

Reengineering University: Modeling Business Processes to Achieve Strategic Goals

Aleksey Shutov

25/12, Bolshaya Pecherskaya str, Nizhny Novgorod, Russia, 603155
ashutov@hse.ru

Abstract. Recognizing the challenges that a contemporary university faces, an inter-faculty group of researchers performed the analysis of organizational and management approach in one of Russia's universities and modeled existing business processes. The university is a multi-campus organization and to manage it efficiently it is necessary to make transition from the traditional management model to a more flexible - network structure. This paper focuses on development of the Goal Tree and designing of AS-IS model. The researchers applied IBM Business Modeler [1] which allows to execute modeling and simulation of business processes. The practical value of the proposed approach is that it enables the university management to improve performance and effectiveness.

Keywords: Network university, business process modeling, organizational structure, simulation modeling.

1 Introduction

The paper examines the challenging tasks of analyzing and assessing University organizational and management model, and the role of business processes in achieving the strategic goals of the University. The assessment will be based on data obtained from simulation modeling and on the developed methods of assessment business processes-on-goals impact. The business processes are modeled with specialized software and described with BPMN (Business Process Modeling Notation) [2] [3]. The correlation between processes and goals is defined with the help of the developed Goal Tree.

A modern university must conform to the needs of society and respond quickly to social changes. Not only should universities prepare specialists, they must become centers of scientific knowledge, academic research and development. Furthermore, inter-university collaboration encouraged by the Bologna process is strengthening: distributed universities emerge which represent international academic communities which use the same curriculum and support student and teacher mobility. Russian universities actively participate in this process [4].

This paper considers National Research University Higher School of Economics (HSE) as the example and source of initial data. Until 2010 this institution was called State University Higher School of Economics and included several campuses: Nizhny Novgorod, St.-Petersburg, Moscow, Perm'. Each campus had a relatively independent

organizational structure. In 2011 HSE was awarded the status of National Research University (NRU HSE) which lead to reengineering and unification of business processes in all branches, and transition from mechanistic, closed and function-oriented model to open and flexible conception promoting management based on self-organization, constant growth and adaptation.

Accomplishment of this task requires new methodology to define university management and organizational on model. It will consider the university as a specific type of organization where a part of stakeholders – students - participate in business processes.

The methodology which we aim to develop will allow the administration of the university to strategize and manage the development based on principles of self-organization and open service-oriented approach to identifying mission, purpose and goals of the university. This opportunity will be realized on the basis of developed models which address social, economic, legal, cultural and technological issues and take into account limitations of university functioning.

Our research consists of the following stages:

1. Study the subject area, identify strategy-based business goals of the university.
2. Create a Goal Tree for the university and develop the matrix of correlation between university processes and established goals, define methods of calculation of process-on-goal impact.
3. Develop an AS-IS model, check the model's adequacy, analyze the model, etc.
4. Develop a TO-BE model, analyze the model.
5. Calculate weighing coefficients for university business processes taking into account their process-on-goal impact.
6. Apply the developed methodology to university development process.

The presented research opens the series of articles devoted to optimization of conceptions of design and implementation of management model for contemporary university. The article focuses on development of AS-IS model. The interdisciplinary scientific approach based on the latest international research has been used to achieve these goals.

The following tasks were completed within this research:

- Goal Tree and Matrix of correlation between university processes and established goals developed, methods of calculation of processes-on-goal impact are defined.
- Existing key business processes of university are analyzed and described (admission procedure, teaching, organization of academic activity, financing of main processes within the university).

The content of the article was divided into the following primary parts:

- Part 2 reviews the literature on organization structure modeling.
- Parts 3 and 4 focus on Goal Tree development, algorithms used to calculate relationship between goals and processes, design of the model.
- Part 5 presents the obtained results.

2 Literature Review

It has been mentioned above that to achieve growth and to occupy leading positions in education and science it is essential for the University to adjust its management approach and provided services to new conditions. Solving these problems requires changes in university operation. These processes need full-scale, thorough study and analysis of all potential development options, taking into account process-on-goal impact.

Modeling of organization processes has been studied by researchers and scientists from such different areas of knowledge as sociology, mathematics, cybernetics and others since 1970s. The researchers mainly focused on proving the effectiveness of network organizations basing on the results of social surveys and mathematical calculations. The authors explained failures of some network organizations, modeled their operations and studied the impact of human factor on the functioning of an organizations. M. Granovetter [5-7] explains that an individual makes decisions depending on his benefits and costs and on what others are doing. Eng Teck-Yong [8] shows how the Internet enhances effectiveness of network organizations. The study about Australia's network universities [9] describes the reasons why federated universities could not use their network to achieve a competitive advantage. Other possible causes of failure in network organizations are presented in *California Management Review* [10]. In [11] the authors made an attempt to describe the model of learning process in a network organization basing on their six years studying of a conglomerate. In [12] the authors apply the notion of network organization to universities. The article analyses operations of five Australia's universities, namely influence of new technologies on higher education, and advantages and disadvantages they provide to academic activity. These works are based on experiments and sociological surveys. In [13] the researcher describes changes in network organizations and makes an attempt to identify factors influencing changes in organizational structure. For the experiment were chosen a military group and a network organization, and the tools of dynamic analysis (DNA, SNA) were applied. Russian Center of studies LANIT describes the main factors that are necessary for universities to succeed in conditions of diversification of state financial support to science and research [14]. In [15], basing on the main principles of network economy, the following strategic development axes in network education can be identified: develop and standardize software used in network education, transform the structure of university, give more independence to faculties and departments, diversify educational services, develop customized education, increase communication and collaboration among various educational institutions and etc.

Other similar publications have also been studied, but the controlling idea is obvious: all these works promote network organizations as an effective structure. Some articles contain descriptions of mathematical models of organization and statistical methods, however the simulation modeling is rarely applied. Simulation modeling and modeling of business processes (its subset) can be helpful when studying the behavior of complex objects. In this paper the task to analyze organization's behavior is approached using modeling of business processes because its tools allow to simulate, analyze and optimize business-models, also applying a wide range of mathematical methods to describe behavior and relationship of objects.

3 Work Description and Development of the Goal Tree

In this section we describe how the data for building a model was collected and how we developed the Goal Tree.

Research Description

The works consisted of several stages and involved specialists from the Faculty of Business Informatics and the Faculty of Management. The researchers used iterative approach, i.e. the task was divided into several stages and at the completion of each stage the achieved result was analyzed and, if necessary, refined or specified. Here are the main stages of work: develop questionnaires for university staff, question the staff, develop the model, analyze results, refine and specify processes, revise the model. Some stages were repeated until the required result was achieved. The stages are expanded on below.

Develop Questionnaire

The questionnaire was aimed at obtaining the following data: goals of university and ways of achieving them, business processes of university, inter-department collaboration to ensure the processes implementation, qualitative problems of processes.

The developed questionnaire consists of three sections: general questions (structure, staff, general information) goals of university, description of university processes. The third and largest section of the questionnaire includes questions about: name of the stage, department in charge, list of tasks executed at each stage, description of tasks, relationship between tasks, input/output documentation, etc.

Questioning

The following people responsible for main processes in the organization were surveyed: Director, Head of Studies, Financial Advisor, Heads of Departments. As the result we could study regulatory documents and describe admission and teaching procedures, management of academic process. A completely fulfilled questionnaire thereby gives a full picture of the processes inside organization and provides the base for building the Goal Tree.

Development of the Goal Tree

All processes of the organization must directly or indirectly ensure that business goals of the organization are achieved, the latter are established in the programme of development. To identify the process-on-goal impact, the Goal Tree was built and the coherence between goals and processes was defined.

The main goals of the University (according to the programme of development) are [16] to become a leader in educational market, develop innovation competencies and research, address social and economic issues.

The following major business processes were identified during the research: admission of students, provision of educational services to students (both state-funded and those on a paying basis), courseware for academic process, financial flows, scientific research in the university.

The results are presented in a table (matrix of coherence). In Table 1 is presented a part of the matrix describing the strategic goal – «Becoming a leader in educational market».

Table 1. Matrix of coherence

Becoming a leader in educational market				Admission	Academic process	Course ware	Financial flows	
				Admission of fee-paying students (v1)	Admission of state-funded students (v2)	State-funded students (v3)	Fee-paying students (v4)	v5
2. Develop int. Masters programmes	1.2 Attract talented graduate and post-graduate students	1.1 Develop new structure of teaching	1. Develop efficient system of staff training					
			a21	a22				
	b11	b12	a11	a12	a13			
	b13	b14	a23	a24				
	b15							
$A3 = b11 \cdot v1 + b12 \cdot v2 + b13 \cdot v3 + b14 \cdot v4 + b15 \cdot v5$			$A2 = a21 \cdot v1 + a22 \cdot v2 + a23 \cdot v3 + a24 \cdot v4$	$A1 = a11 \cdot v3 + a12 \cdot v4 + a13 \cdot v5$				
FA3=A3	$FA1 = k1 \cdot A1 + k2 \cdot A2$			$F = m1 \cdot FA1 + m2 \cdot FA3 + m3 \cdot FC3$				
Superposition of sub-goals				Function of goal				

Rows represent goals and sub-goals of the university, columns describe the main processes. Cells at intersections of goals and processes contain coefficients that show the impact of a process on achieving the goal. The value corresponding to each process (v_i) is the assessment obtained from simulation modeling.

It is suggested that the impact of process' execution on goals be calculated as follows:

- Simulation modeling is executed.
- As the result, for each process value v_i is calculated, which can be time of execution, cost, income, delays, etc.
- Basing on the matrix of coherence, values of functions for sub-goals are calculated. For example, $AI = a11*v3 + a12*v4 + a13*v5$ –value which shows how the processes influence the sub-goal, e.g. «Create new structure of academic process», where $a_{i,j}$ is the weighing coefficient of the process's impact on achievement of this goal.
- Values of functions for goals are calculated, taking into account the already obtained results (Superposition of Goals).
- Final value of processes' impact on a strategic goal is calculated. («Strategic goal»)

In general, calculation of impact of a process on a strategic goal is made with a linear function such as (1):

$$f = k_1 p_1 + k_2 p_2 + \dots + k_n p_n \quad (1)$$

where f – goal, k_i – weight of an i - process in achievement of the goal, p_i - result of the process' execution, n – number of processes. Values of k_i and the choice of result of p_i execution will be defined further in the research.

4 Designing the Model of University Business Processes

This section describes the University business processes. The model uses BPMN (Business Process Modeling Notation) [2] and description is based on IBM WebSphere Business Modeler¹ [1] [3].

Admission of applicants. All applicants fill in electronic or paper form and may immediately conclude the contract for provision of educational services and pay 25% of the required fee. Once the acceptance of forms is finished, the applicants are admitted to state-funded places basing on USE (Unified State Examination) marks. If an applicant concluded the contact but has a USE mark high enough to be admitted on a state-funded basis, the paid sum is reimbursed. The applicants not admitted on a

¹ IBM WebSphere Business Modeler is used within the programme «IBM Academic Initiative ».

state-funded basis are offered admission on a fee-paying basis. By the beginning of the semester new fee-paying students must pay 25% of the tuition fee or provide a letter of guarantee.

The details of the process are shown in fig. 1.

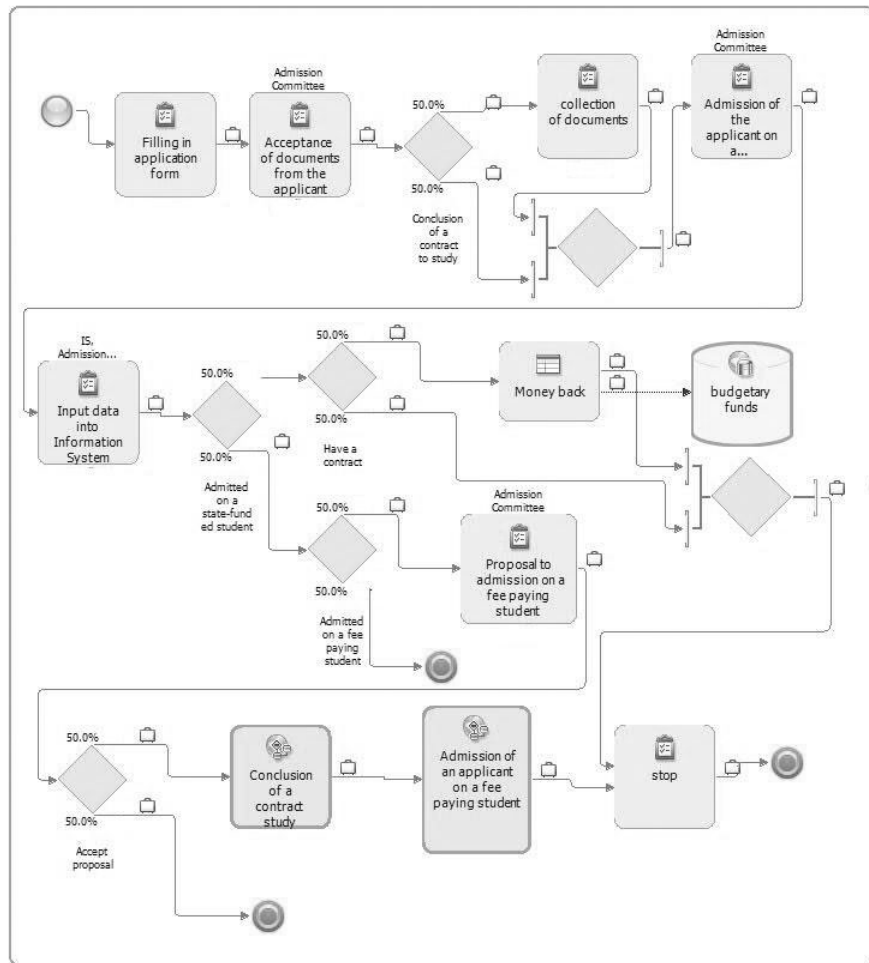


Fig. 1. Admission of applicants

Provision of educational services. This process can be divided into two main processes – teaching and courseware (fig. 2). To make calculations easier, teaching of state-funded and fee-paying students was considered separately and further the process was divided by faculties.

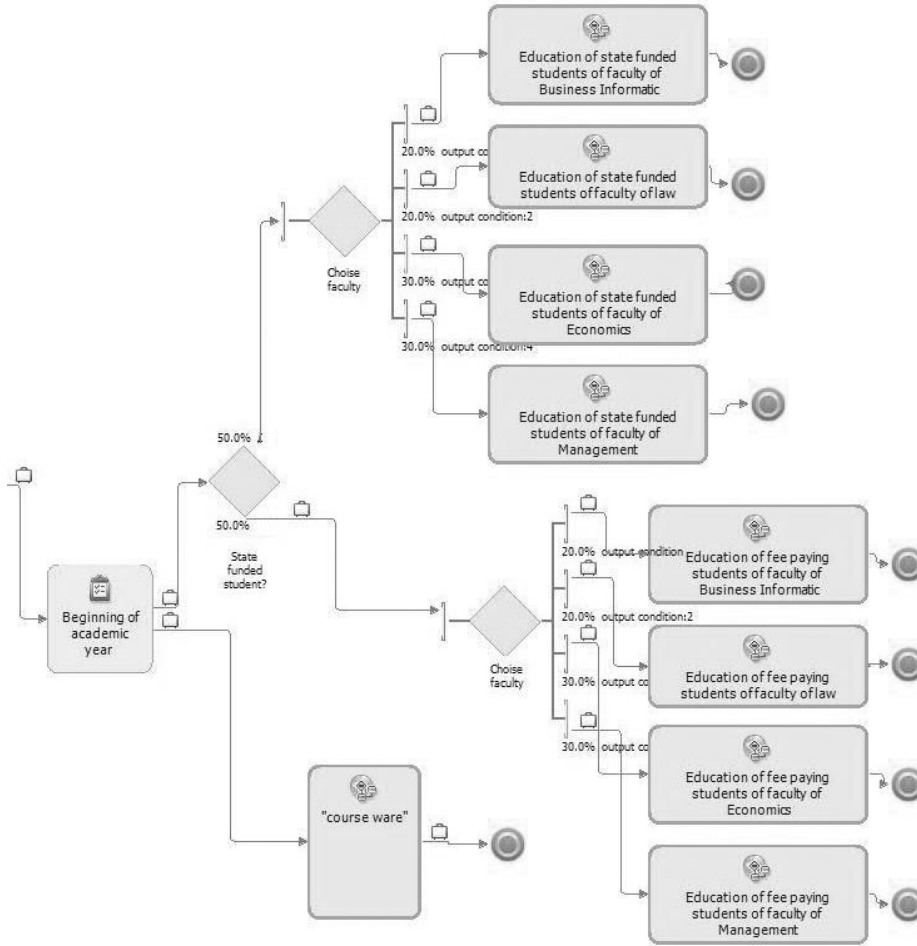


Fig. 2. Provision of educational services

Provision of educational services to state-funded students. After admission the university delivers academic services to its students. During studying the grades of a student are checked and, should they be unsatisfactory, the student is expelled from university. After the first year 5-10% of students are expelled. The process for fee-paying students has the same algorithm but more tasks.

Courseware. Courseware is preparation of teaching loads and programmes. The process of courseware preparation for each academic year is initiated by the main campus in Moscow four or five months in advance and consists of several stages shown in fig. 3. This process is to be accomplished by the beginning of the academic year.

Composition of each type of curricula includes drafting and agreement with the main campus and may be done in several rounds.

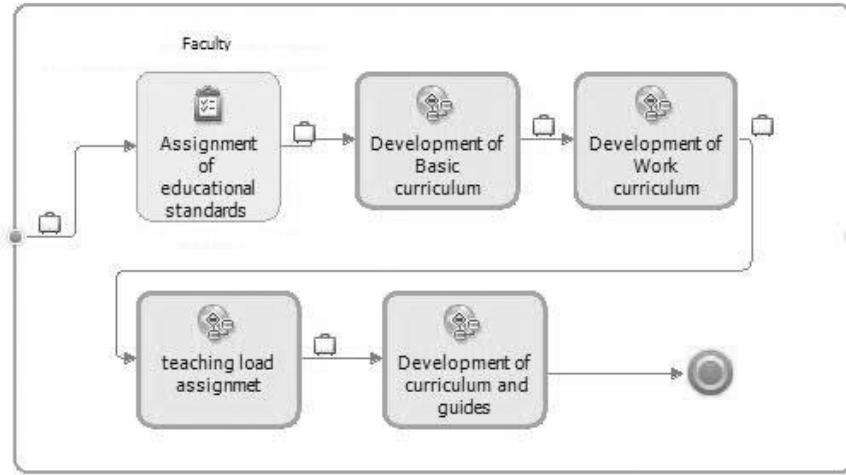


Fig. 3. Courseware

Receipt and distribution of funds. Fig. 4 shows the main budget items such as income and expenses.

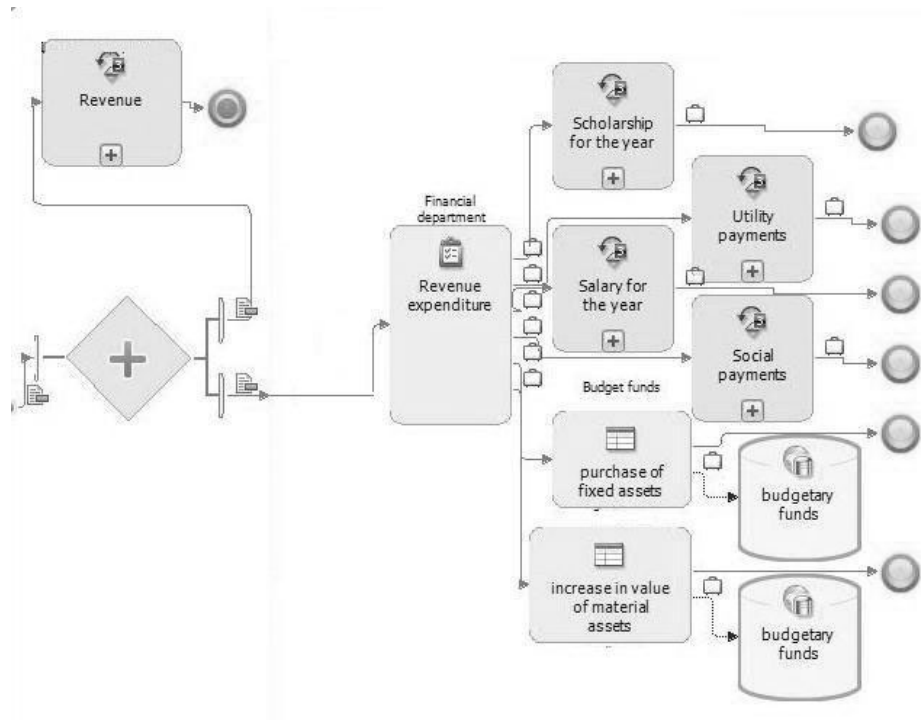


Fig. 4. Receipt and distribution of funds

The University is a state-funded institution, all its financial resources are controlled by the state and all income and expenses are supervised by the exchequer. The budget is planned annually and has quarterly layout.

The funds consist of state-funded and extra-budgetary parts:

- The state-funded part is allocated by the Department of Presidential Affairs and is based on the number of state-funded places at the university.
- Extra-budgetary part – money earned by the university (contracts, fee-paying students, etc). This part is calculated basing on the plan of admission of fee-paying students.

This is one of the main activities to ensure educational process, and at the same time high-quality education is the means of attracting new students therefore increasing the extra-budgetary part of university financial resources.

5 Conclusion

A comprehensive reengineering of university processes is a complex and sophisticated task. We would like to emphasize that this paper presents only the commencement of the research. Within the first stage we have obtained the following expected results:

- Describing existing processes at the example of HSE.
- Building the Goal Tree and defining the methodology of calculating the impact of processes on business goals. (Exact values of weighing coefficients of process-on-goal impact and values obtained from modeling will be calculated further for TO-BE model).
- Building the model of processes.

The Goal Tree was developed on the basis of the programme of University development [16].

The developed model considers the organizational structure of the university, including administrative and academic departments; staff are represented as a pool of human resources with different qualification. Moreover, the model considers information resources, such as various systems.

The researchers conducted simulations for the periods of one, two and three years on the basis of the developed model. The obtained output on the main processes corresponds to real data. The processes were verified by the following parameters:

- Input data: number of students at the beginning of simulation, number of applicants at the beginning of simulation, cost of man-hour for different categories of resources, number of staff in each department.
- Output data: financial expenses, income, temporary costs of execution of processes, labor input for processes, work load.

The work shows the potential and applicability to use the model description (in BPMN) and simulation modeling for various types of analysis and to apply this

method to perform such complex tasks as describing and modeling of operation of the whole organization and down to its separate departments.

The outcomes presented above will serve as basis for further research in the field of university reengineering. We aim to tackle the following problems:

- Define coefficients of process-on-goal impact.
- Build a «TO-BE» model for NRU HSE as a network university, including all campuses.
- Analyze the results of modeling a distributed university (using Goal Tree) and prepare recommendations for university strategizing and managing.

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