Knowledge modeling using CraftCASE tool

Modelování znalostí pomocí nástroje CraftCASE

V. Merunka

Czech University of Agriculture, Prague, Czech Republic

Abstract: The development of business information systems has the communication gap that exists between business and software experts, because they live in their own well-defined and complex cultures. One place where this gap manifests itself is in the constant failure of software developers to fully capture the system requirements. Second example is the inability to exactly analyze and store business knowledge. In our experience, gathered during the last ten years, working on major software projects, not all system requirements are known at the start of the project and the customers expect that their discovery and refinement will form part of the project. Our solution of this dilemma is in the new methodology called BORM (Business and Object Relationship Modeling), which reuses the object-oriented approach known from the area of software engineering into the area of business process modeling. CraftCASE is the original Czech software tool supporting BORM. CraftCASE is developed to capture and analyze knowledge of process-based business systems. The integral part of the analysis using CraftCASE is object-oriented process diagram and process simulator.

Key words: CraftCASE, Business and Object Relation Modeling, object-oriented approach, process-based analysis, information system development, business processes, requirement engineering

Abstrakt: Tvorba informačních systémů trpí komunikační mezerou mezi experty pro business a softwarovými experty. Je tomu tak proto, že každá z obou skupin má vlastní specifické a bohaté zázemí. Jeden příklad, kde se tato mezera projevuje, je trvalé selhávání softwarových vývojářů ve snaze plně pochopit a zachytit systémové požadavky. Druhým příkladem je neschopnost exaktně analyzovat a ukládat znalosti pro business. Podle naší zkušenosti získané během posledních 10 let prací na velkých softwarových projektech nejsou všechny požadavky na systém známy v době zahájení projektu, přičemž zákazníci očekávají, že jejich zjištění a upřesnění bude součástí projektu. Naše řešení tohoto dilematu spočívá v nové metodě BORM, která využívá objektově orientovaný přístup známého z oblasti softwarového inženýrství pro oblast modelování business procesů. CraftCASE je původní český softwarový nástroj podporující metodu BORM pro analýzu znalostí a vývoj procesně orientovaných business systémů. CraftCASE a BORM jsou založeny na získávání a analýze znalostí o procesech. Nezbytnou součástí analýzy pomocí CraftCASE je objektově orientovaný procesní diagram a procesní simulátor.

Klíčová slova: CraftCASE, BORM, objektově orientovaný přístup, procesně založená analýza, tvorba informačních systémů, podnikové procesy, získávání a modelování požadavků

The attitude of business towards Information Technology (IT) is constantly changing as the more and more sophisticated systems and tools become available. Additionally, there is a constant exchange of ideas between the IT and the business communities arising out of the development of knowledge-based systems. One such example is the CraftCASE modeling tool for method BORM, which is presented here. This solution was originally developed to capture business knowledge necessary for the development of IT systems but it has revealed an increasing potential for more general knowledge based system development. The subject of this matter was also presented in September 2005 in Prague at the 14th International Scientific Conference: Agrarian Prospects – Knowledge Economics.

In our experience, in the period of the last ten years, during the work on major projects, ICT analysts face the problem when not all system requirements are known at the start of the project and the customer expects that the discovery and refinement thereof will be part of the project. The problem is even more complicated because the function of the major sys-

Supported by the Ministry of Education, Youth and Sports of the Czech Republic (Grant No. MSM 6046070904).

tems build has impact on the very organizational and management structure of a company or organization where the system is implemented – such as new or modified job positions, management changes, new positions, new departments, etc. (Kotonya, Sommerwille 1999). Therefore, it is desirable to address also the change of these related structures during the work on information systems.

Yet, many systems have a much higher level of complexity, which makes development much more difficult. This view is based on our experience with the IT projects we have performed to-date. Rapidly changing regulations, behaviors and the level of the average users' skills in using new communication technologies are creating a situation where an IT analysts must expect that all system requirements are not known at the start of the project. The problem is even more complicated because the functions of the built information systems have a great impact on the organizational and management structures and on users' behavior of the target area where the system will be implemented (Liping et al. 2005).

Process models composed from business objects represent a proven and actually used method of analysis, design and implementation of organizational changes with the active participation of the customers and with related development of the information system (Knott et al. 2000).

The most common technique for specification of the requirements in current object-oriented methodologies is Use Case modeling, and the subsequent use of Sequence, Collaboration and State-Chart Diagrams. This is the foundation of most Object-Oriented development methods (Goldberg, Kenneth R.S. 1995). However, this approach is often insufficient by itself to fully support the depths required for the initial system specification. There are situations where Use Case Modeling obscures the true knowledge of business logic of a system. Because standard UML-based tools are too oriented at the world of programming concepts, other methods for business knowledge capture and process modeling appeared:

The basic grammar of other process modeling tools is based on Petri Nets. The strengths of this approach are that it is both graphical and has a strong mathematical basis. A practical implementation of Petri Nets is EPC diagram of Aris methodology, for example.

Another techniques are based on miscellaneous varieties of flowchart diagrams. This approach is the oldest diagramming technique used in computer science. It was primarily used for visualizing the sequences of operations in computer programs. Today, flowcharts are frequently used to model business processes. A practical implementation of flowcharts is workflow diagram used in Proforma Workbench or FirstStep Business CASE Tools. Indisputably, it is also Activity Diagram of UML (Henderson-Sellers 1991; Yourdon 1995).

The third technique used here is the use of state machines. These have the theoretical background, as well as Petri Nets. A practical implementation of state machines is state-chart diagram in UML, for example. Indeed, the sequence diagram of UML has features of state machines as well.

The overview of all major approaches for modeling business knowledge is presented in Table 1.

OUR APPROACH – BORM

The method presented here is Business and Object Relation Modeling (BORM) (Knott et al. 2003). It is

Table 1. Business modeling approaches

Approach	Theory behind	Advantages	Disadvantages
EPC – Aris	Petri Nets	very popular in Europe, perfectly supported by Aris CASE Tool, easy and comprehensible method for domain experts	weak relation to subsequent software development techniques, slow analysis, low expressiveness of large models
UML Activity Diagram	flowchart	industry standard, supported by many CASE tools	too software-oriented,difficult to understand by domain experts
UML sequence and state-chart diagram	state machine	industry standard, supported by many CASE tools	too software-oriented,difficult to understand by domain experts
Workflow Diagrams	flow chart	easy and comprehensible method for domain experts, perfectly supported by many business CASE Tools	not very popular in Europe where Aris takes the dominant place, weak relation to subsequent advanced software development techniques

based on the fundamental concepts of state-machine process modeling mixed with the object-oriented approach. This method was originally developed to capture the knowledge necessary for the development of IT systems, but which has revealed increasing potential for more general knowledge based system development. The work on BORM originally started in 1993 and was intended to provide seamless support for the building of object oriented software systems based on pure object-oriented languages together with object databases, such as 'Gemstone'. It is now realized that this method also has a significant potential in capturing knowledge of business processes, business data and business issues.

BORM provides a tool to capture knowledge and to present it in a way that, the authors believe, is far more effective than other business processes, data or functional modeling methods. This increase in effectiveness is due largely to the use of a unified and simple method for presenting all aspects of the relevant model.

This follows from the belief that it is necessary, for the deployment of a new system, not to view that system in isolation, but to view it in the context of the companies' total organizational environment. A new system, when introduced into an organization, will normally totally change the way how the organization operates. In addition, a BORM process model is object oriented from the beginning and is defined in easy to understand graphical notation. From the process, model scenarios can be developed. Scenarios were originally developed in OBA to capture a similar information to that presented in Use Cases of UML. Our experiences on the projects suggest that the process way of thinking is more natural to a business employee. Consequently, stakeholders in the proposed system can more easily understand BORM models and consequently make a greater contribution to the correctness of the system design.

In BORM, any initial diagram supports only problem domain specific concepts; any software-oriented concepts are left until later in the modeling process. In addition, in the early stages BORM uses a single diagram that embodies the same information as the numerous diagrams used by other methodologies; this is an attempt to make it easier for the user to form a complete understanding of the interaction of the various system components.

In BORM (Figure 1), it is possible for each concept to have some of the following:

1. **A set of predecessor concepts** from which it could be derived by an appropriate technique and **a set of successor concepts,** which could be derived from it by an appropriate technique. For example a conceptual object composition from a business object association...
2. **A validity range.** The phases (of the development process) where it is appropriate. State –Transition diagrams for example are used extensively in business conceptual modeling but are not supported by any current programming language.
3. **A set of techniques and rules**, which guide the step-by-step transformation and the concept re-

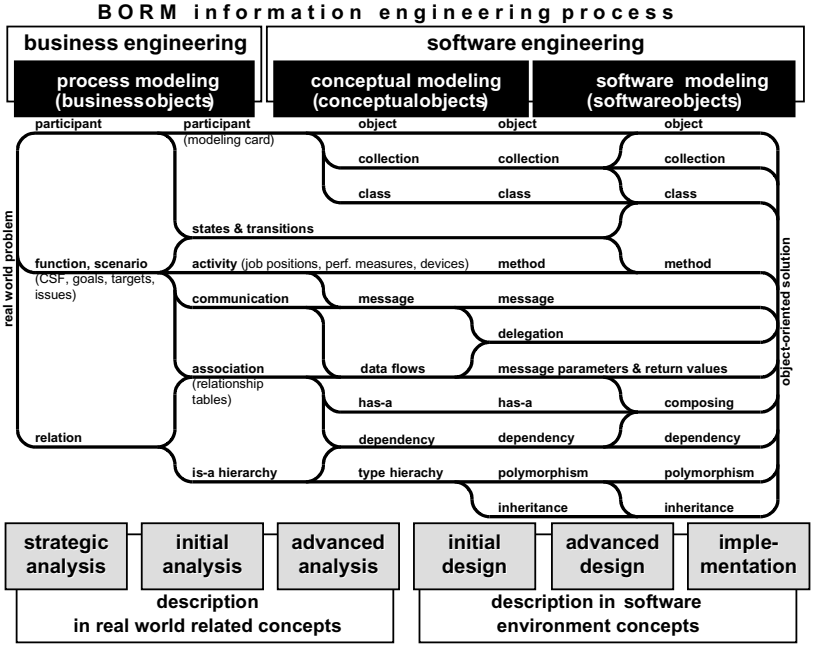

Figure 1. BORM evolution of concepts

visions between the system development phases. These are the following:

(a) Object behavior analysis; which is a technique for transforming the initial informal problem description into the first object-oriented representation.

(b) Behavioral constraints; which is a set of determining rules which describes the set of the possible transformation of the initial model into a more detailed form with precisely specified object hierarchies like inheritance, dependency, aggregation etc.

(c) Pattern application which helps to synthetize the analysis object model by the inclusion of object patterns.

(d) Set of structural transformations (Class Refactoring, Hierarchies Conversions and Substitutions, solving Legacy problems solving programming environment constraints) which are aimed at the final transformation of the detailed design model into a form acceptable in the implementation environment (programming language, database, user interface, operating system, etc. ...).

CraftCASE

CraftCASE® is the original Czech-made modeling and analytical tool supporting the method BORM® developed by the firm e-Fractal Ltd. Web address of this tool is http://www.craftcase.com.

In contrast with other tools, in CraftCASE it is not possible in certain cases to insert objects into the diagrams, which have not been defined in advance. This is because the BORM method is based on the gradual derivation of new terms from the previous ones. A detailed description of this method can be found in Knott et al (2003) or Liping et al. (2005).

For a concrete modeled business problem, it is appropriate to consider first which attributes it will be necessary to designate for the individual objects. For example, for projects dealing with modeling of organizational and management changes in an organization, for scenarios it is appropriate to set the attributes "as-is", "should-be" and "to-be", which will serve for distinguishing whether it involves a scenario describing the existing process or an intended process or a process planned for implementation. And to add, for example, "author", "consultant", "date" and "version" to the set of optional attributes.

BUSINESS MODELING IN CraftCASE

This is an analysis of the entire context of the modeling system – primarily objects, knowledge and processes in the organization, where the system is to be built. In more complicated cases, it is necessary to establish two sets of models. The first of them is the so-called AS-IS model, which displays the existing state, and after it is completed, it is followed by the so-called TO-BE state, which displays the new structure of objects and processes after the implementation of the system (Darnton, Darnton 1997; Partridge 1996; Taylor 1995).

System Functions

The first description of processes in the system is the so-called required system functions. A list of them is launched directly from the launcher.

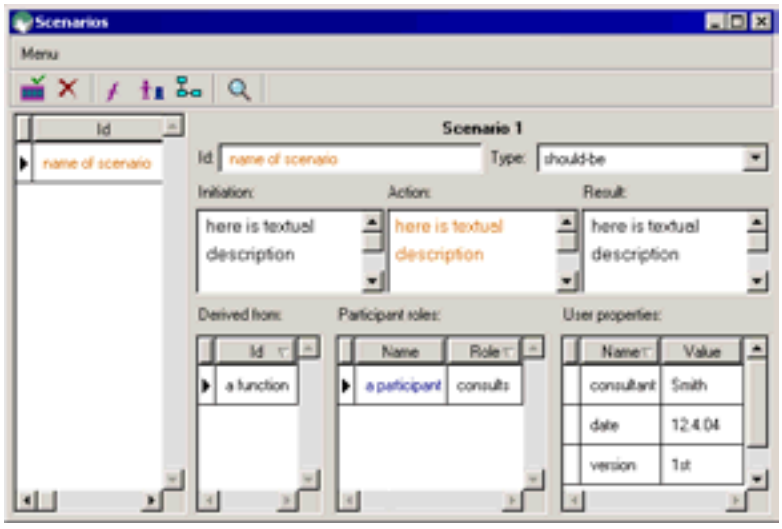

Figure 2. BORM scenario in CraftCASE

The predefined property "internal" and "external" serves for distinguishing in which relationship the given function is to the system, which is being modeled, because according to the BORM method, it is also appropriate to name the functions, which are outside the border of the modeling system, but are related to the subject, to which the entire system belongs.

Participants

A participant is an object, which participates in the processes in the system. They need not necessarily be only living beings – they can be machines, information systems etc. The list of participants is accessible in CraftCASE database.

Scenarios

A scenario is a detailed description of a business process describing some management knowledge. Each scenario should be derived from some system function (Figure 2).

Participants should also be a part of each scenario. For participants, it is possible to set their different roles in the modeling process.

Business process diagrams

It is appropriate to move on to diagrams after the completion of scenarios (which have been derived from functions), participants and data flows. Figure 3 is launched from the launcher. The business process diagrams have the syntax in Table 2.

Table 2. BORM process diagram concepts

Term	Symbol	Description
Role of participants	Rectangle with name displayed inside in left upper corner.	Represents participant of modeling process.
State	Rectangle edged with green drawn inside the symbol for role of the participant. (For starting and end state, symbols identical with UML used)	States express gradual changes of participants over time. States can be decomposed to diagram.
Association	Thick black arrow with full ending between roles of participants. At the arrow, a description is written which specifies in detail the character of the association. Expressions of natural language have precedence here over program descriptions such as "inherits", "composes" ...	Association expresses the data oriented relations between participants (that the participants need each other for some reason). Associations express in a uniform manner the relations, which can be later detailed as composing, legacy or dependence of objects.
IS-A	Thick grey arrow with full ending between roles of participants.	Expresses the hierarchy of supertype – subtype between participants.
Activity	Oval connected by line with participant or its state. Ovals can also be drawn inside the objects applying to them.	Activities represent individual elements of behavior of objects. Activities can be decomposed to a diagram.
Communication	Arrow, which connects activities together. Small named arrows drawn in parallel to the main arrow of communication express data flows.	Communication expresses the sequence of performance and mutual dependence of activities of various objects between themselves. Data flows can be routed in both directions.
Transfer	Arrow, which connects activities and states of a single object.	One part of the transfer is also the activity from which the transfer comes. Transfer with activity represents an activity, which it is necessary to perform in order for the object to change its state.
Condition	Striking out with text description at communications or at connected activity and object.	A condition is used to express the limited validity of communications or activity.

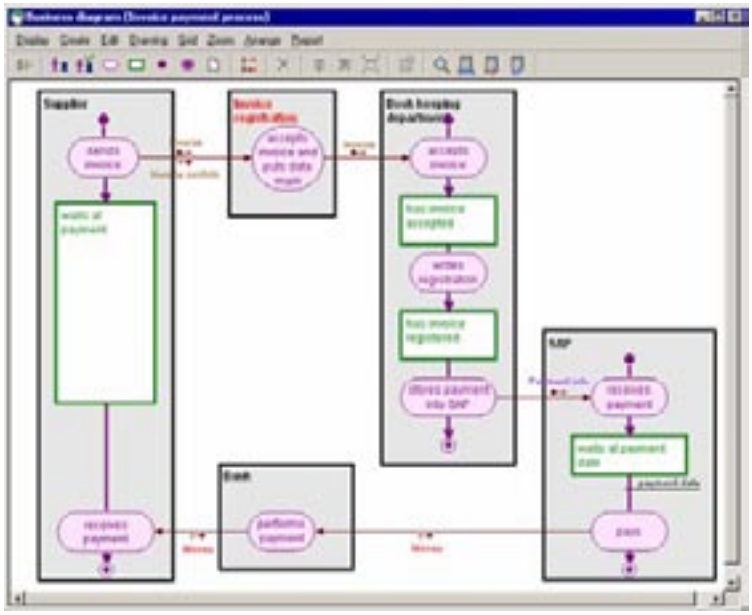

Figure 3. BORM process example

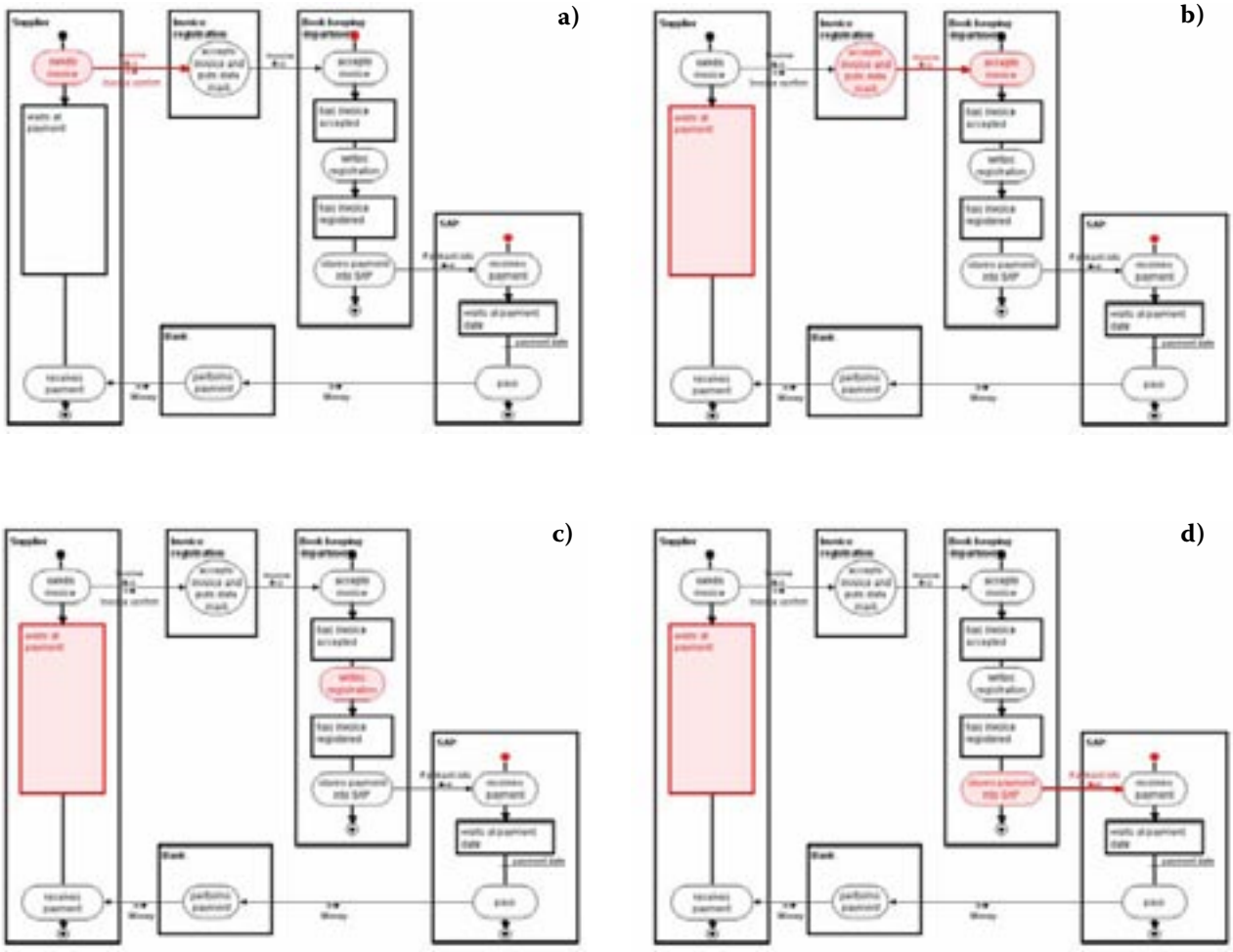

Figure 4. Simulation steps

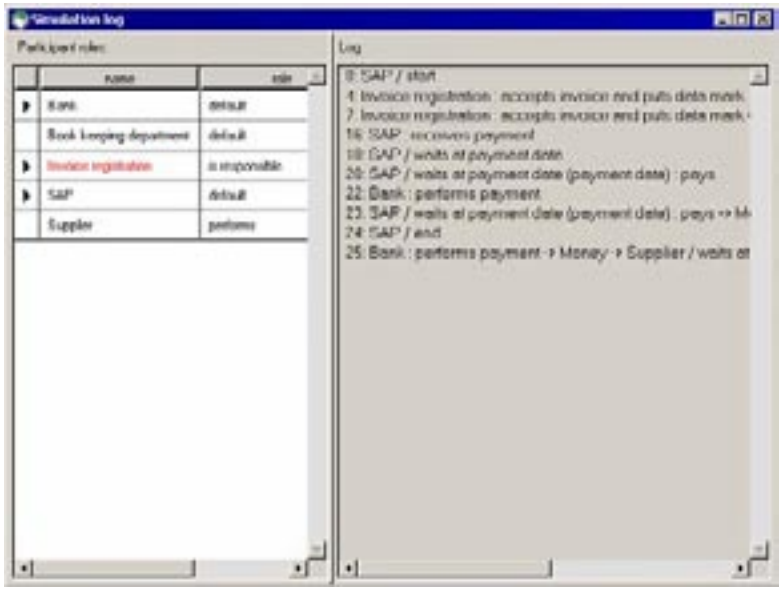

Figure 5. Simulation analysis log

Business process simulator

The business process model can be simulated. If a simulation is prepared, it is possible to go through the process step by step. If there are any conditions in the process, the CraftCASE simulator runs questions in the form of dialogue windows, which the user must answer. The course of simulation is shown by the following example sequence of selected simulation steps of the business process (Figure 4).

During the simulation or after the end of the simulation, it is possible to inspect the simulation log. The simulation log can be copied as a text (Figure 5).

In this tool, it is possible to select more than one participant (or all of them). This makes it possible to inspect the course of the mutual communication between the participants as it occurred during the simulation process.

CONCLUSION

This paper is the contribution into the area of gathering and representing business knowledge. The notation we propose may serve not only as a tool for formal representation of the modeled knowledge, but also, as we have demonstrated, as a useful tool for communicating with developers and experts from the problem domain (managers, employees, etc.). The key advantages of BORM method and CraftCASE tool are its graphic models of knowledge representation, which provide an easy and effective feedback. There are also clear rules how to progress through the information system development process using this knowledge representation.

REFERENCES

Darnton G., Darnton M. (1997): Business Process Analysis. International Thomson Publishing; ISBN 1-861-52039-5.

Goldberg A., Kenneth R.S. (1995): Succeeding with Objects – Decision Frameworks for Project Management. Addison Wesley, Reading; ISBN 0-201-62878-3.

Henderson-Sellers B. (1991): A Book of Object-Oriented Knowledge. Prentice Hall, New York; ISBN 0-13-059445-8.

Knott R.P., Merunka V., Polak J. (2000): Process Modeling for Object Oriented Analysis using BORM Object Behavioral Analysis. In: Proceedings of Fourth International Conference on Requirements Engineering ICRE 2000, Chicago. IEEE Computer Society Press; ISBN 0-7695-0565-1.

Knott R.P., Merunka V., Polak J. (2003): The BORM methodology: a third-generation fully object-oriented methodology. Knowledge Based Systems, *16* (2): 77–89 (March), Elsevier Science; ISSN 0950-7051.

Kotonya G., Sommerville I. (1999): Requirements Engineering: Processes and Techniques. J. Wiley and Sons, New York.

Liping L., Roussev B., Knott R., Merunka V., Polák J. et al. (2005): Management of the Object-Oriented Development Process – Part 15. BORM Methodology; ISBN 1-59140-605-6.

Partridge C. (1996): Business Objects – Reengineering for Reuse. Butterworth-Heinemann; ISBN 0-7506-2082-X.

Taylor D.A. (1995): Business Engineering with Object Technology. John Wiley, New York; ISBN 0-471-04521-7.

Yourdon E. (1995): Mainstream Objects – An Analysis and Design Approach for Business. Prentice Hall, New York; ISBN 0-13-209156-9.

Arrived on 22nd January 2006

Contact address:

Vojtech Merunka, Czech University of Agriculture Prague, Kamýcká 129, 165 21 Prague 6-Suchdol, Czech Republic; e-mail: merunka@pef.czu.cz