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Riga Technical University

2013

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Abstract
The paper discusses implementation of a research that is aimed at development of a simulation model which would allow analyzing different development strategies of the third generation university. Small countries' universities have limits of growth. The problem can be solved with a new approach to university role. The third generation defines university as innovation generation, transfer and implementation center, while maintaining the traditional university functions. The 3G university activities change number of innovative companies in the country. With growth of the number of innovative companies, potential researches and innovation customers' amount grow. With time the amount of conducted research and developed innovative products growth. Innovative products and technologies is the basis of university competitiveness in the 21st century. Universities must develop, accumulate, implement and get benefits from innovative products and technologies.

Keywords: system dynamics; higher education; resource management; organizational learning; funding; quality; knowledge; innovation

Introduction

Universities' planning is actual in any country. Topicality of the problem is underlined with growing demand for highly qualified specialists (as basic product of traditional universities) and limited resources of universities such as financial, personnel and other areas. At the same time the innovative century set new requirements for universities: now they are not only higher education institutions, but also research and innovation implementation centers. In conventional, first-generation university, the university's role is related to train highly qualified specialists. In the second generation, this role is supplemented with research tasks. The third generation defines university as innovation generation, transfer and implementation center, while maintaining the traditional university functions. The new features' addition to universities makes fundamental changes in universities' management system. At that moment in the world, there are not a study, which describes the third generation system in university planning or/and simulation. It is related to the third generation university concept formation. Specified conditions underline the model and the article actuality, authors hope that, sooner or later, most of the leading universities designate the third generation university development concept.

In the paper researched problem is related to strategy planning model development for 3rd generation universities.

Novelty element relates with the 3rd generation university conception realizing in university model.

The object of research is university management and strategy development for university.

The subject of research is university changes, after the 3rd generation university conception realization.

The paper aim is to develop the 3rd generation university strategic planning model.

To achieve this aim, the following tasks are set:

- ✓ To study scientific literature and university management models, based on this research draw conclusions about existing models helpful for 3rd generation university model;
- ✓ To develop 3rd generation university strategic planning system dynamics model;
- ✓ To present the general scheme of the developed model;
- ✓ To show main blocks of the model, as well as main stock-flow schemes of the main blocks.

The study shall use both traditional mathematical, statistical, economic and econometric analysis methods, such as time-series trends, regression method, but the principal method of research is system dynamics method.

The information base of study is Riga Technical University unpublished information.

Methodological basis of research based on works of system dynamic top scientists in education area: Michael Kennedy, Federico Barnabe, Mohammad Vahdatzad, Benedict Oyo, Yaman Barlas, Mohamed Mahmoud, John Hermann.

Research results are tested and implemented in Riga Technical University (Latvia).

Literature review

Considering the application of system dynamics (SD) method in the field of higher education, the authors must mention the following, well-known researchers in SD community as Michael Kennedy, Federico Barnabe, Mohammad Vahdatzad, Benedict Oyo, Yaman Barlas, Mohamed Mahmoud, John Hermann. Taking into account that authors have experience in models development, papers, as well as new conditions, the new model will be developed.

In literature review, first task is to study relevance of SD method for developing university simulation model.

In general, all authors consider applications of SD method in the field of higher education indicate both the complexity of the problem under investigation, and on the specific of the method - research on linkages in an object. It can be concluded about the correctness of the chosen method.

Analysing the before developed models and written papers, authors conclude that most of models are related to the problem of allocation of limited means (financial, personal and so on) or/and with its efficiency (or education quality). Each of authors has own point of view of problems and ways to solve it.

For example, Vahdatzad, M. A., and Mojtahedzadeh, M. T. writes about dual task in university development - government and universities roles: the university has to have the authority to decide on the expansion of its academic courses and research activities based on the university strategic plans, limitations, and capabilities. This would not happen without decentralization of decision-making in the government bodies (i.e., the Ministry of Science, the Budget and Planning Organization, and the Organization for Recruiting). And the university must think of earning money from private sectors and industries by carrying out more project and research work for them. (Vahdatzad, M. A., and Mojtahedzadeh, M. T., 2000).

Benedict Oyo offers generating income from internal activities like short courses, consultancy, and hire of premises on addition to tuition from students (Oyo, B. at al, 2008).

The same decision is visible in previous researches too; it is well-known as “other income”. This is the term used for income from such activities as consultancy, short and full-cost courses, the hire of university facilities, and the activities of any trading arm that the university may operate. In many cases, the problem of overheads mentioned above is less severe because the university is able to charge reasonable overheads to what are, in the main, commercial customers. There is an expectation that while the majority of the funds will go to the unit that generated the

income, a reasonable proportion will be retained by the centre to supplement the main grant income (Kennedy, M., & Clare, C., 1999).

In some cases, it is needed to change university financing system. Each year the university proposes a budget for the next fiscal year and the Ministry of Science makes the final decision about the actual budget. The proposed budget is based on the vision for the future and the actual budget depends on the allocated budget in the past. Problem solving: Decisions for budget allocation are made by different organizations and policy makers without much coordination. The Ministry of Science has to change the usual way of budget allocation from a few per cent increase of the previous year budget to allocation on the bases of needs, performance and the expansions. (Vahdatzad, M. A., and Mojtahedzadeh, M. T., 2000). The an interactive dynamic simulation model can be extended to include more aspects of the university system, such as budget considerations, support staff and in general more detailed representations of variables such as facilities, infrastructure and projects (Barlas, Y., & Diker, V. G., 2000).

In all cases, the authors agree that the funding problem can be solved in three ways: by increasing the amount of funding, reducing costs and increasing the efficiency of use of resources. It must be used in a complex above mentioned ways of problem solving.

Decision of financial problems is not enough; it needs research, models that can handle simultaneously both the quantitative and the qualitative aspects of the university management problems (Barlas, Y., & Diker, V. G., 2000). With qualitative aspects of the university usually we understand quality of education.

The model will provide university managers with scenario planning tools for learning. For instance, it will provide support to course management, faculty workload analysis, and accountability will be developed through the integration of statistical and financial management of course offerings. The model will simulate impacts of long term strategies and the effect of policy decisions, providing feedback prior to the decisions being made. In conclusion, the university has certainly benefited by the development of a microworld. The benefits are efficient and centralized planning, decentralized decision making and resource allocation to faculty, and clear communication of results in a timely manner (Mohamed, M., & Peter Genta, P., 1993).

The model flight simulator lends itself well to problems of enrollment management. By shifting concern from class size and faculty teaching load to admission standards; relative pricing, and growth of potential student population, the model can easily be adapted to address a broad range of other academic planning issues (Hermann, J. F., & DeOlden J., 1996).

Solving the problem of quality in higher education can be in effective management of university, which, in turn, can be achieved with the use of modelling in university management.

Next universities' problem is related to the science and researches.

Low research productivity escalated by a vacuum of research funding and research staff. The problem can be solved with a minimum number of publications: A minimum number of publication(s) is mandatory for research students (Masters and PhD) prior to their graduation. Faculty's academic staff with PhD qualifications together with research students constitutes research groups. Every research group in turn manages at least one research project at a time, and the maximum number of research groups a faculty can have is fixed (Oyo, B. at al, 2008). The first step is to hire more faculty members with more focus in research. Graduate studies create a larger capacity for research activities and provide the university with the opportunity to contribute to new facets of science and technology. Increasing research output is an internal marketing job with the faculty as the customer (who is always right) (Vahdatzad, M. A., and Mojtahedzadeh, M. T., 2000).

Both qualitative and quantitative problems of universities are proposed to solve using simulation in university management. One of relevant simulation method for universities is SD method.

Research methodology

Based on literature review and previously developed models analysis, research group (authors) take decision to adapt mentioned models for Riga Technical University needs. On this way the first problem was that there are no 3rd generation university models developed previously. New approach asks for new model and new methodology. This part of paper describes novelty of approach used in Riga Technical University for 3rd generation university model development, as well as shows best parts of previously developed models which are useful for 3th generation university model too.

Structure of the 3rd generation university model

The general structure of the 3rd generation university model is shown in the Fig. 1.

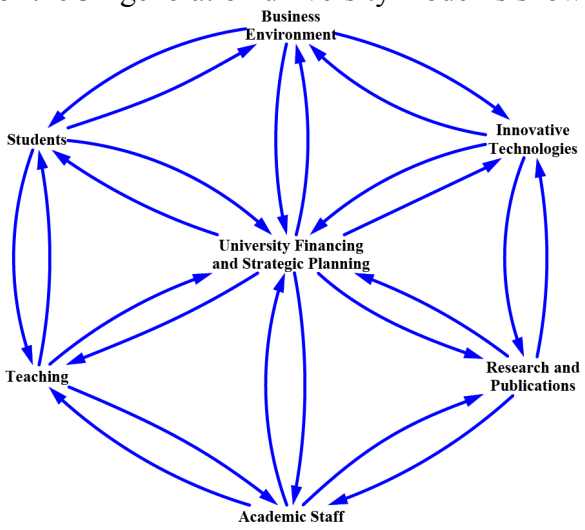

Fig. 1. The general structure of the 3rd generation university model

The general structure of the 3rd generation university reflects the main university participants (students, academic personal), activities (learning, research), their relations, total financing and strategic planning. The conceptual model is based on the idea about an implementation of 3rd generation or 3G university, recognized by the Riga Technical University as a strategic goal based on the interests of different partners and the integration of their roles in the university development.

The approach of 3rd university generation is based on the development not only in the direction of a research organization, but also as a transfer centre of innovative technologies that integrates training, research processes and innovations.

Each model sector has a determined impact on other model elements, but the central role in the model with the biggest impact has the university financing and planning block that defines the long-term development directions of university sectors and departments. A crucial role in the model has the relation between the university and the business environment, research and development (R&D) sector, innovative technology development, external funding attraction. The application of innovative technologies developed at the university is an essential goal of the university activities in addition to the traditional research and educational functions. The creative work and the creativity are an important development driving force and instrument as much as rational research methods.

Components of the 3rd generation university model

The developed model has a relatively complex structure and the relations of its elements; therefore this article describes only the most important components of the whole model.

The first described component (from Fig.1) is the student sub-model. The structure of this sub-model is adapted from Oyo (Oyo, B. at al, 2008). The students sub-model (Fig. 2) includes the system dynamics flows of applicants, admissions per study programmes by analysing performance

and use of sabbatical leaves till the graduation and the further involvement in the scientific and academic work.

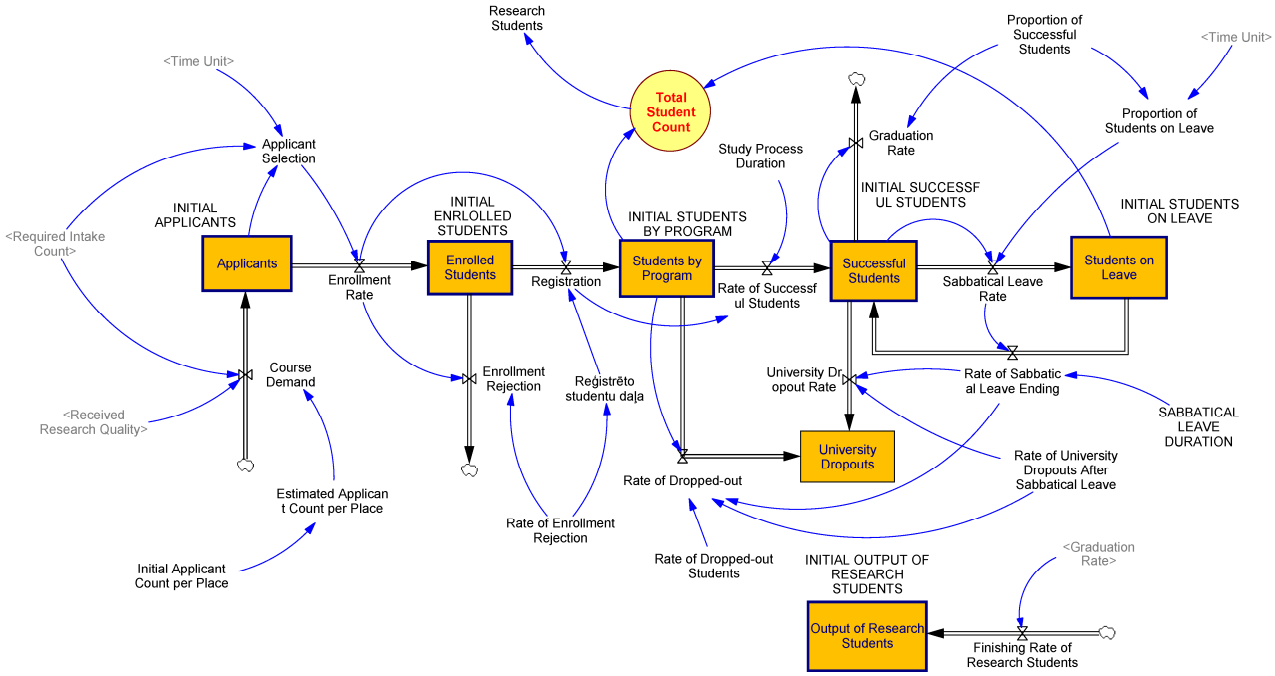

Fig. 2. Student sub-model (adapted from Oyo (Oyo, B. at al, 2008))

As visible from Fig.2, classical student's sub-model stock – flow diagram shows flow from courses demand and application for courses to graduation.

The training (teaching) sub-model (from Fig.1) analyses the relative amount of students and personnel in the university, their impact on the number of the realizable courses, staff load and training quality. On the one hand, 3G university provides higher education services to large masses of people, at the same time, it focuses on the scientific, educational and innovative excellence in providing special opportunities to develop and take the most talented students and academic staff.

The academic staff sub-model simulates the staff reduction due to aging, preparing the next generation of doctors, staff training, experience accumulation and quality improvement. To ensure its activities, the University attracts teaching and research staff, as well as students from different areas.

Science sub-model analyses the number of research projects, the consequent impact and effectiveness of the scientific publications, university research capacity, student involvement in the preparation of scientific publications, its impact on the quality of the final works and studies. The developed model defines the research activities by their nature as interdisciplinary, according to general guidelines for 3G university.

As mentioned above, a significant role in the relationship of science to the business plays the development of innovative technologies. For this purpose, the model implements an innovative production and distribution sub-model (Fig. 3). The innovation unit is implemented based on the classic Bass diffusion model (Bass, 1969).

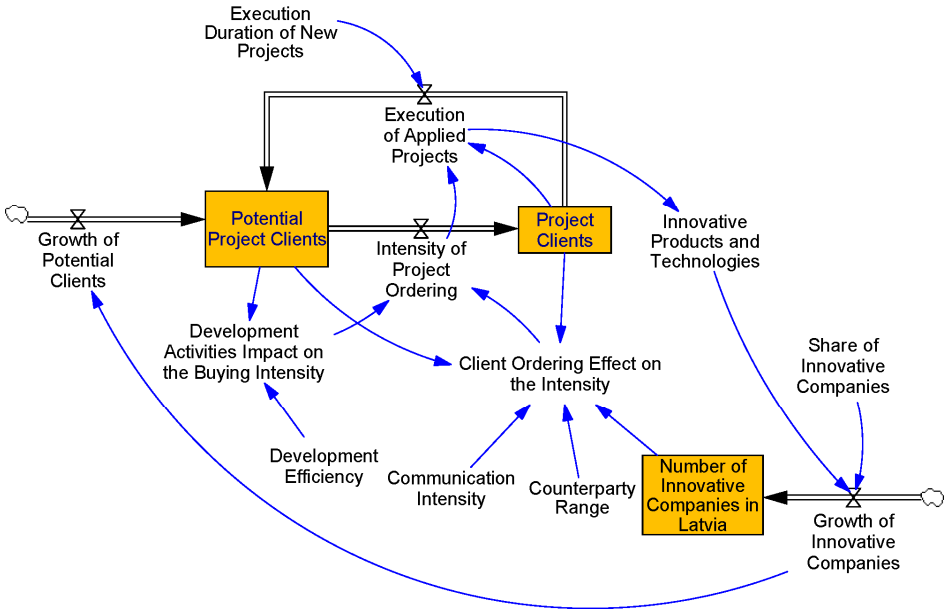

Fig. 3. The innovations sub-model

Based on classic Bass diffusion model, research authors develop innovative production and distribution sub-model. It is main improving, main component of 3G university model. In the sub-model the 3G university activities change number of innovative companies in the country (Latvia). With growth of number of innovative companies, potential researches and innovation customers' amount growth. With time the amount of conducted research and developed innovative products growth. It has influence on all another model sub-models: finances of university grow; academic staff and students' interest in university also growth. Innovative products and technologies is the basis of university competitiveness in 21st century. Universities must develop, accumulate, implement and get benefits from innovative products and technologies.

The financing and strategic planning sub-model (from Fig.1) simulates the university financial flows, revenues and expenses for teaching, learning and research processes, training prices and costs; assesses the capacity of the university, investment needs for the furthers development, for implementation and maintenance of study courses and research projects. This sector is linked to all other blocks in the model, because the university financing and strategic planning defines the existence possibilities of the higher education institutions.

Conclusions

Development of the 3rd generation university model is actual not only for Riga Technical University, but for the entire world. At this moment in the world there is not a fully completed, unified conception of 3rd generation university; accordingly previous was not developed 3rd generation university model. Main value of this paper is development of general scheme of the 3rd generation university model with its components. Authors hope that most of the leading universities implement the third generation university development concept based on the developed scheme.

Analysing practical implementation of developed scheme and developed model, it is concluded, that in some condition development of universities depend on ability to develop and manage innovative technologies. Small countries' universities have the limits of growth. Probably, after 3rd generation university conception development in the world, universities will divide again into high education institutions (or small, local, regional universities) and 3rd generation universities (with research centres and innovation implementation centres). In these conditions Riga Technical University has set a task from being the leading university in Latvia to get position in the top 100 universities in the world by innovation technologies development for university's needs.

Acknowledgements

Travel costs and participation fee for this conference are financially supported by ERDF project „The development of international cooperation, projects and capacities in science and technology at Riga Technical University" Nr.2DP/2.1.1.2.0/10/APIA/VIAA/003".

The presented research was developed based on the RTU research project "Elaboration of the RTU Kipsala complex development concept".

Special thanks to Rita Camane, who was a corrector of English text of the paper.

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