6th International Conference on Information and Communication Technologies in Agriculture, Food and Environment (HAICTA 2013)

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

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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 planning. 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 modeling. 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 third 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.

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.

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This issue is stressed in specific areas of technical systems analysis and design in area 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 initial 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 and Hulin [1] and Aalst [2]:

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 analysts 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 (2013) 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 (2013). 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 Modeling (BORM) is an approach to both process modeling 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 Modeling 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 realized that this method has significant potential in business process modeling 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 and 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 [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 (Visual Application Programming Paradigms for Integrated ENvironmentS) 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 in [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 by Goldberg [15] is written by OOP pioneers and 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 by Shlaer and Mellor in [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 Behavior Analysis (OBA) being firstly published in [15]. BORM modified Object Behavioral Analysis (OBA) is a step-by-step iterative approach to analysis. Tools 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, modeling 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 analyzed 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 modeling cards. Each OBA stages may consist of several steps.
3.1. Identify the System Behaviors

This stage consists of a number of steps, which have the goal of understanding the problem, recognizing and describing the main system behaviors. (These behaviors 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.
- 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 modeled 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 behaviors, as well as determining the objects that perform these behaviors. In addition to those four attributes each scenario must also refer to the required system function it realizes. 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.

3.2. Modeling Cards

The goal of the second stage of OBA is the creation of the initial set of objects within the modeled system. The existence of each recognized object in this stage must be rigorously based on some system behavior 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 modeled with the help of modeling cards. Each modeled object has its own modeling card. It is a special kind of small table describing in three boxes participant's name, attributes and behaviors. 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.

3.3. Model Processes

This final stage has two objectives. Firstly, we walk through the various scenarios using only the behavioral information contained on the modeling 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 behavior required for the scenario, which is not present on any modeling card. In which case it must be added and all other information repositories updated. On the other hand, we may discover object behavior 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 behavior" to be present on the modeling cards. This information, is often in the form of extra visible properties or behaviors 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 optimize 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. The Application - Process Modeling 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 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 in [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 favor 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 perceive 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 favorable 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 fulfill themselves and shop only at the place of their work in a metropolis and the settlements are just a kind of sleeping accommodation 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.
Fig. 1. Business process example.
4.1. 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 1 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. Our notation is the re-used UML notation from the state diagram, activity diagram and sequence diagram [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. Moreover, we can use a visual simulator in order to animate these processes and evaluate. Our simulator has included the communication module inspired by Facebook-like chatting. them within a group of users (see Fig. 3).

Fig. 2. One simulation step.
5. 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 requirements of law-based 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 Art BPM]. This approach is already implemented in the MetaEdit CASE tool by the Finnish company MetaCase Ltd., which we collaborate with. 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.

Acknowledgements

The authors 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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