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IN THE 21st CENTURY
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INNOVATION MANAGEMENT AND TECHNOLOGY TRANSFER WITHIN A MODEL OF INNOVATION CENTER AT THE UNIVERSITY POLITECHNICA OF BUCHAREST

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Abstract

Flexibility of services is one of the most important aspects of Small and Medium Enterprises (SME) survival in a crisis economy. Product life cycles are shorter and shorter, SMEs must be able to evaluate the market risks and yet to remain creative and develop their innovation capacity for their products and services. Analyzing the results of a survey among research specialists in engineering (expert interviews which gives the title of another article), the need for innovation and innovation management in the SMEs is significant. These enterprises can be guided (coached) with a new approach. This is a model of an Innovation center, where SMEs, but not exclusively, are guided to identify and manage their innovation potential and supported with valuable know-how in technology transfer from the technical University. The model is new for it has itself a flexible structure and unites the know-how of technology transfer with the entrepreneurial skills of the SMEs. The value of the model developed and applied into the technical Universities is that it is a new instrument for optimizing the innovation management of small enterprises and for helping them to increase the quality of their products and services. Universities have to adapt their provided services to the market and permanently add value to the services provided.
Key words: *flexibility, innovation capacity and management, SME, technology transfer*.

Introduction

The creation, utilization, innovation and transfer of knowledge and technology are having an important role in economy, cooperation between universities and companies is one important way of enforcing innovation processes, although in the latest time the concept of technology transfer might have become a commonplace (Roessner, Manrique, Park, 2010, p. 475–493). The relationships between universities and industries, besides facilitating the best diffusion and transference of new knowledge, can lead to the creation of jobs and increased income when successful, which means enormous gains for these institutions (Chaimovich, 1999). Small and Medium Enterprises (SME), as the core of the economic development – 99% of all European Businesses are SMEs – (European Commission, 2011, p. 2) need to cope with shorter product life cycles and the market risks, and yet to be competitive on market. The Small Business Act for Europe was adopted in June 2008 and reflects the policies of the EU for the SMEs. One of the 10 principles to guide the conception and implementation of policies regards the promotion of the upgrading of skills in SMEs and all forms of innovation (Commission of the European

ISSN 2029-6932

Communities, 2007, p. 14-16). This is the path of EU-project financing, within the EU - project collaboration. On the other hand, the R&D landscape in Romania is not too bright. The number of researchers decreased from 170.000 in 1989-1992 (quite after the revolution in 1989) to only 13.000 in 2011; in the 124 state owned research institutions, according to the National Institute of Statistics, there were 124 state owned research institutes in the year 2010. On the other side, the figures in the private sector increased. And this is the focus of the present study. People are the best asset of an organization, so the investment in human resources is the most valuable. Know-how transfer and knowledge creation by all means are important objectives of all the stakeholders. Apparently state owned research institutions are less competitive as private owned institutions. A new approach and new models (a reference model) are required, to surpass the situation and develop functional research and technology structures.

Problem of Research

One of the problems of technology transfer organizations in Romania is the sustainability of these structures. They are usually established with public financing but innovative approaches for building up and running such a center are essential for persisting and developing and, on a higher level, for economic growth, so financing from alternative sources is vital. On the other hand, a brief analyze of the SMEs reveals that these usually lack a research infrastructure, although they need support in their decision of make-or-buy. High costs of some products which an SME needs as a part of its own production, could lead, if properly transformed into a project, to significant cost reductions and a good price-quality ratio. Based on the management and coordination experience of technology transfer centers (Gross, 2009; Golob, 2006; Bercovitz, Feldmann, 2006), a model of an innovation center will be proposed, strongly service and client oriented, based on the harmonica model (Micu, Alexandrescu, Trifan, 2008, p. 158), which is briefly explained below. The technology transfer is from the research of one or more SMEs. Research is done in a collaborative way with research institutes, or at the University Politehnica Bucharest. Unique selling feature is the fact that the center has the know-how and the experience for the innovation management and programme coordination. One essential point is that the center combines the problem solving approach with the feature of a center of excellence, offering to SMEs instruments to develop their own management capacities and their innovation potential and for elevating the significance of the products or services provided.

The proposed model of innovation center has a high degree of generalization, which can be adapted to any kind of scientific and research activity appropriate to any technical branch, it is actually a Reference Model, as stated in (MacKenzie, Laskey, McCabe, Brown, Metz, 2006). A reference model is an abstract framework for understanding significant relationships between the entities of some universe, and for the development of consistent standards and/ or specifications supporting that universe. It consists of a minimal set of unifying concepts, axioms and relationships within a particular problem domain, and is independent of specific standards, technologies, implementations, or other concrete details.

Taking into consideration the importance of the technology transfer for SMEs and using an IT approach for eventual further digital modelling solutions, a corresponding Reference Model (see Fig. 5) was needed, in order to consolidate the existing models into a consistent whole, to offer a mechanism for enabling the comparison of different systems, to provide a common basis for communication within the researcher community.

Research Focus

Client oriented approach in the field of innovation for SME means to provide customized services with an established structure as long as projects are running and size the structure down, when less or no projects are available. The harmonica model integrates the know-how in the core research fields as well as the management and coordination know-how for optimizing the administrative and personnel costs. A basic team of 1-2 persons is the contact point for new project acquisition and coordinators in case of establishing the project teams. In this way, a highly flexible structure is achieved and the advantage of the basic team is that it maintains the center and is a permanent base for relaunch (Micu, Alexandrescu, Trifan, 2008, p. 158).

Methodology of Research

General Background of Research

The internet research regarding public information about the technology transfer on national level offered only a part of the image. Technology transfer is useful, industry and especially SMEs need it and there are a lot of attempts to get in connection to European information exchange platforms and other networks regarding EU financing for innovation. The public research agencies are in full process of integrating information about all the research projects with public financing into a General Research Register, while the next step is towards certification of the technology transfer centers.

And yet, there many other projects based on public private partnerships, where private enterprises solve specific technical problems, develop new processes and products, conduct research for new patents, recruit university graduates and access cutting-edge research (Abramo, D'Angelo, Di Costa, Solazzi, 2011, p. 85).

Although the higher the technology, the greater the difficulties to market the products, it is a matter of attitude to find a balance between the research activities on a low budget while hoping for better economic opportunities and the focus on those projects for the private beneficiaries. It is a fact that research items don't turn immediately into cash flow, so the acceptance and the reaction is slower than in business (Swamidass, Vulasa, 2009, p. 344)

The trigger for the researching and developing the proposed model, was a concrete problem that had to be solved for a mechatronic device within the Center of Mechatronics, brought up by an SME (Micu, Alexandrescu, Trifan, 2008). Thus, one result of the research and technology transfer was the vibration platform (Micu, Bucsan, Bogatu, Kostrakievici, 2011), on request of the SME. The technical problem was analyzed, a consortium was formed and the research began, in form of a PhD research, with informational input from a medical institution.

Three further examples of technical problems requested by SMEs, turned into projects and solved by the consortium were: a force measuring plate (Micu, Andrei, Bucsan, Bogatu, Comeaga, Kostrakievici, 2010), a length measurement system in orthopedics (Micu, Bucsan, Bogatu, Cristea, 2011) and a special orthopedic device for measuring the reaction force depending on the characteristics of solde materials and ground surface (Vasilescu, Micu, Bogatu, 2011, p 87-96). All the four project examples had as output prototypes, which either had been produced within the requesting SMEs (ideal case, after the technology transfer), or in another place, with additional costs for production.

The triple helix model, as it can be observed in Figure 1, is a spiral model of innovation, that captures multiple reciprocal relationships at different points in the process of knowledge capitalization and denotes the university-industry-government relationship as one of relatively

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equal, yet interdependent, institutional spheres which overlap and take the role of the other. This is a simple model, with small variations, representing the functions of the three actors. During the time, the implications got more and more complex and also the models developed into complex structures with complex functions.

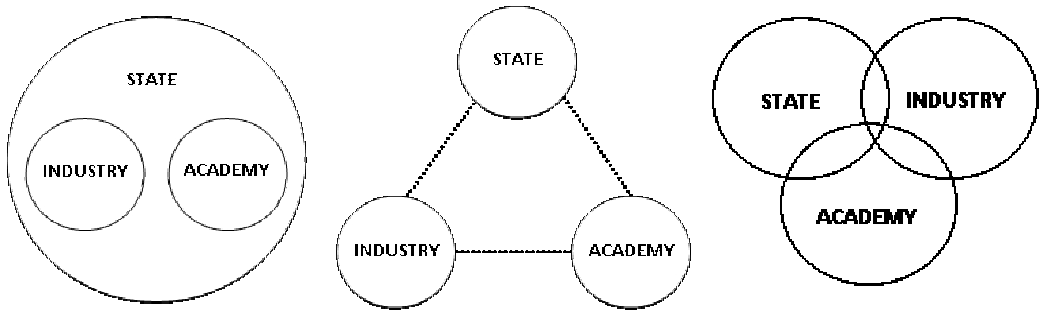

Figure 1: The Triple-Helix of University-Industry-Government Relations (Etzkowitz, 2002).

The first of the three pictures shows a model in which the state incorporates industry and the university. This would represent the Former Soviet Union and some Latin American countries in a previous era, when state owned industries were predominant.

The second picture is the model of institutional spheres separate from each other, which, at least in theory is how the US is supposed to work.

Previous models were about the state dominating the other institutional spheres or the spheres separate from each other, the new model in the third picture shows how the institutional spheres overlap and collaborate and cooperate with each other.

Some structural and management missing links were identified, so the necessity for developing a more flexible new structure, for having a dynamic approach of solving technical problems came up and after looking for existing best practices on national level and not finding them, the model got shape. Some parts and functions of the concept have been experienced during the last ten years, meanwhile the model has been developed, continuously improved and adapted. At this moment, the model is about to be implemented.

Sample of Research

The internet search was done after key words like (technology transfer) AND (university) AND (innovation center), (spin off), (proof of concept), (knowledge transfer), assuming that these entities should be visible, for their aim is to provide research services. In the Journal of Technology Transfer edited by Springer, there have been identified suitable articles (see the Figure 2). Afterwards, key words in Romanian ("centre de transfer tehnologic in Romania" and "transfer tehnologic în universităţi" and "managementul inovării") regarding the technology transfer and innovation management on national level have been sought.

Instruments and Procedures

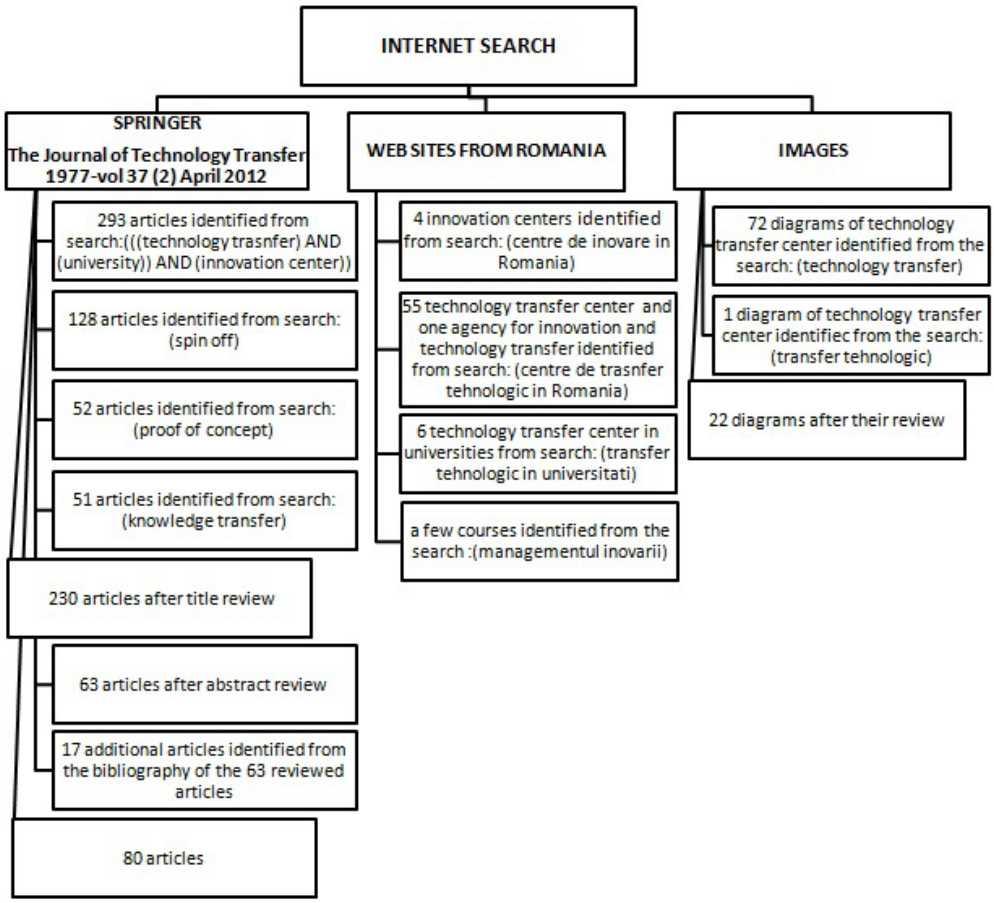

Figure 2: Internet search procedure for relevant information on technology transfer in Romania.

Only one diagram in Romanian language representing a model of technology center was identified, while in English, there are 72 hits. The phenomenon on international level is reflected, on a national level, there is an aggregation process, but information is insufficient.

Data Analysis

Analysing the internet sources and all the provided information in Romanian, the conclusion is for the time being, that there are technology transfer centers in Romania, but the description and the activities are not comprehensible. In principle it is less important that we can't name the precise number of such entities in Romania, but the fact that the aggregation of information, for getting an accurate picture of the phenomenon and understand the right measures to be taken, is ongoing, justifies the focus on this issue and demonstrates the necessity of a reference model of an innovative technology transfer center.

One example of the internet search hits is about the technology transfer centers in the field of mechatronics from Romania, presented and briefly described in Figure 3.

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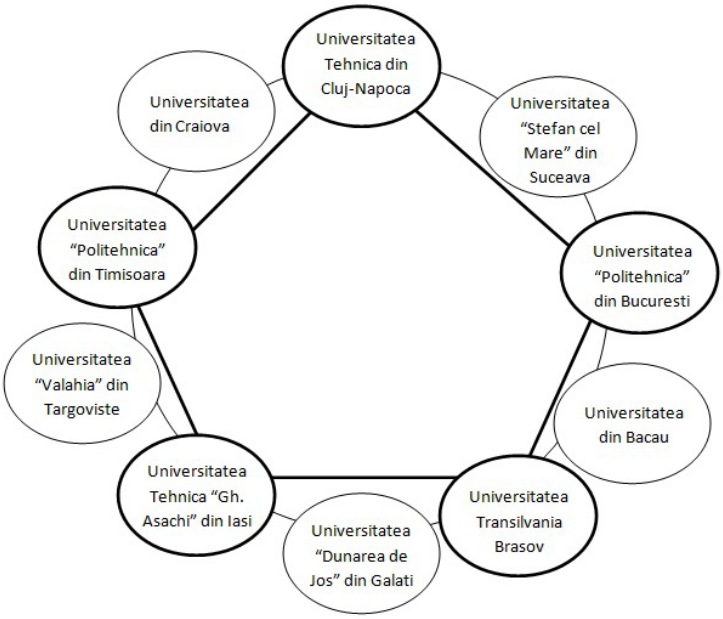

Figure 3: Representative entities with R&D activities in mechatronics (Universitatea VALAHIA din Targoviste, 2006-2008).

On the other hand, world statistics (from 2005 to 2009) offer substantial informations, figures and interpretations about the Field of Technology, especially in mechanical engineering. In Table 1, a total of patent applications in mechanical engineering is shown.

Table 1. Total patent applications by field of technology (WIPO Economics & Statistics Series, 2011, p. 76).

Field of Technology: Mechanical engineering	Publication Year					Growth Rate
	2005	2006	2007	2008	2009	2005-09 (%)
Handling	39,810	40,164	39,241	39,107	40,023	0.1
Machine tools	32,768	32,481	32,038	33,825	36,506	2.7
Engines, pumps, turbines	37,918	36,753	38,218	39,696	44,682	4.2
Textile and paper machines	35,324	34,337	32,968	30,891	29,746	-4.2
Other special machines	42,035	40,546	38,767	40,369	42,592	0.3
Thermal processes and apparatus	22,691	22,521	22,472	23,194	25,738	3.2
Mechanical elements	39,385	38,881	40,473	43,723	43,680	2.6
Transport	60,644	58,892	59,269	61,343	65,526	2.0

An international statistic reference about Romania is among the upper-middle income countries, showing the modest percentage of patent applications, as it can be seen in Figure 4. This demonstrates how much there is to be done in the innovation field on a national level, more investments and incentives for innovative activities would be the proper way to use and develop the existing potential of creativity and innovation management.

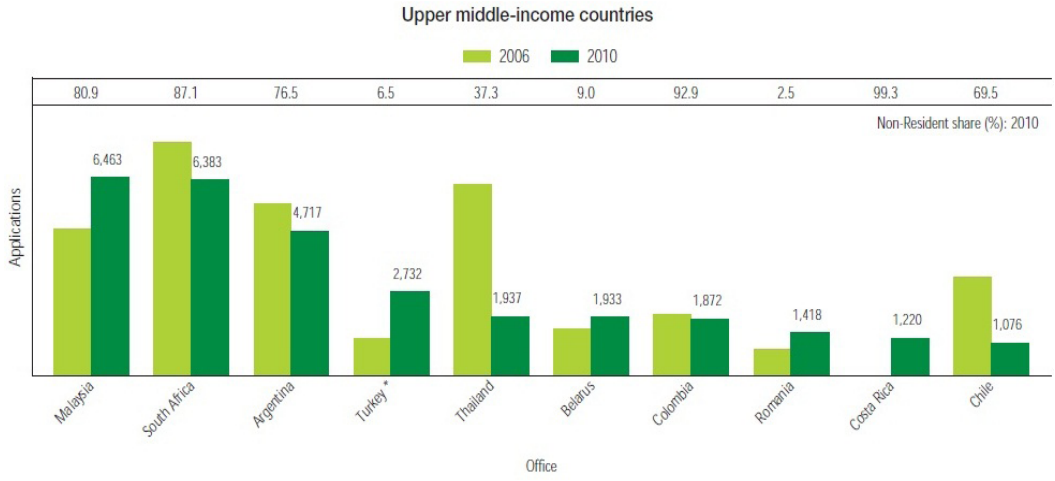

Figure 4: Patent applications at offices of selected middle -income countries (WIPO Economics & Statistics Series, 2011, p 45).

Results of Research

The proposed model of the Innovation Center is presented in the Figure 5. The university research infrastructure addresses mainly the SMEs, who are the beneficiaries. Financing comes from industry or from public funds. Researchers and students or doctoral students as well, are involved in research topics, together with experienced research specialists.

Another issue is the intellectual property management provided by the innovation center. A database about patents, licenses, also publications make the access to specialized information easier. These are the formal university industry technology transfer (Bozeman, 2000, p. 627–655)

After the assessment of all projects by specialist teams, some are prototypes are produced through technology transfer. The differentiation from other transfer centers in Romania is the service marketing, for the center itself, by being practice-oriented.

The additional services provided are the informal technology transfer: technical assistance, consultancy, courses and networking (publications, conferences, fairs, contacts between the institutions and beneficiaries etc.)

Successfully implementation of projects mean a better infrastructure for the Politehnica, during the project, new equipment is acquired.

Another possible output of the system consists of spin-offs (Djokovic, Souitaris, 2008, p. 225–247), in case that new ventures are created. This is a multiplication effect of the center: former members, who were involved in research projects of the center, will be financing as partners possible further projects.

The central pillar of the proposed model is the innovation center, but for a proper work it needs input from university, state and industry. The university provides partly the necessary infrastructure and a part of the personnel (researchers, students and doctoral students) for the center. State offers the legal framework and industry (big and small companies as well) is especially interested in collaborations, in order to bring new products on market or to improve the quality and/or performances of the existing products and for keeping up the contact with the scientific world. Financing comes from the industry, from the university, beside public funds and refinancing.

The Human Resources Department recruits students, doctoral students and provides specialists for the innovation centre, immediately after a new research issue is established. The research results can be published, patented or licensed. The marketing department checks by a market research, if there is a market demand for a certain product, and if there is no demand in that form, the researchers are counselled in new research directions or trained in order to improve the product and make it marketable. If the industry shows interest for the patent, the product will be realized through technology transfer. The role of the marketing department is to promote the product on market and even to induce a need and, to some extent, to create the market. The revenues will finance further activities of the innovation center. Another output of the center is given by conferences and trainings. This fosters the networking and facilitates new contacts and a framework for potential new collaborations. This is a springboard for young professionals to come into the R&D branch and work for knowledge creation.

An essential remark for the reference model of the innovation center is that Human Ressource, Marketing&PR, Financial are not real departments, but only functions. The outstanding flexibility of the model is given by the project management approach, where no unnecessary position is kept, except for the time when projects are running. The project coordinator is building up a team of project managers and each of them builds up the project team for each project and starts the specific project and all the contracts are project-based.

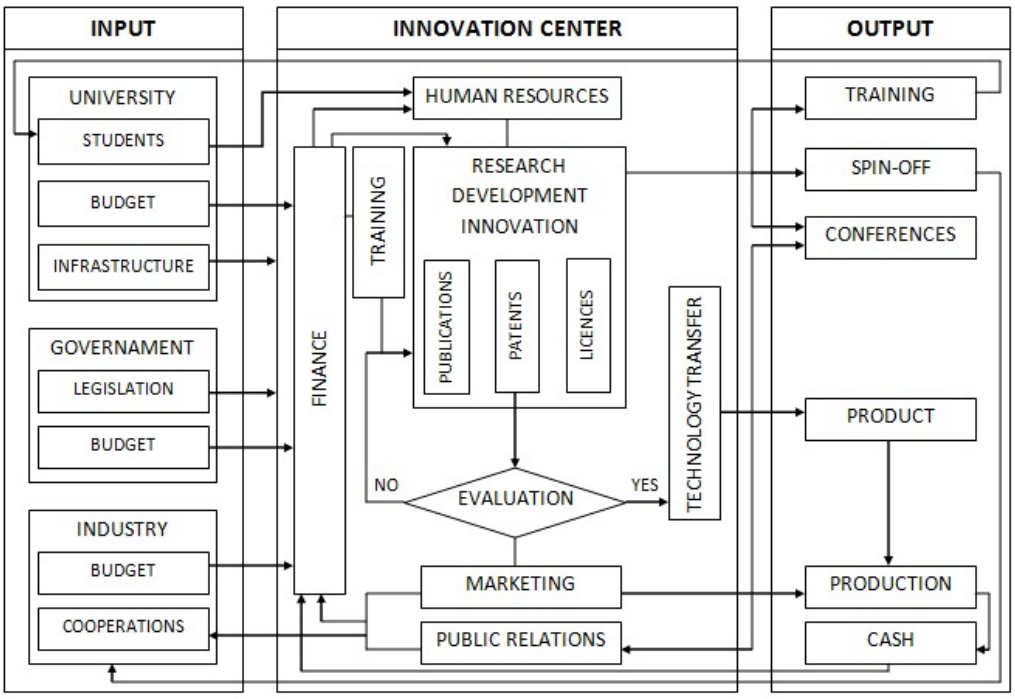

Figure 5: The Model of the Innovation Center at the University Politehnica of Bucharest.

Discussion

One part of our research method, based on internet search revealed a demand for a thorough research of the technology transfer process in Romania and for the aggregation of informations in this respect. Therefore a model of an innovation center was created, strongly service and client oriented, based on the harmonica model. This model is just one part of a more complex study regarding the innovative technology transfer, as it also can be seen in Figures 6 and 7.

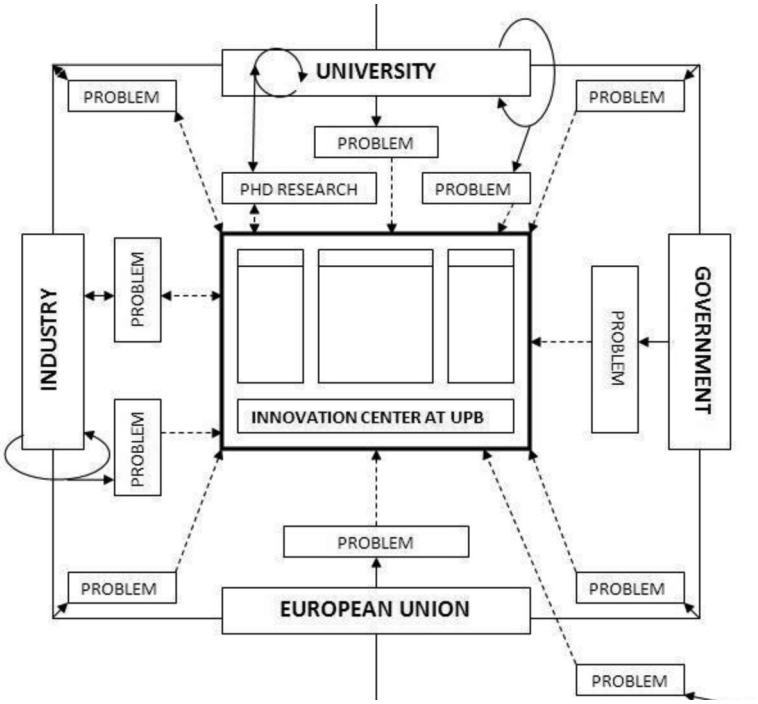

Figure 6: Identification of needs/problems of the different entities and project generation in the innovation center at the University Politehnica of Bucharest.

Technical problems to be solved are inputs to the center and based on the institution type, consortia are formed: public institutions (government and university, two universities, European Union and Universities), private institutions (large or small companies) and the Public-Private-Partnerships (public institutions and private companies). Investments come either from public or from private institutions.

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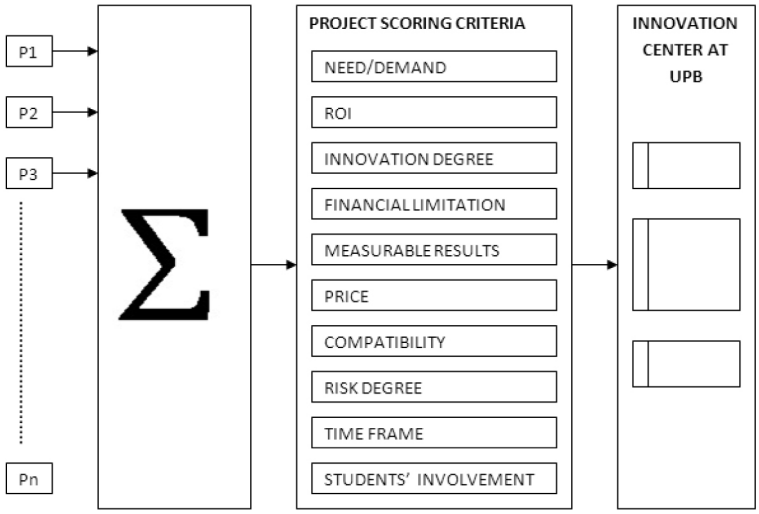

Figure 7: Evaluation criteria of needs/problems and project generation for the innovation center at the University Politehnica Bucharest.

A scoring matrix is build up for project idea evaluation. The needs and/or problems are transformed into projects and based on ten criteria scored from 1 to 10 (1 least, 10 most) these are assessed by relevance, in order to be added to the project portfolio of the center or not. Some criteria (price and degree of risk) get low scoring, when their value is high. Other criteria like Return on Investment (ROI) and Innovation Degree are in direct proportion. Although the analysis is basically ex-ante, some empirical values or estimated values of a branch can help the assessment process.

In both aspects, cooperation between university and company is an important instrument in the generation of science and technology in a country since by splitting costs and sharing risks between the two institutions, cooperative research allows for greater investment in the development of new technologies for products and processes that guarantee greater competitiveness to organizations and the broadening of the scientific knowledge of the nation (Segatto-Mendes, 2001).

Conclusions

The presented model is a strong management instrument especially in a difficult economic situation and is on implementation course at the University Politehnica Bucharest. Beneficiaries of the model are the SMEs, especially through the project coordination, through provided consultancy services and the additional services provided. Marketing & PR is an important department, which has three main functions: to review the market and find out about the customer needs, to make the innovation center visible through campaigns, communication and feed-back to customers and to contribute to the management learning effect for the SMEs. The model has a high degree of generalization and aims to add value to the services for SMEs in supporting them to develop their entrepreneurial skills for a better innovation management. The optimization of the model is a priority for short time research project together with a study about turning it into a best practice model. It is also an opportunity to enforce a new reference model for sustaining the innovative climate and face the challenges through the opportunities of collaboration.

References

Abramo, G., D'Angelo, C. A, Di Costa, F., Solazzi, M. (2011). The role of information asymmetry in the market for university–industry research collaboration. *Journal of Technology Transfer,* **36** (1), 84-100.

Bercovitz, J., Feldmann, M. (2006). Entrepreneurial Universities and Technology Transfer: A Conceptual Framework for Understanding Knowledge-Based Economic Development. *Journal of Technology Transfer*, 31, 175-188.

Bozeman, B. (2000). Technology transfer and public policy: A review of research and theory. *Research Policy*, 29, 627-655.

Chaimovich, H. (1999). Por uma relação mutuamente proveitosa entre universidade de pesquisa e empresas. *Revista de Administração da USP*, *34* (4), 18-22.

Commission of the European Communities (CEC) (2008). *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions (A "Small Business Act" for Europe),* 14-16.

Djokovic, D., Souitaris, V. (2008). Spinouts from academic institutions: a literature review with suggestions for further research. *Journal of Technology Transfer, 33*, 225-247.

Etzkowitz, H. (2002). *The Triple Helix of University - Industry – Government Implications for Policy and Evaluation.* Science Policy Institute Working Paper.

European Commission (EC) (2011). *Report from the Commission to the Council and the European Parliament, COM,* (2011) 803 final, 2.

Golob, E. (2006). Capturing the Regional Economic Benefits of University Technology Transfer: A Case Study. *Journal of Technology Transfer*, *31*, 685-695.

Gross, C. (2009). Technology transfer: opportunities and outlook in a challenging economy. *Journal of Technology Transfer*, 34, 118-120.

MacKenzie, M., Laskey, K., McCabe, F., Brown, P., Metz, R. (2006). *Reference Model for Service Oriented Architecture.* OASIS Committee Draft 1.0, February 2006.

Micu, C. A., Alexandrescu, N., Trifan, L. (2008). CIMEC - The Center for Innovation in Mechatronics. International Conference for *Entrepreneurship, Innovation and Regional Development (ICEIRD)*. Skopje, Macedonia, p. 155-162.

Micu, C. A., Andrei, C., Bucsan, C., Bogatu, L., Comeaga, D., Kostrakievici, S. (2010). *Platforma pentru masurarea fortelor*, Oficiul de Stat pentru Invenţii şi Mărci, Brevet de invenţie nr. RO122876 B1/ 30.03.2010.

Micu, C. A, Bucşan, C., Bogatu, L., Cristea, S. (2011). *Sistem de măsurare a lungimilor în ortopedie*, Buletinul Oficial De Proprietate Industriala, Sectiunea Brevete de Inventie, RO-BOPI 1/2011, din 28.01.2011, pag 12.

Micu, C. A., Bucşan, C., Bogatu, L., Kostrakievici, S. (2011). *Platformă vibratoare*, Oficiul de Stat pentru Invenţii şi Mărci, Brevet de invenţie nr. RO 125205 B1.

National Institute of Statistics (INSSE) (2010). *Time Series about Research, Development and Innovation.*

Roessner, D., Manrique, L., Park, J. (2010). The economic impact of engineering research centers: preliminary results of a pilot study. *Journal of Technology Transfer*, 35, 475-493.

Segatto-Mendes, A. P. (2001). *Teoria de Agência Aplicada à Análise de Relações entre os Participantes dos Processos de Cooperação Tecnológica Universidade-Empresa*. Tese de Doutorado. Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, SP, Brasil.

Swamidass, P., Vulasa, V. (2009). Why university inventions rarely produce income? Bottlenecks in university technology transfer. *Journal of Technology Transfer*, *34*, 343-363.

Universitatea VALAHIA din Targoviste, Facultatea de Ingineria Materialelor, Mecatronica si Robotica, (2006-2008). *Promovarea retelei nationale de mecatronica, în vederea participarii la PC7 si integrarea acesteia în European Research Area – PRO-ERA-PC7*, Proiect finantat prin Programul CEEX, Modulul III, 01.08.2006 – 31.07.2008.

Vasilescu, A. M., Micu, A. C., Bogatu, L. (2011). Experimental determinations of the round reaction force depending on the characteristics of sole materials and ground surface. *U.P.B. Sci. Bull., Series D*, 73 (2), 87-96.

WIPO Economics & Statistics Series (2011). *A7 Patents by field of technology*, World Intellectual Property Indicators, Switzerland, p. 76.

WIPO Economics & Statistics Series (2011). *A2.4 Patent applications at offices of selected middle- and low-income countries*, World Intellectual Property Indicators, Switzerland, p. 45.

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Received: *May 09, 2012* Accepted: *June 19, 2012*

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