debates, for example.

5. The Application - Process Modelling of Urban Planning

One of the recent BORM applications of organizational modeling and simulation was the project of improvement the decision-making on the level of mayors and local administrations. It offers the possibility to model and simulate real life situations in small settlements. The project activities were for

Figure 1: Urban sprawn (photo of the Czech Association of Architects).

modeling, simulation and reengineering processes related to the regional government processes of small towns and villages, and the subsequent development of supporting information systems addressing life situations of local people.

Nowadays we have to solve many problems related to the small settlement development and expansion, landscape care and over-all efforts to improve the quality of life and the level of democracy while preserving the conditions of the sustainable development (addressing living standard, cultural and historic value, agricultural and industrial production, transport infrastructure construction, tourism potential, etc.).

One of the specific problems that our approach can be applied to is the *urban sprawl* as it is stressed by Frumkin [8]. The cause of the *urban sprawl* in the small settlement development is the fact that the elected members of local administrations (e.g. mayors and clerks) are not (and as the logic states they cannot be) fully educated in all the details of law, state and local administration agenda and their effects on living in the settlements. They don't know how to use fully the legislation in favour of the settlements and usually depend on a misleading interpretation provided by their governing bodies and more often by another subjects (usually privately involved in the process in question and thus biased).

Urban sprawl is a phenomenon that emerged in the last decades in the advanced industrial countries (USA, France, Great Britain) and recently also in our country. Inhabitants of affected settlements usually percieve the urban sprawl positively at first, mainly because of the lobbying. It can be described as an uncontrolled expansion of certain kind of urban build-up into the free landscape caused by favourable land prices, demand for cheap but modern estates,

etc. Dualny [6] writes about harmful absorption of original small settlement structures, which causes following negative effects:

1. Pawning of *infrastructure development* of the original settlement. New inhabitants fulfil themselves and shop only at the place of their work in a metropolis and the settlements are just a kind of sleeping accomodation for them. New inhabitants' lack of interest in contributing to the settlement development leads to misusing of democratic principles of the self administration against the original local inhabitants and inevitably to the rise of social segregation between the original and the new inhabitants.
2. *Urban sprawl* causes disruption of the cultural and historical value of the settlement, disruption of the ecological stability of the area, deconstruction of the transport infrastructure, loss of touristic attractiveness etc.
3. *Loss* of the quality agricultural soil.

5.1. Modeling and simulation

We analyzed the legislation and local officials' knowledge related to the processes and agendas of the urban planning of the landscape areas and small settlements with regards to the new housing and building law and regional management trends in the European Union.

Our approach using process models and their visual simulation helps the officials (especially in the smallest settlements) to clarify the legislation and shows them possible ways of its usage. Our models and their visual simulation show how the BORM can be used to improve the process of decision-making on the level of mayors and local administrations. It offers the possibility to model and simulate real life situations in small settlements. The example at the figure 2 shows the BORM business object diagram of a process of obtaining building permission. The figure 2 shows the concrete simulation step. A diagram is a visual representation of object associations and communications in a particular process (see figure 2). Our notation is the re-used UML notation from the *state diagram*, *activity diagram* and *sequence diagram* UML [21] but combined and simplified into the only one new diagram that shows the process as object-oriented participants in the form of mutually communicating Finite-State-Machines (see example 2). Moreover, we can use a visual simulator in order to animate (see figure 3 on page 12) these processes and evaluate[2] them within a group of users (see figure 4 on page 12).

6. Conclusion

In this paper we presented the OBA technique used as a structured text-based (e.g. scenario forms, miscellaneous tables and modeling cards) approach to modeling and simulation of business requirements and software development, which has been modified in order to meet specific reqirements of law-based

[2]Our simulator has included the communication module inspired by Facebook-like chatting.

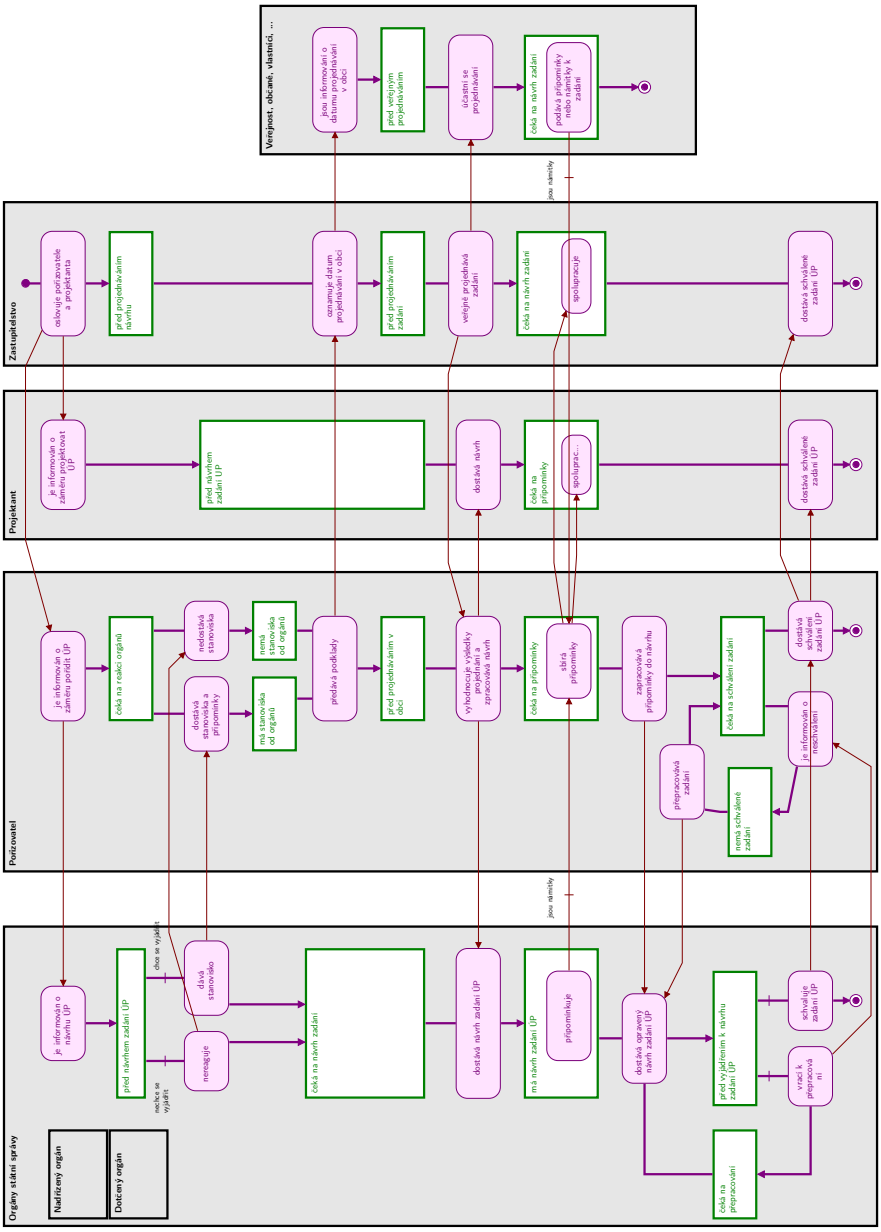

Figure 2: Process model of a country planning project on a local plan of a small settlement.

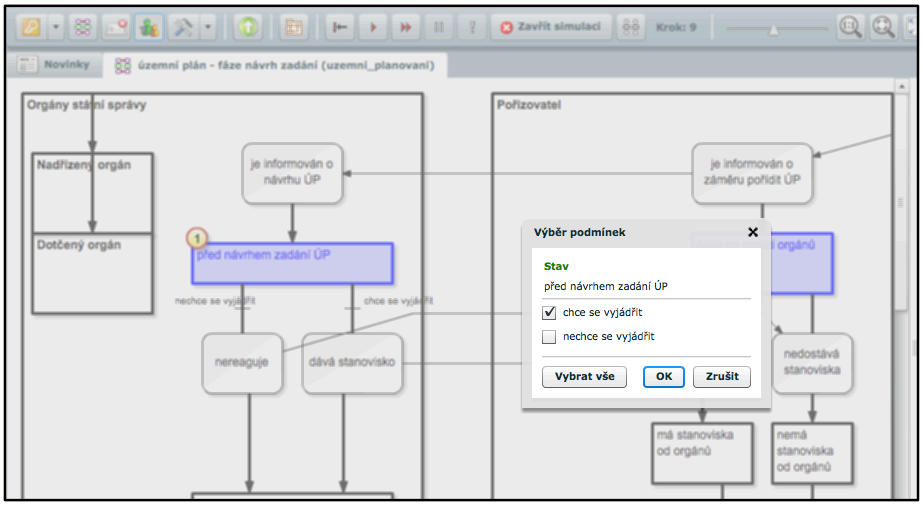

Figure 3: Interactive simulation in the Craft.CASE tool - Urban plan initiation process.

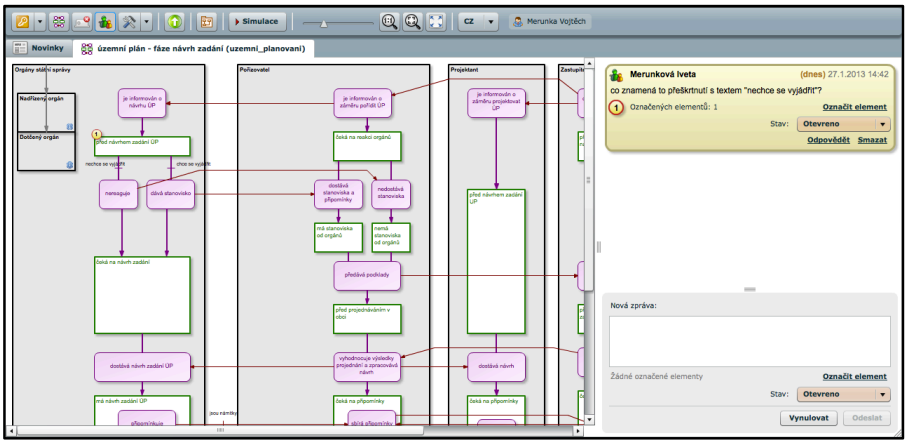

Figure 4: Discussion forum and chatting in Craft.CASE, dialogue of users during visual simulation.

socio-technical processes of country planning. We believe that this approach can help in future possible integration of BPMN and UML models for complex projects requiring the strong collaboration between software system architects and problem domain experts in area of organization structures modeling and subsequent simulation as it is predicted by Scheldbauer [17]. This approach is already implemented in the MetaEdit CASE tool by the Finnish company Metacase Ltd., which we collaborate with. MetaCase [14] Our future work will be focused on implementation of the proposed concepts in other UML-based CASE tools. The hot candidate is the Eclipse environment. The autors would like to acknowledge the support of the research grant SGS11/166/OHK4/3T/14 and NAKI MK-S-3421/2011 OVV.

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