ITHEA

International Journal

INFORMATION TECHNOLOGIES & KNOWLEDGE

2009 Volume 3 Number 3

International Journal

INFORMATION TECHNOLOGIES & KNOWLEDGE

Volume 3 / 2009, Number 3

IJ ITK is official publisher of the scientific papers of the members of the ITHEA International Scientific Society

IJ ITK rules for preparing the manuscripts are compulsory.
The rules for the papers for IJ ITK as well as the subscription fees are given on ***www.ithea.org***
The camera-ready copy of the paper should be received by e-mail: info@foibg.com.
Responsibility for papers published in IJ ITK belongs to authors.

General Sponsor of IJ ITK is the Consortium FOI Bulgaria (www.foibg.com).

International Journal "INFORMATION TECHNOLOGIES & KNOWLEDGE" Vol.3, Number 3, 2009

Edited by the Institute of Information Theories and Applications FOI ITHEA®, Bulgaria,
in collaboration with the V.M.Glushkov Institute of Cybernetics of NAS, Ukraine,
and the Institute of Mathematics and Informatics, BAS, Bulgaria.

Publisher: ITHEA®

Sofia, 1000, P.O.B. 775, Bulgaria. www.ithea.org, e-mail: info@foibg.com

Printed in Bulgaria

ISSN 1313-0455 (printed) ISSN 1313-048X (online) ISSN 1313-0501 (CD/DVD)

MODERN BUSINESS MODELING APPROACHES AND TOOLS FOR MANAGEMENT

Elena Serova

***Abstract**: Improving management systems is getting more and more important and topical, as the organizational structure of modern society consists of many features, peculiarities, relations, and is continuously getting more intricate. Although the society has been complex for a long time, it is only now that we are starting to comprehend its real complexity. It has become obvious that changing a characteristic can easily cause or require change to other parts of the system. Attempting to achieve an enterprise's highest efficiency, each modern executive should use computer modeling from time to time, as it is an efficient tool for management system research that weighs qualitatively and quantitatively characteristics of system functioning. A prerequisite of modern management is to know the principles and capabilities of modeling, be able to create research and use such models. This report considers the role of business modeling for modern management tasks. Generalizing theory development in the area along with international practices and domestic experience, the author chooses the main directions of modeling for modern management and those fields of management where applying computer modeling is more efficient.. This paper weighs perspectives of modeling used to solve business problems; considers modern modeling approaches used to describe architecture, develop operational models and carry out reengineering; briefs on existing techniques and instrumental tools used in modern business modeling.*

***Keywords**: business process, business modeling, business process modeling techniques, simulation modeling, structure-function approach, discontinuous event-driven approach, agent modeling, modeling tools.*

***ACM Classification Keywords**: I.6.5 Model development – Modeling methodology*

Introduction

Business modeling techniques and tools have proven their usefulness. Development and implementation of ERP (Enterprise Resource Planning Systems), decision making support complexes, consultancy on describing organization architecture, changing business processes, auditing and certifying operations are just a few examples of how these tools can be used. To successfully complete such projects, modern business modeling approaches and tools are indispensable.

When solving business problems, modeling tools are primarily used to ensure mutual understanding at every organizational level, bridge the gap between strategic vision and its implementation. To do that, modern business modeling tools use special software, languages and systems that help develop models and diagrams to demonstrate how business processes are built and how staff interaction is organized, and what needs to be changed to optimize the whole architecture.

Computer modeling allows for considering processes that run in a system at any level of detail. Almost any algorithm of managerial activities or system behavior can be modeled. In addition, models that can be researched with analytic methods can be analyzed with simulation methods as well. These are the reasons why computer modeling methods are becoming a principal research method for complex management systems.

Companies that actively use cutting-edge information technologies consider modeling as a stage of executive decision making [Lychkina, 2007]. They provide their managers with systems that help make strategic executive

decisions. In addition, computer modeling based tools use methods and advantages such as object-oriented programming, video and multimedia supporting real-time animation.

Computer modeling allows for describing complex nonlinear business interactions, e.g., modeling economic agents' behavior in a crisis situation, weighing effects of different scenarios or forecasting further stream of events. The essence of computer modeling in business is to get quantitative and qualitative results from the existing model. By receiving from the analysis of business processes (structure-function modeling), qualitative results allow for finding previously unknown features of a complex system (e.g., management one): structure, development trends, sustainability, integrity, etc. Most quantitative results help forecast certain future values of variables characterizing the real system that is researched or explains those from the past, and can be obtained with modern simulation modeling techniques described in this paper. Naturally, all the modeling methods used to solve modern business problems are not mutually exclusive and can be applied to management system research either simultaneously or in a combination.

Goals and Objectives of Computer Modeling for Management Task

Computer models of complex management systems should show all major factors and correlations characterizing real situations, criteria and limitations. Models should be universal enough to describe objects close in application, simple enough to allow research needed at reasonable cost, and allow achieving the following objectives:

- to abolish a series of functions and reduce the number of management levels, to disengage mid-level workers;
- to rationalize solving management problems by implementing mathematical methods of data processing, using simulation modeling and artificial intelligence systems;
- to create a modern, dynamic organizational structure, improve the enterprise's flexibility and manageability;
- to reduce administrative costs;
- to reduce time spent to plan activities and make decisions;
- to increase competitive advantages.

To make the role of computer simulation modeling in the modern management more clear, I have to mention application of the structure-function approach to solving business problems. The essence of computer modeling in business is to get quantitative and qualitative results from the existing model. Qualitative results allow for finding previously unknown features of a complex system (e.g., management one): structure, development trends, sustainability, integrity, etc. Most quantitative results help forecast certain future values of variables characterizing the system researched or explain those from the past.

It is an essential difference of the computer simulation modeling from the structure-function one that the former gives both qualitative and quantitative results.

There is another direction of computer modeling. It solves management problems with mathematics and logic and, as a rule, uses Excel spreadsheets. The problems solved are those of stock management as well as transport, industrial or marketing logistics [Gorshkov et al., 2004]. The same is done with problems of linear and multiple regression forecasting, resource utilization review, etc. Such tools are quite popular, although specific management software, both scientific and commercial, that uses structure-function and simulation approaches, is more perspective.

Naturally, all the modeling methods listed above: simulation, mathematical logic and structure-function—are not mutually exclusive and can be applied to management system research either simultaneously or in a combination. Modeling tool Bpwin [Maklakov, 2003] can export models into a most efficient simulation modeling tool—the Arena system developed by Rockweel Automation (http://www.arenasimulation.com), and allows for optimizing business processes with simulation modeling (Fig.1). Using such an approach, various processes can be simulated and optimized: industrial technological operations, inventory control, banking, restaurant services, etc.

This is an example of how two leading directions of computer modeling can be integrated to solve modern management problems, demonstrating how simulation modeling can be applied to get quantitative results when modeling business processes.

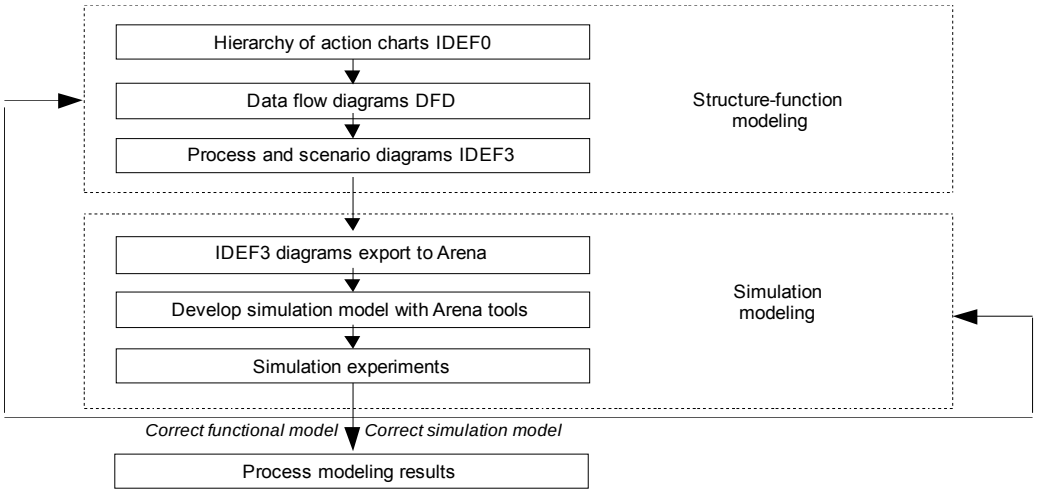

Fig. 1. Integrating simulation and structure-function modeling when solving modern business problems

Structure-Function Approach to Business Modeling

The most intuitive and quite popular example of the structure-function computer modeling in modern management is the business process modeling.

The market situation modern companies operate in is quite unstable which makes them respond to change quickly and accurately. Sooner or later, businesses have to restructure, and managers have to think how to change the existing business processes in order to improve the enterprise's operations. Thus, a manufacturer may wish to reconsider purchasing, ordering or delivery. Business process reengineering is tied together with altering the architecture of information systems. The key to success of a reorganization project is close cooperation of all the groups interested in solving the problem, primarily IT specialists and experts in the business area. It is achieved by building structure-function computer models that reflect business processes which are comprehensible for all participants. Such models should simultaneously help formalize and document the current state of affairs and find room for improvement. There are several computer technologies aimed at automating structure models—the CASE (Computer Aided Software Engineering) tools. The definition of CASE involves various tools used to analyze and model, and business process analysis tools are just a small fraction of the class.

Organization and structure changes in a company, especially when they involve an ERP implementation, bring serious risks. Implications of such changes should be carefully studied and analyzed before they start. Such ERP as SAP R/3, BAAN, ROSS iRenaissance, etc. use methods and tools proven by extensive experience and allow minimize risks and resolve issues arising from reorganization of business processes, including those linked with implementation of modern IT systems.

Today's approach to business process description suggests continuous improvement and modification, analysis and prognosis, as well as timely changes to the business model. The description should adequately reflect current state of affairs to underlie an integral comprehension of business development strategy and business automation. The following series of steps is best for business development or modification [Proshin, 2006]:

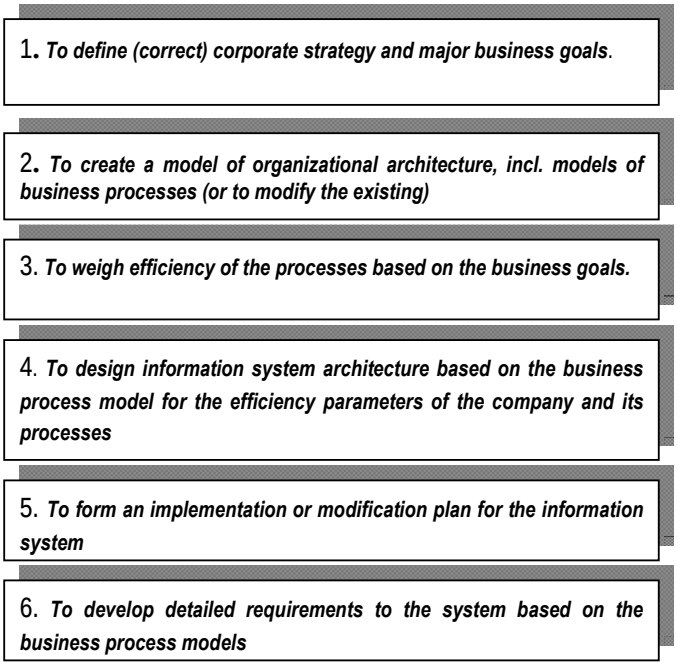

Fig. 2. Business development (modification) steps

There are several techniques to describe and model business processes. The most popular are: Business Process Modeling, Work Flow Modeling and Data Flow Modeling [Repin, Yeliferov, 2008].

Suggested in the 1970s by Douglas Ross, the Structured Analysis and Design Technique (SADT) underlies the IDEF0 business process modeling standard. AllFusion Process Modeler 4.1 (BPwin 4.1) by Computer Associates (CA) is a modeling tool fully compliant with IDEF0 that allows analyzing, documenting and planning changes in complex business processes [Maklakov, 2003].

Another actively used process description methodology is the Work Flow Modeling—the IDEF3 standard to build process models as time sequences of jobs (functions, operations). The IRIS source environment by IDS Scheer AG that creates methodological and work instructions with eEPS (extend Event-driven Process Chain) models, is based on IDEF3 [Ilyin, 2006].

DFD (Data Flow Diagramming) notations allow reflecting job sequences within a process and information flows circulating between those jobs. The DFD methodology minimizes subjectivity of business process description and can be efficient when implementing process approach to organizational management.

The developing UML (Unified Modeling Language) methodology is also quite widely used. It considers a series of diagrams (e.g., the Activity Diagram) that can be used to describe business processes [Vendrov, 2000], although business modeling is not what UML is intended for.

Along with the techniques listed above, there are other ones offered by various software producers. Even such corporations as IBM and Oracle offer their own business process description and modeling tools. E.g., the Oracle Workflow technology used to automate job flows contains tools for process description and formalization. The most popular state-of-the-art business process management standard is BPEL (Business-Process Execution Language). Based on this product, an integral platform for all applications used can be created. Public and private institutions throughout the world are switching to BPEL. Certain pilot projects have been carried out in Russia as well, successfully solving IT infrastructure optimization problems [Proshin, 2006].

Simulation Modeling to Solve Business Problems

The structure-function method allows describing existing business processes, finding their drawbacks and building a model of the enterprise's operations. However, the difficulty is the optimization of particular processes, or the study of how various parameters influence a certain business process. To solve this problem, the structure-function model may be insufficient, and other modeling techniques and tools turn out to be more appropriate. An approach that solves such business problems and gives quantitative characteristics of business processes is simulation modeling. Simulation models can provide statistics of processes as if they were happening in reality. Normally, such models are built to find an optimum solution with limited resources, when other mathematical models are too complex. Owing to its simplicity, the idea of simulation modeling attracts both executives and system researchers. The simulation approach to business problems requires special software that is widely denoted with such terms as "simulation system" and "simulation modeling system". The terms refer to an aggregate of a simulation model of a complex process, a set of simpler models of the same process, algorithms and relevant software associated with the models. Some examples of such systems applied to business modeling are the Arena simulation modeling system by Rockweel Automation (http://www.arenasimulation.com), AnyLogic by XJ Technologies (http://www.xjtek.com) or GPSS (General Purpose Simulation System) by Minuteman Software (http://www.Minutemansoftware.com). To create simulation models, one should know special algorithmic languages that can express concepts which modeling specialists use. Each language is specific in:

- how complex the concepts of simulation modeling are represented;
- language base;
- number of basic concepts.

An important factor to choose a simulation modeling language is if there is an efficient translator for the chosen computer hardware. A multifunctional user interface makes many language operators excessive. This is why a special simulation modeling language is ideal to build a simulation model for business problems.

The modern simulation modeling theory offers four major approaches [Borshchev, Filippov, 2006]:

- dynamic system modeling (simulation modeling systems MATLAB Simulink, VinSim, etc.),
- discontinuous event-driven modeling (GPSS, Arena, eMPlant, AutoMod, PROMODEL, Enterprise Dynamics, FlexSim, etc.) [Serova, 2007],
- system dynamics (VenSim, PowerSim, iThink, etc.), and

- agent modeling (AnyLogic [Karpov, 2005], Swarm, Repast, etc.).

Each direction develops its own tools, simulation modeling systems and languages.

System dynamics (SD) and dynamic systems are traditional, established approaches; whereas the agent modeling (AM) is comparatively new. SD and dynamic systems operate mostly with continuous processes, while the event-driven and agent modeling cover discontinuous ones.

The following two approaches are used most often to solve business problems as basic formalization and structuring conceptions in modern simulation modeling systems:

- process and transaction oriented modeling systems based on process description. In the modern IT market, they represent the discontinuous event-driven simulation modeling approach and are the most representative class of such systems. These are such systems as GPSS, Arena, Extend, AutoMod, ProModel, Witness, Taylor, eM-Plant, QUEST, SIMFACTORY II.5, SIMPLE++, etc. [Serova, 2007];
- agent modeling that uses models to study decentralized systems which dynamics and functioning is not defined by global rules, on the contrary, those rules are a result of the group members' individual activities. In Russia, such systems are represented by AnyLogic [Karpov, 2005];

Simulation modeling systems with discontinuous event-driven and agent approaches have proven most efficient in such areas of business modeling as business process and service modeling. The Arena simulation modeling system is integrated with a CASE tool, BPWin, whereas GPSS possesses tools needed to model processes relevant to such a dynamically developing area as the service-oriented economy [Serova, 2007].

Conclusion

Aiming at securing a stable economic position in a very competitive environment and attracting funding, the most forward-looking companies pay more and more attention to developing and implementing cutting-edge computer modeling systems. A principal tool to solve modern business problems related to cost cutting and restructuring, business modeling, service-oriented economy and decision-making procedures in management systems, is computer simulation modeling technologies. They include developed graphic interfaces for model construction, result presentation and output statistics filing. Moreover, simulation modeling widely uses methods and advantages of object-oriented programming, video and multimedia supporting real-time animation.

State-of-the-art simulation modeling technologies used at every level of enterprise management: strategic, tactic and operational—is a direction for development and a criterion for stable economic growth in the modern competitive environment.

Thus, an organization willing to use state-of-the-art business modeling tools can choose a methodology out of several standard options. The choice should be based on the clear understanding of the models' capabilities and drawbacks, as well as the purposes. Business modeling tools and instruments are evolving and tend to switch from a visual description of certain narrow business areas towards a holistic description of organizational architecture. The application of modeling is widening from information exchange within a small group of specialists to management of distributed organizations requiring comprehensive information of all the organization's operations. The opportunities of integration between different business modeling approaches that have appeared allow for fully implementing modeling and analysis tools into the organization's existing infrastructure. The most perspective direction seems to be the growing correlation of business modeling and analysis systems with management systems.

Bibliography

[]Ananiev, Serova, 2008] I. Ananiev, E. Serova. The areas of IDEFO notation effective application for tasks of business-processes description. Vestnik of St. Petersburg State University, 2008.

[Borshchev, Filippov, 2004] A. Borshchev, A. Filippov. AnyLogic — Multi-Paradigm Simulation for Business, Engineering and Research. The 6th IIE Annual Simulation Solutions Conference, Orlando, Florida, USA.March 15-16, 2004.

[Borshchev, Filippov, 2006] A. Borshchev, A. Filippov. From System Dynamics and Discrete Event to Practical Agent Based Modeling/ site by XJ Technologies., 2006.

[Gavrilova, 2007] T. Gavrilova, S. Puuronen. In search of a vision: ontological view on user modeling. KDS-2007, conferences' score.

[Gorshkov et al., 2004] A.F. Gorshkov, B. V. Yevteyev, V. A. Koshunov. Kompyuternoe modelirovanie menedzhmenta (Computer modeling in management). – Moscow: examen, 2004.

[Grabaurov, 2001] V.A. Grabaurov. Informatsionnye tekhnologii dlya menedzherov (IT for managers). – Moscow: Finansy i Statistika (FIS), 2001.

[Ilyin, 2006] V.V. Ilyin. Modelirovanie biznes-protsessov. Prakticheskiy opyt razrabotchika (Business process modeling. A developer's practical experience). – Moscow: Williams Publishing House, 2006.

[Karpov, 2005] Yu. Karpov. Imitatsionnoe modelirovanie sistem. Vvedenie v modelirovanie s AnyLogic (System simulation modeling. Introduction to modeling with AnyLogic). – SPb.: BHV-Petersburg, 2005.

[Lychkina, 2007] N.N. Lychkina. Imitatsionnye modeli v protsedurakh i sistemakh podderzhki prinyatiya strategicheskikh resheniy na predpriyatiyakh (Simulation models in enterprises' strategic decision making support procedures and systems). Biznes-Informatika, No. 1, 2007.

[Maklakov, 2003] S.V. Maklakov. Modelirovanie biznes-protsessov s AllFusion Process Modeler (Business processes modeling with AllFusion Process Modeler). – Moscow: Dialog MEPHI, 2003.

[Moshella, 2004] David Moshella. Customer-driven IT: how users are shaping technology industry growth. -- Boston, MA: Harvard Business Press, 2003.

[Proshin, 2006] F. Proshin. Biznes-modelirovanie: zadachi i instrumenty (Business modeling: problems and tools). IT News. 2006. http://www.olap.ru/home.asp?artId=295

[Repin, Yeliferov, 2008] V.V. Repin, V.G. Yeliferov. Protsessnyy podkhod k upravleniyu. Modelirovanie biznes-protsessov. Prakticheskiy menedzhment (Process approach to management. Business process modeling. Practical management).-6th ed.– Moscow: Standarty i Kachestvo, 2008.

[Serova, 2007] E. Serova. Imitatsionnoe modelirovanie v sovremennom menedzhmente (Simulation modeling for modern management). SPb.: SIMMOD-2007.

[Turban, 2006] E.Turban, D. Leidner, E. McLean, and J. Wetherbe. Information Technology for Management. – WILEY, 2006.

[Vendrov, 2000] A.M. Vendrov. Proektirovanie programmnogo obespecheniya ekonomicheskikh informatsionnykh sistem (Designing software for economic information systems). Moscow: Finansy i Statistika (FIS), 2000.

GPSS World reference manual. Fourth Edition 2001. Copyright Minuteman Software. Holly Springs, NC, U.S.A. 2001; http://www.minutemansoftware.com/reference/reference_manual.htm

GPSS World Tutorial Manual. Copyright Minuteman Software. Holly Springs, NC, U.S.A. 2001. http://www.minutemansoftware.com/tutorial/tutorial_manual.htm

Authors' Information

Elena Serova *– PhD (Economics), Deputy Chair, Dept. of IT in Management, Graduate School of Management, St. Petersburg State University; Per. Dekabristov 16, St. Peterburg 199155, Russia; e-mail: serovah@som.pu.ru; serovah75@gmail.com*