THE SUCCESS OF THE AESM EXPERIMENT ON THE ORGANIZATION OF THE DOCTORAL SCHOOL

Eugenia FEURAŞ, univ. prof., dr. hab. AESM

Abstract

This article presents the results of the experiment on the organization and functioning of the doctoral school of AESM, founded by AESM in 2011. These results show the evolution of the PhD candidates' competencies, acquired over the period of doctoral studies, the satisfaction level of the knowledge obtained in the compulsory and optional subjects, the opinion of the PhD candidates regarding the fulfillment of the contract terms by the PhD supervisors and candidates themselves, PhD students' work intensity and their international mobility, etc. The survey results show the high efficiency of doctoral studies organized within the present regulatory framework, according to the European models and good practices.

Keywords: doctoral school, doctoral studies, competencies, the satisfaction level, survey results.

Introduction

By and large, the objectives of Moldovan universities do not differ from those of similar EU institutions and other regions of the world: a better relationship between higher education, research and innovation, greater publicity of research results and training in public space, strengthening the links with the real economy, efficient management of institutions.

The differences concern the institutional system that moves creakingly on the path of reforms and a lack of best practices that would ensure efficiency and effectiveness at all levels of education, including higher education at the third cycle - doctoral studies.

AESM is committed to reducing the deficit of good practice related to training highly qualified specialists through establishing the Doctoral School of AESM in 2011.It focused on the application of European mechanisms for organizing doctoral studies while taking into account existing national restrictions, such as reduced state funding, rigid registration tax, prohibitive NCAA rules, specific mentality of PhD supervisors and doctoral students.

In spite of many criticisms of us, and despite the fact that for all these years AESM has subsidized doctoral training, even if actual training costs are much higher compared with the budgetary funds allocated and the tuition fee for those with private funding, we have tried to be consistent in achieving goals.

In order to assess the results of the experiment, in 2014,the PhD students were asked to fill in an anonymous questionnaire. Data were collected during the International Symposium of Young Researchers, during which doctoral students were required to show maximum sincerity being assured of non-transmission of information that would prejudice their status in any way.

As the end of the analysis of data collected and processed we have come across a series of indicators that identify successes and problems that the doctoral school AESM has faced for those 3 years of experiment, which are grouped into the following categories:

1. General characteristics and motivations.
2. Inputs and outputs of professional experience.
3. Development of skills obtained during doctoral studies.
4. Satisfaction with knowledge obtained from compulsory and optional subjects.
5. Opinion on the fulfilment of contract commitments by PhD supervisors and doctoral students themselves.
6. Intensity PhD students' work and their international mobility.
7. Doctoral students' satisfaction with information and material and technical infrastructure of AESM, as well as the services offered by the doctoral school.

1. General characteristics and motivations

Given the structural aspect, more than ¾ of doctoral students are young people aged 26-35 years, i.e. people with greater creative potential. Secondly, they are predominantly female persons (55%), which is a deviation from the general trend of male domination enrolled in doctoral programs. Thirdly, the PhD students are mostly married, and almost every second PhD student has children, which is another deviation from European and international practice, where most doctoral students are single and have no children. This information shows that the time pressure on doctoral students is high: it comes from professional activity, research activity, but also from the family, especially if the family has children.

The survey-based composition of doctoral students by scientific specialties was asfollows:

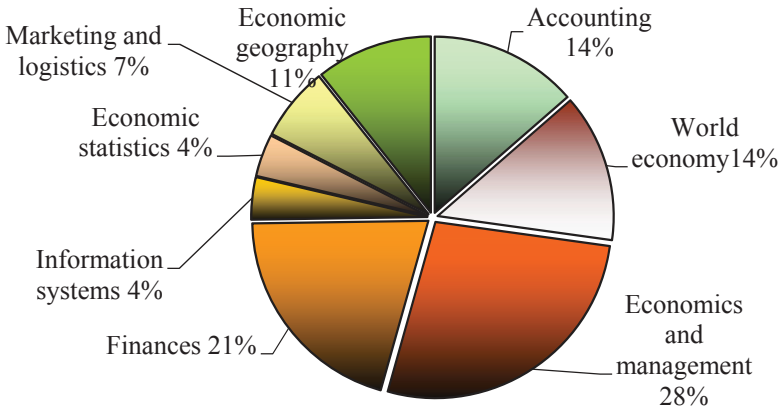

Figure 1. The survey-based composition of doctoral students by scientific specialties, %

Of all doctoral students surveyed, 60% were enrolled on tuition fee basis and 40% were financed from the budget. Thus, **the burden of expenditure on research is supported by 2/3 of PhD students.** The same proportion is maintained regarding the form of study: 60% of respondents were full-time students and 40% - part time. It should be noted that in European countries there is a trend of decreasing the share of part-time doctoral students, since doctoral studies require a significant and continuous effort from PhD students, thus determining their full-time enrolment.

The difference between the newly entered doctoral students who chose doctoral studies upon their obtaining Master's Degree and those having work experience is not striking - 43% against 57%. This report shows the existence of incentives for those who work or were employed to pursue their studies. The PhD students selected their motivations as shown in Figure 2.

Therefore, **AESM doctoral students are ambitious people, 1/3 of them desiring a career advancement and 1/5 – promoting own ideas**. However, the number of those who chose civic orientation is not smaller either - **¼ want to do something for society and obtain social recognition**. As PhD students know well that developing a doctoral thesis requires a colossal effort, translating into insignificant gains for holders of scientific title, the share of those who have decided to pursue their studies in hopes of getting more income is very low - 5%. Higher earnings can be obtained only through career advancement; this criterion is a double incentive for doctoral students: psychological and monetary.

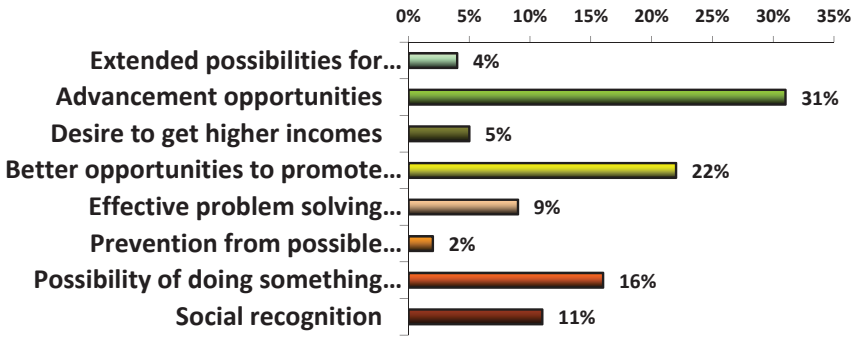

Figure 2. Motivations determining to pursue doctoral studies, %

2. Inputs and outputs of experience

Since 57% of PhD students have had work experience, it is interesting to know which activities they perform making them choose doctoral studies. No less interesting it is to know which path the PhD students will take after completing doctoral studies. The table below answers these questions:

Table 1. Professional inputs and outputs of doctoral studies

Previous Work Experience	Type of activity	Further field of activity
	Research institutions	**5**
36	**Higher education institutions**	**29**
17	**Public organizations**	**26**
47	**Private organizations**	**33**
	Activity abroad	**7**

Data from table 1 show that **about half of the doctoral students came to study from the private sector and one third of them will return there. The second of those inputs refers to institutions of higher education: a great part of these people intend to stay in the education system, but under the condition of combining teaching with work in public or private institutions**. The number of those who intend to work in scientific research institutions is very small; 7% of PhD students have the intention to experience the phenomenon of "brain drain".

An important moment related to the efficiency of doctoral studies is the degree of correlation between the theme of PhD thesis and students' professional activities. In this context, the situation at AESM is good: **9 out of 10 PhD students mentioned a very high and rather high degree of correlation.** In the view of the Likert scale, data are presented as follow:

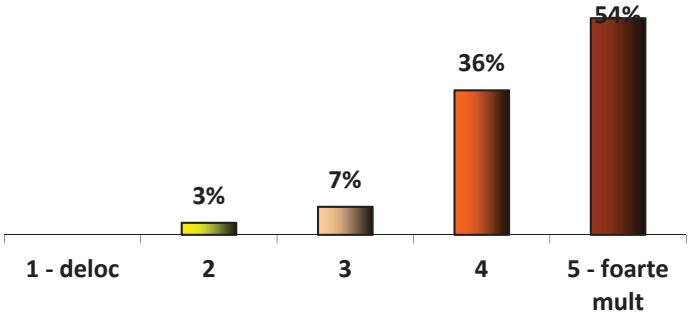

Figure 3.The degree of correlation between the PhD thesis and current professional activities, %

What is worse is the doctoral thesis status. **More than half of PhD students develop initiative-focused doctoral theses, with a share of10% of them written within international projects and the share of 36% of those written within national projects**. The high proportion of initiative-focused themes shows increased financial costs of developing a thesis and lower possibilities for disseminating the research results.

3. Evolution of expertise obtained during doctoral studies

The Doctoral School of ASEM was the first in Moldova to implement the system of doctoral studies as learning modules. To assess the effectiveness of organized courses, students have been asked to assess themselves the level of expertise at the beginning and after the first year of doctoral studies (courses are held during the first year of doctoral studies and evaluated with 60 ECTS). The responses have enabled us to notice the following evolution of expertise acquired, according to the Likert scale:

Table 2. Evolution of expertise obtained during doctoral studies, %

Areas of expertise	Evaluation	1	2	3	4	5
Theory	ex-ante	-	12	33	48	7
	ex-post	-	-	18	46	36
Research methods	ex-ante	-	14	36	50	-
	ex-post	-	-	15	46	39
Generic skills	ex-ante	4	7	21	50	18
	ex-post	-	-	4	46	50
Language skills	ex-ante	-	-	40	30	30
	ex-post	-	-	18	38	44
IT literacy	ex-ante	-	7	18	43	32
	ex-post	-	-	4	41	55
Research ethics	ex-ante	-	11	30	44	15
	ex-post	-	-	7	33	60

The table data shows a visible improvement of expertise. The scale 2 was exceeded by all doctoral students, with the share of reaching level 4 ranging from 33-46% and that of level 5 ranging from 36-60%. Significant progress has been reported in such expertise areas as research ethics, generic skills, theory and research methods. IT and language skills have shown a modest progress.

4. Satisfaction level of the knowledge obtained in subjects taught

The learning modules covered compulsory subjects and four sets of optional subjects. To assess the quality of courses taught and their need for doctoral training, the questionnaire included questions on satisfaction level of knowledge obtained, according to the Likert scale:

Table 3. Satisfaction level of the knowledge obtained in compulsory subjects, %

Compulsory subjects	1. unsatisf.	2	3	4	5 very satis.
1. Information technologies in economy	4	4	7	55	30
2. Advanced Microeconomics and Macroeconomics	-	8	8	50	34
3. Advanced econometrics	4	8	16	36	36
4. History and methodology of economic research	-		1	36	53
5. Foreign language	-		23	27	46
6. Specialtysubject	-		1	15	74

Table 4. Satisfaction level of the knowledge obtained in optional subjects, %

Optional subjects	1.unsatisf.	2	3	4	5 very satis.
1.Project management	-	-	4	33	63
2. Ethics and science communication	-	4	4	33	59
3. Financial management of scientific research	-	-	15	45	40
4. Internationalization of scientific research	-	-	21	37	42
5. Time-management	-	-	5	29	66
6. Intellectual property law	-	-	6	38	56
7. Career management	-	-	10	45	45
8. Leadership and teamwork	-	-	9	27	64

The table data shows a higher **satisfaction level of optional subjects compared to the compulsory ones**. On the one hand, this can be explained by the fact that the optional courses are of shorter duration than the compulsory ones, thus inspiring less boredom. On the other hand, the information obtained is an important signal to teachers that give compulsory

courses: there is a need for improvement of course content taught, teaching methods and assessment techniques.

5. Opinion of PhD students on the fulfilment of own contractual commitments and those made by PhD supervisors

An extremely important moment in the efficient and successful completion of doctoral studies is the fulfilment of commitments set out in the contract between the PhD supervisor, PhD Student and doctoral school. Of all obligations of the parties in the questionnaire were included the most important aspects, the PhD students' opinion being expressed as follows:

Table 5. PhD students' opinion regarding the fulfilment of contractual commitments by the PhD supervisor, %

Satisfaction level	1 poor	2	3	4	5 excellent
1. Thesis expert	-	-	-	15	85
2. Control of the activities carried out regularly in the development of thesis	-	-	-	19	81
3. Assistance in conducting research	-	-	-	19	81

If we compare these two tables, we can see that the PhD students are quite self-critical, recognizing that they fulfil their contractual obligations worse than the PhD supervisors do. Thus, over 80% of PhD students consider that the satisfactory level at which the PhD supervisors fulfil their obligations is "excellent", which is reached only by 37-52% of PhD students. Problems arise especially in conducting research on schedule, which translates into very low rate of defending doctoral theses in due time, as well as regular reporting of activities performed in the thesis, which affects its quality.

Table 6. PhD students' opinion regarding the fulfilment of own contractual obligations, %

Satisfaction level	1 poor	2	3	4	5 excellent
1.Conducting research as scheduled	-	-	19	44	37
2. Regular (quarterly) reporting of activities carried out in the development of thesis	-	-	19	33	48
3.Discussing with the scientific advisor of the theoretical and methodological issuesthat arise in the development of thesis	-	-	7	41	52

A factor with a decisive impact upon the efficiency of doctoral studies **is PhD students' work intensity**–what amount of time is allotted to writing the doctoral thesis as purpose of doctoral studies. According to the responses obtained, **nearly half of PhD students - 46% devote less than 2 hours a day to this activity,** 43% - 3-4 hours, 7% - 7-8 hours and only 4% - more than 8 hours a day. In fact, 8 hours per day must be the amount of time spent on a long the doctoral studies and no exception should be made for a small number of students or for a relatively short period.

In recent years, international mobility has become the factor of increasing the efficiency of doctoral studies. Unfortunately, the lack of sufficient financial means, family issues, current professional activities and insufficient knowledge of international languages have determined **half of ASEM PhD students not to have any internship abroad**. The other half took advantage of internships in the following areas, represented in Figure 4.

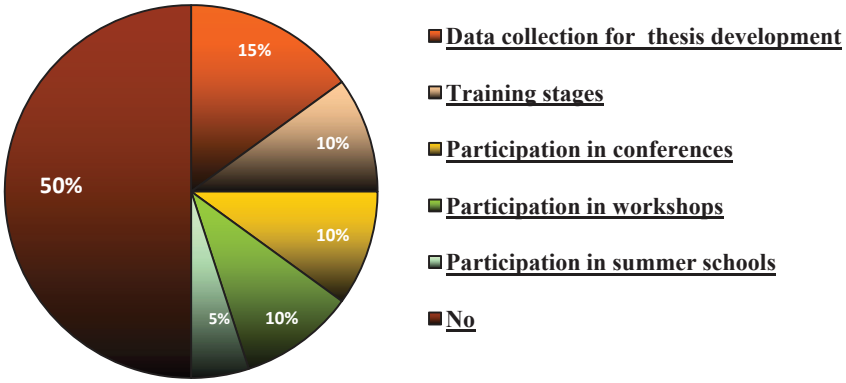

Figure 4. Types of international internships performed by the ASEM PhD students

Therefore, within information and training-focused internships, the PhD students have been able to take advantage of both participation in conferences, and participation in workshops. No less important are the conditions under which doctoral studies are conducted. We refer to research infrastructure quality and the quality of services provided by the doctoral school. In this context, the satisfaction level of PhD students is as shown in table 7.

Table 7. The PhD students' satisfaction level of the infrastructure provided by AESM, %

Indicators	Yes	Partially	No
PhD students' satisfaction level of material and technical infrastructure provided by ASEM, %	**82**	**18**	**-**
PhD students' satisfaction level of information infrastructure provided by ASEM, %	**61**	**36**	**3**

The data confirm a higher level of material and technical equipment of ASEM and several drawbacks regarding provision with information. One reason would be temporary disconnection from international databases due to outstanding payments to be made by other institutions, subscribed to data systems, rather than ASEM.

Table 8. PhD students' satisfaction level of services provided by the ASEM doctoral school

Indicators	1unsatisf.	2	3	4	5 fully satisf.
Guidance and counselling services are efficient	-	-	-	**19**	**81**
The problems that arose were resolved promptly	-	-	-	**19**	**81**
The doctoral studies coordinator presents the required information in due time	-	-	-	**4**	**96**

The above-mentioned information entitles us to consider that AESM's experiment of organizing and conducting doctoral studies has been successful and effective. Our next step is to prepare the provisional authorization of the AESM Doctoral School's operation and implementation of the stipulations laid down in the Regulation on the Organization of Higher Education Doctoral Programme, 3d cycle, developed by the Ministry of Education of the Republic of Moldova.

CONTRIBUTION OF RENAM TO INFORMATIONAL SERVICES DEVELOPMENT FOR HIGHER EDUCATION AND RESEARCH

Petru BOGATENCOV (RENAM), Ion COVALENCO (ASEM, RENAM)

Abstract

The transition of the traditional science and higher education to e-Science and e-Education is fueled by the ever increasing needs to have access, process and visualize of exceedingly large amounts of data that can't be managed without modern communication and computing instruments. In the past years the European Commission has funded, through a number of targeted initiatives, creation of specialized eInfrastructures for providing IT services to research and educational communities to support collaborative research and education. In Eastern Europe, including in Moldova the existing resources of eIfrastructures are less developed than in Western Europe (ANTUN BALAZ, et. al., 2011). Advancing the Information Society, strengthening of the local eInfrastructures, activating new user communities, enabling access to modern educational content and technologies, to new instruments for collaborative research, would strongly contribute to closing the existing gap, and thus bridging the digital divide, stimulating research and consequently alleviating the brain drain in the region. At present the main facilities like Research and Educational networking infrastructure for effective data exchange, access to large-scale computing and other e-Infrastructures services is rapidly increasing in Moldova. eInfrastructure designates a new generation of integrated ICT based infrastructures and is widely considered as a key enabler of research and education development.

Keywords: Research and educational networks, computing infrstructures, e-infrastructures and services

Introduction

The term e-Infrastructure refers to a combination and interworking of digitally-based technologies, resources, communications, and organizational structures needed to support modern, international leading collaborative research. Such infrastructures are oriented to support a distributed medium based on high-bandwidth networks, distributed computing Grid, HPC, scientific Cloud resources and respective data repositories. Nowadays e-Infrastructures provide researchers electronic resources accessible on a 24-hour basis, regardless of the place, and is a unique tool for the development of collaborating applications. Modern e-Infrastructures require tremendous data exchanges and respective communication bandwidth.

Eastern Europe countries including Moldova are developing national e-Infrastructure platforms consist of networking and computational (Grid, HPC, Cloud) facilities, electronic libraries, scientific data repositories, etc. Taking into account European models, National Research and Educational Network (NREN), National Grid Initiative (NGI) and HPC users' association have been established in Moldova, which are actively participating in the regional and pan-European projects, including initiatives focused on integration in pan-European e-Infrastructures. There are many qualified research teams intensively using computational and data resources provided at national and European levels.

The main aim of this article is to introduce the status of e-infrastructures in Moldova emphasizing on networking and available computational facilities, e-services and international collaboration. The overview of network infrastructures operated by the NREN RENAM and the computational and storage resources provided by the coordinated by NREN National Grid Initiative are introduced including its collaborations with the pan-European research and education network GÉANT (GÉANT pan-European research and education network, 2014), European and regional Grid, HPC and Cloud infrastructures (EU FP7 EGI-InSPIRE project, 2014). The key research applications and services are presented covering a wide range of scientific disciplines, such as particle physics, life sciences and computational chemistry, earth and climate sciences, economical behavior, computational engineering, etc.

1. Research and educational networking infrastructure and services

European Commission started deployment of common research and education Pan-European networking infrastructure with the aim to unite all research and educational institutions in Europe since 1993. At present research and educational networks are considering as basic element for other components of modern e-Infrastructures development.

In Moldova NREN RENAM (Research and Educational Networking Association of Moldova) was established in 1999. Main activities of RENAM are developing taking in account experience of other European NRENs and consist of:

- constant development of communication and informational infrastructure and modern high-capacity communication media;

- providing access to the national and foreign scientific databases and organizing access to scientific publications and educational informational content;
- National R&E network now is capable to interconnect all principal research, educational, medical and cultural institutions and to provide them with Internet access, e-Learning, e-Science, distributed and high performance computing and other services.
- Creation and development of basic infrastructure (nodes and highways) of Nation-wide scientific-educational networking backbone and providing a stable mutual access to national and foreign information resources;
- Elaboration and implementation of new eInfrastructure technologies, services and information resources in order to ensure a high level of educational processes, investigations and close interaction with the European and the world scientific and educational community.

The main functions and services that are supporting by NREN in Moldova summarized in the Fig. 1.

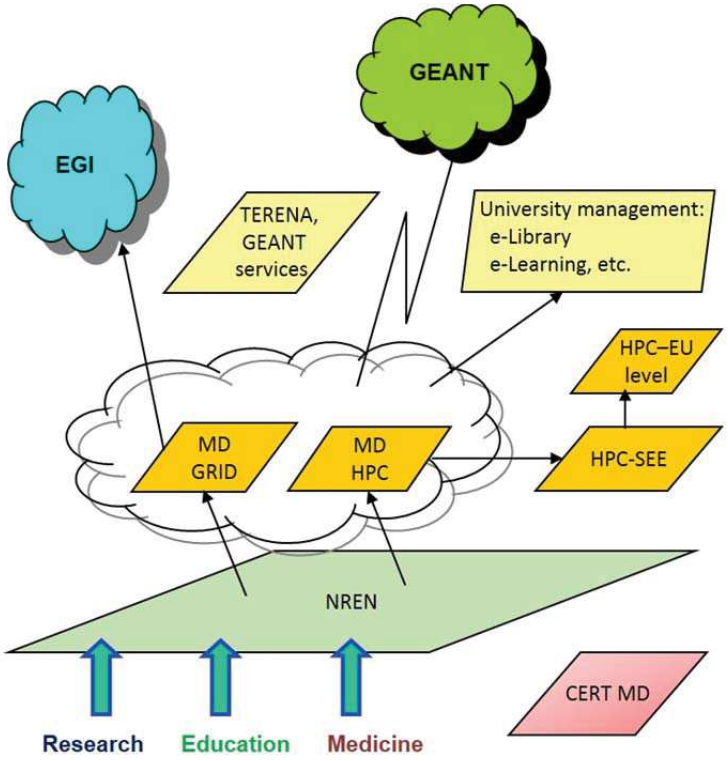

Figure 1. Operational structure and main services of NREN in Moldova.

For research and educational community in Moldova, networking infrastructure that also offering Internet access was established in 1998-2000 within several initiatives supported by a series of national and international projects. Now RENAM network consists of fiber-optic communication channels that uniting institutes of the Academy of Sciences of Moldova

(ASM), leading universities and other national scientific - educational institutions. For users from research and educational community implemented and developing a variety of technologies and services (AAI, mobility, access to computing resources, etc.) (BOSTAN I., et. al., 2014).

A modern network infrastructure is one of the basic components of e-Infrastructure that is supporting the requirements of e-Science and e-Education. For the network level it is crucial to possess high performance and scalable advanced infrastructure operated by NRENs for the sustainable development and implementation of new services. As a preferable solution from the initial stage of network design we considered optical fiber based networks that have a wide variety of network deployment approaches and technology choices. Such networks ensure the fixed cost of the use of the infrastructure and at the same time provide scalability up to Tbps, as the network grows.

Research, educational and medical institutions have supported the foundation in 2006-2007 of the National Grid Initiative, which was created with the aim to develop and maintains of the distributed scientific computing infrastructure for processing large amounts of data.

Mobility technologies, big data, virtualization and cloud computing is rapidly changing requirements for NREN infrastructure and utilized communication technologies. One of the most important conditions for building distributed information processing and high-performance computing systems is the presence of high-speed and reliable access channel to access networked resources. For this purpose at the national level is using RENAM network infrastructure, which unities informational resources of the ASM and leading universities in the integrated information processing complex with access to the Internet. RENAM network topology represents three-tier architecture. The first level is local networks of universities' campuses, organizations and institutions. The second level is the optical network for connection access nodes (points of presents, with bandwidth 1Gbps and more) that linking local networks of research institutes and universities to RENAM network backbone. The third level comprises the central communication node that provides access to the Trans - European Academic Network GEANT (see Fig. 2) via the main external fibre optics channel Chisinau - Iasi (with scalable bandwidth up to 3*10 Gbps). Creation and putting in operation in 2010 of the fibre optics channel for access to the GEANT network was realized in the framework of international projects SEE-GRID-SCI (funded by the European Commission) and NIG 982702 - New RENAM-RoEduNet gateway based on CWDM technologies implementation (funded by NATO).

European Commission supported some initiatives to investigate the status of NRENs from organizational and technical points of view in Eastern Europe and propose the appropriate approaches for their further development. In 2006 - 2007 NRENs from Eastern Europe region were involved in the EC project "Distributed Optical Gateway from Eastern Europe to GÉANT (Porta Optica Study - POS)" (Porta Optica Study project, 2008), which aimed at the analyzing of the most suitable approaches for realization of regional optical infrastructure that could be further integrated to Trans-European Academic network GÉANT. During the project realization a detailed study of possible solutions to build fiber

optic infrastructure for connecting R&E networks of the Eastern European countries to GÉANT network was performed. In the project were developed recommendations build a number of cross border connections that will unite neighbor NRENs, determined principal ways to organize connection of elaborated regional infrastructure to GÉANT via Points of Presence in several countries. In 2011-2013 a new feasible study of research e-Infrastructures development in the Eastern Europe countries was performed in the framework of CEENGINE project (EU FP7 CEENGINE project, 2012).

In both projects formulated utilization of "Dark Fibre" (DF) paradigm was suggested as the most appropriate solution for NRENs optical infrastructures implementation. This concept should be well understood in order to properly evaluate the economic aspects of such infrastructure development. Fibre acquisition and operations involve new cost categories that have to be recognized and added to the economic model of operations of fibre based NRENs. In addition, the economical assessment should be done for long term – DF is usually a long-term acquisition and should be evaluated as such. NRENs DF interconnections, so called Cross Border dark Fibre – CBF concept, is now widely used by European NRENs for optimization of GÉANT optical backbone construction.

Figure 2. RENAM network - current state of national and international connectivity.

One of the successful examples of the elaborated CBF connections realization was the project of DF link implementation between NRENs of Romania and Moldova. Integration of NREN of Moldova to the regional Research & Educational networking infrastructure has begun in 2001 when cooperation with Romanian NREN RoEduNet was established and the first joint project "RENAM-RoEduNet networks direct link and gateway construction" was elaborated and submitted to NATO Networking Grants Programme. The project was successfully realized in 2003 and since this time access to GEANT resources for Moldovan NREN users is carrying out through Romanian NREN. Basic conditions of external connectivity development for NREN of Moldova through RoEduNet are determined by the following principal documents:

- RENAM–RoEduNet Agreement that determines the policy of direct RENAM – RoEduNet connection utilization and stipulates parameters of RENAM access to GEANT infrastructure. The first release of the Agreement that had been signed in 2002 was based on available connection parameters offered by radio-relay technology; the Agreement was renewed in 2006 and in the second version were reflected perspectives of the optical connection construction and utilization;
- The adopted list and specification of external routes elaborated during EC "Porta Optica Study" project (contract number 026617) realization (Porta Optica Study project, 2008).

In 2007 RENAM and RoEduNet jointly submitted application to DANTE (Delivery of Advanced Network Technology to Europe, located in United Kingdom) - GEANT network operator. This document indicated the parameters of the RENAM network traffic capacity that can access GEANT network through RoEduNet.

RENAM and RoEduNet elaborated argumentation and technical solution of fiber optic communication link creation for support of regional scientific and education cooperation and providing access to GEANT network for research and educational communities of Moldova. The funding of the link practical realization was supported within European Commission SEE-GRID-SCI project and necessary funding of the optical communication equipment procurement was provided by NATO Committee on Science for Peace and Security joint project entitled "New RENAM-RoEduNet gateway based on xWDM technologies". The DWDM based solution was implemented for permanent operation of the created optical link.

RENAM together with other NRENs from countries included in the Eastern Partnership Programme (EaP) initiated in 2012 dialogue with EU experts having the aim to investigate possible solutions for integrating EaP region to GÉANT and support of potential project elaboration focused on regional research and education network creation. An examination performed by the expert team from GEANT focused on determining the resilient and cost effective technical solutions for deploying regional optical network infrastructure that would unite all EaP countries. Special attention devoted to finding solutions of effective integration of EaP networking infrastructure to GÉANT. The various approaches of the EaP regional network infrastructure development and its integration to GÉANT were discussed. Fig. 3

presents schematic view of the whole regional network architecture proposed in the Concept Note of the new regional E@P.connect project.

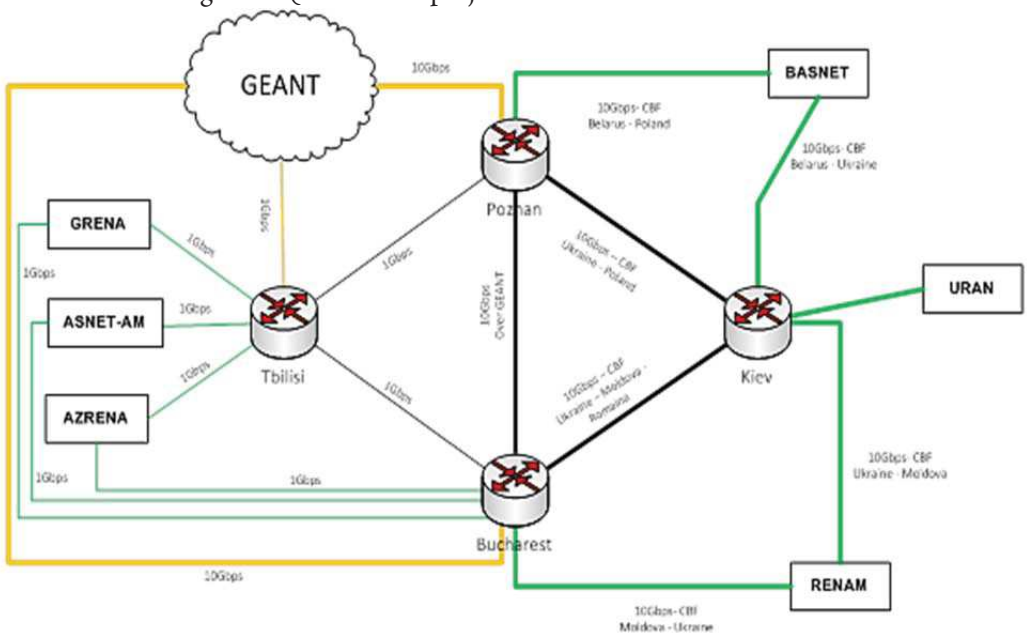

Figure 3. Schematic view of the regional network architecture.

2. Computing infrastructure and services

Modern Scientific Computing infrastructure is based on using parallel architectures specialized on running complex applications and integrates the following components:

- HPC - Clusters' systems;
- HPC - Supercomputers;
- Distributed computing infrastructures – Grid and Scientific Clouds;
- Libraries and software packages for parallel algorithms design and programming
- Instruments for complex applications development and porting.

Historically in Moldova, the first scientific computing resources had begun developing from the initial deployment in 2006 of the first Grid cluster that was integrated in the regional South-Europe Grid infrastructure. Since this time Moldova is actively involved in regional and European programs for cooperation in the field of scientific computing (PETRU BOGATENCOV & GRIGORE SECRIERU, 2012). European institutions are paying significant attention to new initiatives for the development of high-performance computing infrastructures, resources and technologies to support development and execution of complex parallel applications. In recent years, several initiatives have been launched, aimed at creating of supercomputer centers and their integration into a common European HPC infrastructure. Taking in account the significant investments in creating of high-performance computing

infrastructures in Europe, currently main attention is focused on designing and implementation of instrumental support for rising effectiveness of unique computing systems use. Coordination of activities in this area is carried out within the European initiatives like PRACE project (Partnership for advance computing in Europe) that having the aim to create a unique HPC ecosystem. This ecosystem has to bring together providers of computing resources and diverse users' communities - from research, educational institutions, specialized software companies as well as from small, medium and large enterprises - consumers of computational experiments results. HPC ecosystem includes several levels of HPC installations depending on their performance and mod of utilization. On the top, "zero" level (Tier-0) are located supercomputing resources of the world leading supercomputer centers. HPC facilities available in Moldova taking in account it real capacity at present are corresponding to Tier-2 level representing HPC centers of research institutes and universities.

Important for Moldova was participation in the regional project HP-SEE (High-Performance Computing Infrastructure for South East Europe's Research Communities) that allowed for local research and educational institutions to get access to regional HPC resources. Regional HPC infrastructure combines powerful HPC clusters and various supercomputers provided by the project participants from five countries involved in the project: Greece, Bulgaria, Romania, Hungary and Serbia. Regional HPC infrastructure is heterogeneous - includes supercomputers and clusters based on Intel/AMD CPU and GPU. HPC resources that are offering to users' community included also two supercomputers IBM Blue Gene/P installed in the Bulgarian Supercomputing Center of the Agency "Electronic Communication Networks and Information Systems" and in the Western University of Timisoara (Romania).

During HP-SEE project realization in Moldova have been identified and proposed for implementation several technologies and tools for offering access to advanced computing resources and services that developing in the South-East Europe for researchers from Moldova. Members of the project from Moldova participated in a series of specialized trainings organized within HP-SEE, LinkSCEEM-2 and PRACE projects. For providing access for developers and users of complex applications from scientific and educational institutions of Moldova in the framework of HP-SEE project in 2012 was signed the Cooperation Agreement between RENAM and computer centers in South-Eastern Europe. The Agreement determines conditions of providing access to the regional high performance computing resources that comprises more than ten high performance systems.

HP-SEE project achieved its aim to strengthen scientific cooperation and to promote activities in the field of high performance computing. As a result, it contributed to regional development and involvement of Moldova into the European HPC resources development trends.

In May 2010, the Academy of Sciences of Moldova and RENAM Association had signed a Memorandum of Cooperation with the Joint Institute for Nuclear Research (Dubna, Russia), which related to cooperation in the field of joint development and use of HPC and

distributed computing infrastructures. In the Memorandum determined wide spectrum of joint activities including elaboration and preparation for execution of complex applications that can be launched for running on remote high performance computing resources. This Memorandum strengthened cooperation between researchers from different countries and created conditions for solving complex problems without the need for scientists to travel to resource centers for getting access to computational resources and perform the necessary calculations.

Support of international projects allowed to begin forming national high-performance computing resources in Moldova. In the State University of Moldova was installed high-performance computing cluster with parallel architecture. Multiprocessor clusters were deployed in the Institute of Mathematics and Computer Science of ASM and in RENAM Association.

Distributed computing infrastructures and service are very important component of the modern scientific-educational eInfrastructures. Historically the first distributed computing infrastructure deployed in Moldova was Grid computing infrastructure - a specific e-Infrastructure element, which provides remote access to distributed computing power. Grid infrastructure is able to offer:

- Joint use of computing resources
- Access to distributed data storage resources
- Shared access to large experimental facilities and remotely controlled experiments
- Creating a distributed experimental facilities and resources
- Automatic retrieval of data and resources in the network
- Promoting cooperation and joint implementation of projects.

In 2013 in Moldova began activities dealt with deployment of the scientific cloud infrastructure. Development of scientific clouds is rather new, but perspective direction of computational technologies development. For SEE region needs in cloud technologies deployment were analyzed during execution of SEERA-EI project funded by European Commission ERA-NET Programme. The analysis produced had shown strong interest of the regional research communities in use of scientific clouds computing resources. As a resulting outcome of SEERA-EI project was recommendation to launch regional Pilot Call for projects in the area of scientific cloud computing.

Another important initiative for Moldova that combines analysis of optimal solutions and practical deployment of regional scientific cloud infrastructure is the regional project "Experimental Deployment of an Integrated Grid and Cloud Enabled Environment in BSEC Countries on the Base of g-Eclipse (BSEC gEclipseGrid)" supported by Black Sea Economic Cooperation Programme (http://www.blacksea-cloud.net). The aim of this project was to select middleware for implementation of computing architecture that provide a collaborative, network-based model that enables the sharing of computing resources: data, applications, storage and computing cycles. Special outcome of the project was introducing a federated Cloud infrastructure, which can provide different solutions for universities, scientific and research communities and more.

Next stage of distributed computing infrastructure development is focused on realization of the perspective approach of combining the Grid and Cloud resources together as a single

enhanced computational power and offer the possibility to use Grid or Cloud resources on demand. As an example, if the user requires parallel computational resources, he will submit a job on the Grid, but if the user needs any specific software or environment to solve some special problem, access to distributed data repositories, he can use a dedicated Cloud service or virtual image for this purpose. This united platform will make possible to solve the following problems:

- increasing the effective usage of computational resources;
- providing additional different services for scientific and research communities;
- close collaboration between different countries to solve common problems.

The general scheme showing the evolution of the integrated computational infrastructure in Moldova presented in fig. 4.

As perspective development of cloud services we considering further development of the cloud infrastructure with implication computational resources of the all institutions connected to NREN. This will allow to select and unify basic services, effectively realize and deliver them to all interested research and educational institutions. As basis services that have to be unified and adapted to use in common cloud infrastructure we considering electronic libraries catalogues, e-libraries access, universities management systems, learning management systems (like Moodle, Sakai, etc.), information system for national research projects support. The mentioned list of unified services is opened for development and new services can be implemented and provided by using cloud resources. To simplify and unify the access to all services offered by common computing infrastructure will be used federated principles – instruments of the National Identity Federation can ensure users' authentication and authorization procedures.

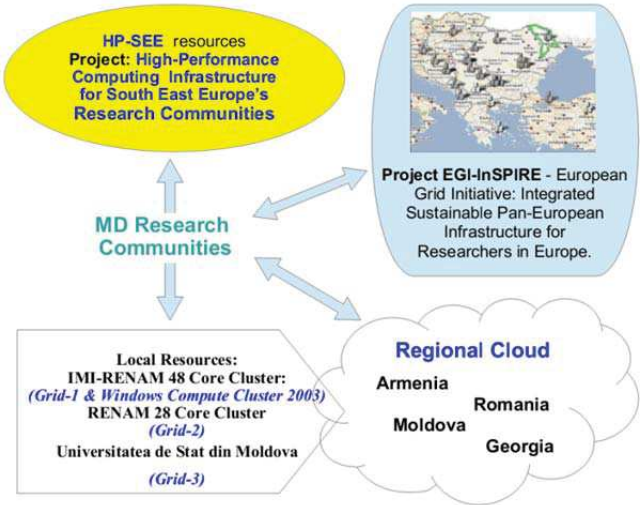

Figure 4: The evolution of the HPC, Grid and cloud infrastructures in Moldova

For management of computing infrastructures at the national level in each European country had been set up organizational structures liked National Grid Initiatives (NGI). MD-

Grid - National Grid Initiative of Moldova was officially inaugurated on the plenary session "National Grid Initiative MD-Grid: presentation and inauguration" of RENAM Users Conference – 2007 on May, 14 2007 after receiving approval letters from Ministry of Information Development of Moldova and the Academy of Sciences of Moldova (http://www.grid.md). To create MD-GRID NGI used organizational model of the Joint Research Consortium (JRU) develop and recommend at the European level. The MD-Grid NGI Consortium governed by RENAM as the coordinating body joins 10 research, education and industry institutions that expressed their intent to participate in the processes of National computing infrastructure building and using. Several new scientific and educational institutions have expressed interest in the future to join the MD-GRID NGI.

The main activity directions of the created in Moldova National Grid Initiative are summarized as followed:

- MD-Grid NGI participates in strategic European Programs for the development of eInfrastructures. The operation of the MD-Grid NGI implements the general EU policy on the development of national initiatives for the coordination of actions related to eInfrastructures and especially to scientific computing infrastructures.
- Integration of scientific computing actions (infrastructures, middleware and applications) with the broadband network into a standard e-Infrastructures system. The optimization of exploitation of advanced network resources and services, which can serve the new e-Science generation and will attract the greater users' community of the information society to the mass adoption of advanced e-Infrastructure services.
- The permanent development and administration of the National computing infrastructure.
- The organization access for national users' communities to the regional and European computational resources (HPC, Grid, scientific clouds, etc.).
- The educational and training events organization; the technological support of national users' communities.

MD-GRID NGI operates the National Center for issuing digital certificates – Certification Authority (CA), which serves as a local CA and process registration requests for the issuance of certificates for Moldovan scientific and educational institutions (VALENTIN POCOTILENCO, et. al., 2009). MD-Grid CA operates under the auspices of the European Certification Center EUGrid-PMA and uses its rules and procedures for issuing digital certificates (EUGridPMA - Building Trust for Distributed IT Infrastructures for Research, 2014). Taking into account the importance of national infrastructure for authentication and access authorization (AAI), to ensure the provision of safe access to national and international computing and information resources, the existing Certification Authority is preparing procedures for issuing new certificates, which must meet the requirements of the research and educational organizations of Moldova in deployment of users' identity management systems.

3. Support of training and rising awareness of e-infrastructures users

User support and training is an important issue for the success of the implementation of parallel and distributed computing technologies. Organization of trainings for the developers of parallel applications in remote mode (online) is a relatively new approach for Moldova. To achieve this goal was produced the analysis of various open source Learning management systems, which can be used for development and use of the interactive tutorials in on-line mode. Were analyzed software packages and systems that implementing the following remote training and learning technologies:

- human networking support and distance learning;
- on-line interaction between research groups (for closed groups);
- Systems of Web-conferencing.

As a platform for Web-conferencing was selected and deployed Big Blue Button (BBB) tool, which allows integrating third-party applications, in particular networking tools and distance learning systems. After studying the variety of distance learning packages, the interest was focused on Sakai and Moodle Learning Management Systems. For organization of computing infrastructure users' trainings in the State University of Moldova and in the Institute of Mathematics and Computer Science of ASM were installed two selected open source software packages: Sakai and BigBlueButton. Integrated software toolkit allowed to organize the environment for research groups' communication. Trainers received comprehensive tool to prepare educational curricula, to support the interactive multimedia learning process and means for on-line delivery of learning content.

Another important element that enhancing eInfrastructures users' literacy is organization of certificated education. NREN of Moldova together with universities – members of the Association is actively involved in promoting of specialized IT trainings and certified education. At present to eInfrastructures users' communities available and fruitfully developing certificate education organized by CISCO Academy and Microsoft Academy training programmes. Established contacts and started negotiations of certificate training organization in Moldova with Oracle University and Juniper Networks Certification Program.

Conclusions

The rapid development of information technologies directly contributes to the development of research and educational processes. New technologies significantly influence to the quality of specialist preparation and their adaptation to real working environment. This paper is summarizing experience of propagation of new information technologies and their wide utilization by creation and development of basic networking and computing infrastructures in Moldova.

Participation of NREN in e-Infrastructure components development and operational support is very important for keeping their services portfolio updated and attractive for users' community. From other side these activities influence on modernization of basic networking

infrastructure, requiring redesigning of the network and implementation of new architectural solutions. NREN is staying in touch with community need when follows modern trends in new e-Infrastructure components and services realization.

In many cases, implementation of distributed e-Infrastructures requires international cooperation that includes efforts of many NRENs for uniting resource's providers from different countries and creation dedicated networking segments for complex e-Infrastructure components operation. This is why development of modern e-Infrastructures is considering as motion power for basic networking infrastructure and international connectivity development.

For organization of e-Infrastructure components operation at national level, it is important to create clear rules and organize cooperation of various teams responsible for networking and computational components maintenance and development. We consider that NREN personnel have to be engaged in preparation of users' community to utilize effectively new services and resources. For achieving its goals this activity requires close interrelation with connected research and educational institutions, computational resources providers, finding experiences teams and persons that can and ready to share their skills with other community members, prepare own specialists employed in NREN that can support and train end users. That will allow overcoming existing barriers – sometimes users not ready to use eInfrastructure services and possible opportunities because considering it rather complicated and requiring extreme efforts from them. Only realization of the whole set of measures for making access to eInfrastructure resources more easier will allow to make new e-Infrastructure services more attractive.

Another promising direction of services development is using of Cloud resources that are creating as a part of the national, regional and in perspective - European Cloud computing infrastructure. National scientific Cloud infrastructure can interact with National Cloud infrastructure for e-governmental services that developing in Moldova in the framework of the M-Cloud project. This will allow offering additional computing resources for demanded and convenient IT services deployment at the national level.

References

BOSTAN, I., TIGHINEANU, I., SECRIERU, G. and BOGATENCOV P. (2014) RENAM - collaborative e-infrastructure for research and education in Moldova. "Networking in Education and Research", Proceedings of the 13th RoEduNet IEEE International Conference, Chisinau, Moldova, 11-12 September, 2014, pp. 31-35. ISSN-L 2068-1038

Development of Grid e-Infrastructure in South-Eastern Europe. / Antun Balaz, Ognjen Prnjat, Dusan Vudragovic, et.al. (2011), J. Grid Comput. 9, 135, 22 p., DOI: 10.1007/s10723-011-9185-0.

EU FP7 CEENGINE project, (2012) [Online], Available from: http://www.ceenet.org/posts/ceengine/ [Accessed: 18th December 2014].

EU FP7 EGI-InSPIRE project (2014) [Online], Available from: https://www.egi.eu/about/egi-inspire/ [Accessed: 11th March 2015].

EUGridPMA - Building Trust for Distributed IT Infrastructures for Research, (2014) [Online], Available from: https://www.eugridpma.org/ [Accessed: 12th February 2015].

GÉANT pan-European research and education network (2014) [Online], Available from: http://www.geant.net [Accessed: 12th March 2015].

BOGATENCOV, P. and SECRIERU, G. (2012). Calculul Performant: Oportunități şi Perspective pentru cercetare. Revista de Ştiinţă, Inovare, Cultură şi Artă "ŞTIINȚĂ ŞI INOVARE" (AKADEMOS), Nr. 1 (24), Chisinau, ASM, pp. 64-69; ISSN 1857-0461.

Porta Optica Study project, (2008) [Online], Available from: http://www.porta-optica.org/ [Accessed: 16th January 2015].

POCOTILENCO, V., ALTUHOV, A., BOGATENCOV, P. and SIDORENCO, V. (2009). MD-Grid CA: New security service in Moldovian grid infrastructure. "Networking in Education and Research", Proceedings of RoEduNet International Conference, 8th Edition, Romania, Galati, December 3-4, 2009, pp. 44-46.

FUNCTIONING OF THE KNOWLEDGE TRIANGLE IN THE EXAMPLE OF IT EDUCATION

ZHIVITSKAYA H., LUKASHEVICH M., SMIRNOU V.

Belarusian State University of Informatics and Radioelectronics
The Republic of Belarus, Minsk

Abstract

The analysis of the interactions between knowledge triangle components in IT-education in the Republic of Belarus is described. This paper describes the results of research in the framework of the program of the European Union Tempus IV «Fostering the Knowledge Triangle in Belarus, Ukraine and Moldova» - «FKTBUM». The analysis of the obstacles to the effective integration of higher education, research and innovation is performed.

Keywords: knowledge triangle, information technologies, research and development, innovation

1. Introduction: Knowledge Triangle (in IT education)

Belarusian State University of Informatics and Radio electronics is a major educational and scientific complex. BSUIR scientific schools of thought are recognized leaders among national and international computer science and radio electronics centers, which allows us to offer state-of-the-art postgraduate programmers and to successfully promote fundamental and applied research. BSUIR offers state-of-the-art laboratories and training facilities, enabling to implement scientific research in all relevant areas.

Commitment to innovative education and development technologies, state-of-the-art training and research facilities, experienced faculty - all this is what makes us train highly qualified specialists with innovative thinking, ready to contribute to the high technologies and who are highly sought after by employers.

Today the University includes 10 faculties, 40 departments, the Institute for Information Technologies, the Research and Development Department comprising 56 scientific laboratories and research groups, 7 centers, including 2 multiple-access centers and a Research and Development Centre for Industrial Energetics and Automation.

The University personnel is 2193 persons. The faculty consists of 750 full-time lecturers, including 350 conferees. The student body exceeded the number of 15,000.

2010 saw the introduction of the first national IT Business Incubator.

On December 24, 2010 the University quality management system was certified for the international quality management standard ISO 9001-2009 and for the German TGA quality management system DIN EN ISO 9001:2008.

On May 26, 2011 the University was certified as a Scientific Organization by the National Committee for Science and Technologies and the National Academy of Sciences.

BSUIR graduates are not only highly skilled specialists, but also polimaths and active society members, intellectuals and patriots ready to contribute to development of Belarus.

Education. There are 54 higher educational institutions in the Republic of Belarus, where 46 are the state ones and 8 are private. According to the Nation-wide qualifier of the Republic of Belarus by OKRB-011-2009 "Specialties and Qualifications", 22 HEIs are specialized in «Equipment and Technologies" (educational codes are 32 - 68).15 HEIs are specialized in IT "Informatics and Computers" (educational code 40).

BSUIR is a leader in training of IT specialists and has all courses in "Informatics and Computers" (educational code 40).

Education is provided in cooperation with research organizations and also with leading industrial enterprises. Research work at the universities is performed according to agreements with regional enterprises with involving students into such work. Scientific developments of the teachers and researchers of the universities are used in educational process as well in solution of applied problems of the enterprises.

Interaction schemes of interaction between knowledge triangle participants:

university + enterprise = joint laboratory

university + enterprise = branch of department

university + enterprise = education center

university + research institution = branch of department

university + research institution = joint laboratory

Researches. There are several scientific and research organizations, where BSUIR graduates can work, including The National Academy of Sciences of Belarus organizations (The United Institute of Informatics Problems, Institute of Applied Physics, Institute of Mathematics, Institute of Heat and Mass Transfer, Institute of Physics). Besides, some HEIs have their own research laboratories, which also need IT graduates.

Innovations. There are two sectors of enterprises, which can be employers for BSUIR IT-graduates:

- public sector (OJSC "AGAT – Control Systems", JSC "MPOVT", JSC "INTEGRAL", JSC "Peleng", "Horizont", Scientific Research Institute of Computers, Minsk Electrotechnical Plant named after V.I.Kozlov, JSC "KBTM-OMO", JSC "Amkodor-Belvar", etc.);
- private sector (EPAM Systems, iTechArt Group , Itransition JSC, Qulix Systems, ABA IT Park, Samsolutions, ISoft Solutions, Softech Flesh Solutions, Numerical Methods, etc.).

The ideal knowledge triangle in IT education is presented in figure 1.

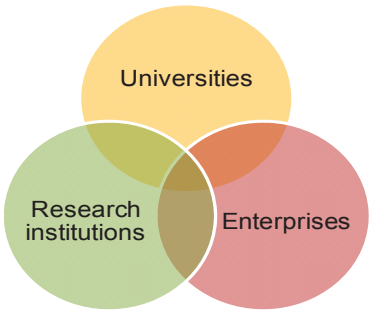

Figure 1. The ideal knowledge triangle in IT education

2. Situation in the Republic of Belarus (in IT sector)

2.1. General information about the existing Knowledge Triangle

There is a lack of time to adapt all innovations, which IT companies require to the IT graduates, into educational programs. So, education sector sets a task to give fundamental knowledge of a number of basic disciplines and to give opportunities for studying of actual technologies in cooperation with Hi Tech Park. Creating of joint laboratories with the real sector of economy companies allows studying students according to the actual directions in the IT industry.

Nowadays BSUIR, with a grate number of the IT graduates, is closely cooperating with Hi Tech Park. BSUIR rector is a member of Hi Tech Park Supervision Council, which selects the residents and projects and coordinates the main activities in Hi Tech Park.

Regular round tables are organized with participation of education and Ministry of Education representatives to show the interest in cooperation between the IT industry and profile IT faculties of Belarusian higher education institutions. Within these actions the current problems of student`s education for IT sector and possible ways of these solving are discussed. Such round tables help to generalize the cooperation experience between companies and HEIs, to discuss ways of further joint actions.

The researches, conducted in 2014, showed that over the last 10 years export of computer services considerably grew in Belarus. And if the companies don't have difficulties in finding new customers, there is a question of providing these services with qualified personnel. The demand of IT specialists with different skill level exceeds supply three times more.

Close cooperation with the IT companies bridge theoretical students' knowledge, university graduates and practical skills.

2.2. Short description of the existing most significant legal, organizational, financial and personnel frame conditions Knowledge Triangle

In 2014, 1076 graduates of the Belarusian higher education institutions were employed by Hi Tech Park companies (which is 18% more, than in 2013). 78% of young specialists studied free, which raised a question of graduate placement. Traditionally about 40% of young specialists employed by Hi Tech Park come from Belarusian State University of Informatics

and Radioelectronics (faculty of computer systems and networks, faculty of information technologies and control) and from Belarusian State University (faculty of applied mathematics and informatics).

Graduate placement is organized according to Regulation on distribution, redistribution, and job referral, graduate placement after finishing undergraduate and graduate programs, specialized secondary education and vocational studies. New term "basic organization" appeared in Regulation in 2011. The basic organization has the privilege when higher education specialists, specialists of specialized secondary and vocational education are assigned. Commission for the Distribution had to distribute graduates to the state organizations and the organizations with the state share of property in authorized capitals earlier, now "basic organization" is a wider concept, it can be both joint-stock companies, and residents of Hi Tech Park, and the same budget companies. If there are several basic organizations, their needs of experts are provided one by one, depend on the dates when Cooperation Agreements were signed.

Very important issue (High Tech Park proposal) is to work out new requirements to some positions. This moment, requirements by the current legislation are stated in the classification reference book of positions "Service positions of any kind of activity" and consist of general information. New requirements are planned to systematize specialist requirements depending on concrete knowledge area and level. The reason is the increasing problem of qualification confirmation in labor market for citizens of the Republic of Belarus. After development of the qualifications description, higher education institutions will be able to correct training process to know precisely what students need to study.

3. Target concept of Knowledge Triangle functioning in the Republic of Belarus (in IT education)

Knowledge Triangle in IT education includes University, as the organization, which prepares specialists, the IT company, as the organization for which specialists are intended and the joint research laboratories. There are two main tasks of joint laboratory activity: conduct the researches/approbate new technologies in various areas of information technologies, embed the results in university educational process and also embed research laboratory results in business processes of software development in the company.

Successful example is joint laboratory BSUIR-IBA, which won prestigious award of IBM company – IBM Faculty Awards in 2012. BSUIR was one of three higher education institutions among the CIS countries which won this award.

4. The existing conditions of educational, scientific and innovative activity integration in the Republic of Belarus

Belarus is creating the acceptable conditions to implement the closest educational, scientific and innovative activity integration between three directions.

The following tendency is observed in IT: curricula become outdated quickly, and higher education institutions can't train the graduates, who can start develop software immediately,

without additional preparation. Therefore education sets task to study fundamental disciplines firstly (algorithmization and data structures, mathematical disciplines, etc.) and to give various opportunities for studying the most relevant technologies in cooperation with Hi Tech Park.

Nowadays BSUIR, with a grate number of the IT graduates, is closely cooperating with Hi Tech Park. BSUIR rector is a member of Hi Tech Park Supervision Council, which selects the residents and projects and coordinates the main activities in Hi Tech Park.

According to the dev.by research, BSUIR is the main provider of the IT graduates (40 % of employees).

Hi Tech Park tries to support IT faculties of Belarusian higher education institutions to improve the quality of education in the sphere of information technologies. Regular round tables are organized with participation of education and Ministry of Education representatives to show the interest in cooperation between the IT industry and profile IT faculties of Belarusian higher education institutions. Within these actions the current problems of student`s education for IT sector and possible ways of these solving are discussed. Such round tables help to generalize the cooperation experience between companies and HEIs, to discuss ways of further joint actions. It is evident that the issues are very serious and, it is a challenge that can only be met by us all together.

Hi Tech Park pays special attention to staff development, who are involved in the process of training in higher education institutions, and, as a result, holds the training seminars regularly. But there is still a problem of lecturer's shortage, who have not only fundamental theoretical knowledge, but also practical skills. The reasons are the lack of prestige and small salary.

Belarus started long and difficult process of qualifications national system development last year. The main project is to create the professional standard in IT which coordinates Hi Tech Park.

Sectorial council, which included the leading IT companies, Ministry of Labor and profile higher education institutions, coordinates professional standards and qualifications. Hi Tech Park resident companies are interested in professional standards and qualifications development. First of all, each IT company has its own requirements for qualification of employees and they are significantly different from each other. If education institutions will have qualifications requirements, they will be able to correct training process. Sectorial council is developing qualification requirements for two most famous professions in IT sector now; it is software developer and tester.

5. Performance requirements for triangle knowledge in the Republic of Belarus

5.1. Functional requirements: description of specific requirements for particular organizations needed to meet the goals set in section 3

Organizations are subject to the following functional requirements necessary to meet the goals:

1. Legislation and regulatory system should at least not impede the functioning of triangle education – research – innovation, and at most create favorable conditions for active cooperation between its members.

2. Heads of educational institutions and managers of enterprises should be aware of the importance of creating favorable conditions for the functioning of triangle knowledge and understand its internal organization and mechanisms needed.

3. The enhancement of synergies between members of triangle knowledge requires enough financial support and information resources, especially at first, when cooperation has just launched. The implementation of innovative projects also requires enough support.

4. Teaching burdens should be reduced to 400 – 600 hours/year to ensure full involvement of the university academic staff into innovative projects.

5. A sufficient number of business analysts in scientific and innovation research is required, which leads to the necessity of creating retraining opportunities in this sphere.

6. The pay gap between educational and industrial sectors (according to the economic sector) should be reduced. The pay should at least be no more than 1.2 times higher in industry than in education. Salaries paid in the educational sector should ideally even exceed those paid in the respective branch of industry.

7. A significantly greater flexibility in the creation of study programs (educational standards, curricula of specializations and disciplines), as well as much simpler procedures of their inspection and approval, are required.

5.2. Non-functional requirements: ways to meet the goals set in section 3 for particular organizations of triangle knowledge

1. In the sphere of education, research and innovations, a special milieu should be created to make it economically beneficial for organizations to participate in the functioning of triangle knowledge.

2. Both tangible and intangible incentives should be created for managers, who take active part in the system education – research – innovation.

3. The discussed issue should arouse sustained interest and important events should have a wider coverage in mass media and other information sources.

6. Requirements to the future conditions of integration of educational, research and innovation activity in the Republic of Belarus

Personnel and financial conditions: The university, as well as the academic and research structures on its base (joint laboratories and educational centers) should be more attractive for the top professionals in this sphere.

Therefore, it is reasonable to reduce the workload of the academic staff to 500-600 academic hours in order to stimulate them to conduct research in the IT sphere.

Besides, top professionals of IT companies should be engaged to work part-time in joint laboratories.

Reasonable is also to explore the possibility of granting more autonomy to universities following the experience of western European universities and providing a number of tax

advantages, for instance extending the benefits enjoyed by residents of the High-Tech Park to universities so as to allocate funding for scientific research projects and higher salaries of high-qualified teachers.

The academic staff should also have a wider range of opportunities for internships in foreign IT companies, research centers and universities.

Equally important is to engage students in the work of joint laboratories, especially for fulfilling study projects, following the example of MIT Media Lab (Massachusetts Institute of Technology).

Legal conditions

In order to ensure the successful cooperation of triangle knowledge, the legal framework should be created/expanded both at the local level of the university or an IT company, and at the national level.

The legal framework should deal with the following subject matters:

1) greater autonomy of universities (national legal acts).

2) tax advantages for universities (national legal acts).

3) regulations of work of innovation business incubators at universities, tech parks (national, local legal acts).

4) motivation of academic staff of the university to conduct research (local legal acts).

5) motivation of staff in IT companies to conduct research in joint laboratories at universities (local legal acts).

6) integration of the university's research outputs into business processes of IT companies to raise the efficiency of an enterprise.

7. Challenges and risks

There are the following challenges and risks, which hinder to implement goals and requirements.

1. There are difficulties to amend legislative acts (Codes, laws, etc.).When you want to amend legislative documents, you will face with the serious limitations, including the amendment procedure, where large number of organizations and officials are involved (generating and submitting proposals; consideration; decision-making according to proposals; development of amendment project; consideration the project in legislative authority) and amendment terms. For example, 2 years have passed from the moment of amendment proposal submission and process isn't finished yet.

2. Heads of state organizations misunderstand the importance of innovative processes, technologies transfer, science, innovations and education integration. There are no initiatives in many state organizations, which help to introduce innovative technologies in all areas of activity, including technologies transfer and higher education institutions involvement. State organizations heads have really wary attitude to any new methods and technologies, and oriented not on enterprises development, but follow safe and proven method.

Private organizations misunderstand the importance of innovations because of limited development of business, and don`t need innovative development yet. At the same time large

private companies understand the importance of these processes, because its development closely connects with innovations.

3. Lack of funding. Now state organizations aren't ready to invest in technologies transfer.

4. Increased requirements to safety and issue of commercial confidentiality, which became a problem for HEIs to conduct researches for companies. Private IT companies usually control as developers as the place where it is fulfilled. As a result, numbers of projects which can be fulfilled in cooperation with HEIs with scientific laboratories are unrealized.

5. Higher education institutions employees are not ready for technologies transfer. Many higher education institutions employees should be advertised. Marketing strategies are really undeveloped. So, HEIs potential is unknown abroad.

6. Lecturers are busy with their academic activity. Annual volume of academic hours is 700-1000. Some part of these academic hours doesn`t include (second part of the working day). So, there is no time for research activity.

7. Top managers are not able to give work correctly. These risks can be minimized by developed system of business analysis. There isn't enough knowledge in subject area. The competent analysis is possible only with in the serious scientific training of the analyst. This training can`t be fulfilled in short-term period. Usually, business analysts are not trained enough in IT companies, and they are not competent enough in HEIs.

8. Decrease in personnel capacity of higher education institutions, because the most successful and talented specialists work in private companies. It is shown evidently that in the IT sphere, where salary in private company is 2.5-3 times more than in education, moreover, it can be even 10-15 times more. The issues, which are solved by such specialists, are not high tech and creative, but boring and routine. As a result, the potential is lost.

References

1. Education Code of the Republic of Belarus
2. Decree of the President of the Republic of Belarus #300 of 1.07.2005
3. Labour Code of the Republic Belarus
4. Law of the Republic of Belarus #708-XIII of 21.10.1996 “On Scientific Work”

http://www.bsuir.by/şi Perspective pentru cercetare. Revista de Ştiinţă, Inovare, Cultură şi Artă “ŞTIINŢĂ ŞI INOVARE” (AKADEMOS), Nr. 1 (24), Chisinau, ASM, pp. 64-69; ISSN 1857-0461.

Porta Optica Study project, (2008) [Online], Available from: http://www.porta-optica.org/ [Accessed: 16th January 2015].

POCOTILENCO, V., ALTUHOV, A., BOGATENCOV, P. and SIDORENCO, V. (2009). MD-Grid CA: New security service in Moldovian grid infrastructure. “Networking in Education and Research”, Proceedings of RoEduNet International Conference, 8th Edition, Romania, Galati, December 3-4, 2009, pp. 44-46.

STATE POLICY OF INNOVATION - ORIENTED SMEs DEVELOPMENT: IN CASE OF THE REPUBLIC OF MOLDOVA.

Alla LEVITSKAIA[1], Svetlana GHENOVA[2], Svetlana CURAXINA[3]

Abstract

In this paper, an analysis of government programs to support innovation development in the Republic of Moldova. Existing program of collaboration and cooperation between business and science and implementing a program of grants for the development of innovative SMEs under the leadership of the Academy of Sciences of Moldova. Emphasizes the importance of decentralization existing National Innovation System, necessity of its connections with regional emerging innovation systems. As an example the experience of the Innovative Educational cluster with the leading role of innovation incubator "InnoCenter" of the Comrat State University. Since 2012, Innovation incubator implements innovation projects and developing the infrastructure both inside and outside of the university borders - in close cooperation with the main actors of the regional innovation space.

Keywords: innovation policy, innovative development, Republic of Moldova.

Introduction.

Research and development institutes (RDIs) in the Republic of Moldova (RM) are a legacy of central planning system and were a part of a production system "which was not directly driven by production needs or market demand" [1]. During the socialist period existed a lack of a market for technologies and feedback mechanisms between end users and inventors. All this factors limited the diffusion of technology and innovation. The separation between the supply and demand for innovation was particularly visible, industry - the responsible ministry mediated research links.

[1] PhD, Assoc. prof., Director of Innovation Incubator "InnoCenter" Comrat State University, Comrat, Republic of Moldova.
[2] PhD, Assoc. prof., Innovation Incubator "InnoCenter" Comrat State University, Comrat, Republic of Moldova.
[3] PhD, Senior Lecurer, Innovation Incubator "InnoCenter" Comrat State University, Comrat, Republic of Moldova.

Typically, the former Soviet Union countries had three main actors in the Science and Research system: the Academy of Science (AS) with own research institutes (now only 17 from 45 in 1991), branch sector and universities. The first actor focused only on the fundamental research, second - developed mainly military - industrial complex with extensive, top- down characteristics. The third actor – Universities focused on teaching process.

Today the innovation system in Moldova presented by several organizations of the AS: Centre for International Projects (CPI), Department of European Integration and International Cooperation (DIECI), Advisory Expertise Council (AEC), Public Centre for Fundamental and Applied Research Funding, Agency for Innovation and Technology Transfer (AITT). Supreme Council for Science and Technology Development has created the Agency for Innovation and Technology Transfer (AITT), which functions in accordance with the statute approved by the Supreme Council.

State policy in the R&D

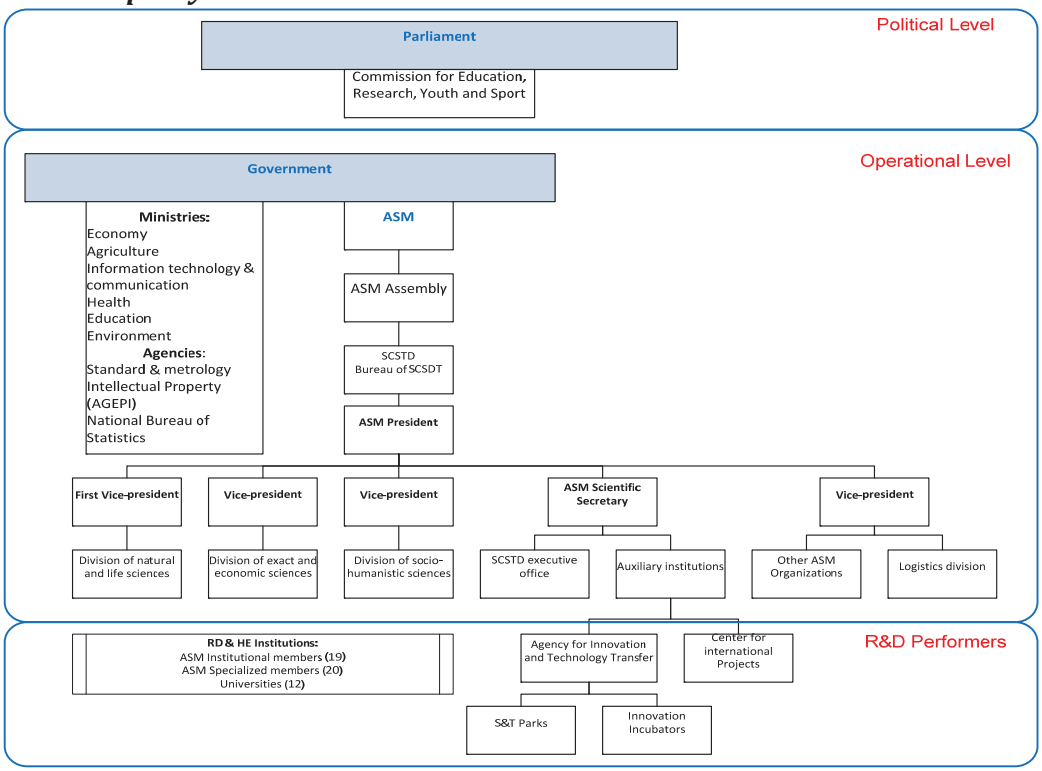

Fig.1. Existing Innovation System in Republic of Moldova.
Source: Mini Country Report/Republic of Moldova. INNO Policy Trend Chart with ERAWATCH (2011-2012

State policy in the R&D was determined in the "Code on Science and Innovation" and the first Government Partnership Agreement with the Academy of Sciences for the period

2005-2008, supported and subsequent Government Decisions on partnership between the Government and ASM. According to recent government decision established that the parties to the agreement for the funding of science and innovation in the 2013 budget allocations was made in the amount of at least 0.34% of GDP. Research and development is one of the most significant drivers of innovation. It is assumed that they have a direct significant impact on the activities carried out in business innovators, and spending on R&D is a way to measure a country's innovation potential. Treaty of Lisbon provides for spending 3% of GDP to research and development (R&D). In 2013 27 EU countries are placed at about 1.71% of GDP [2].

The previous agreements were established during more favorable conditions for financing the development of science and development. This first agreement envisaged an increase in the amount of allocations for science and innovation from 0.35% of GDP in 2005 to 0.80% - in 2009. Real allowances were increased, but did reached the expected level in 2009 accounted for 0.70%. In 2010, in connection with the critical state of the national economy, the parties agreed that the allocations for science and innovation will be 0.53% of GDP, which is 0.42% real GDP [3].

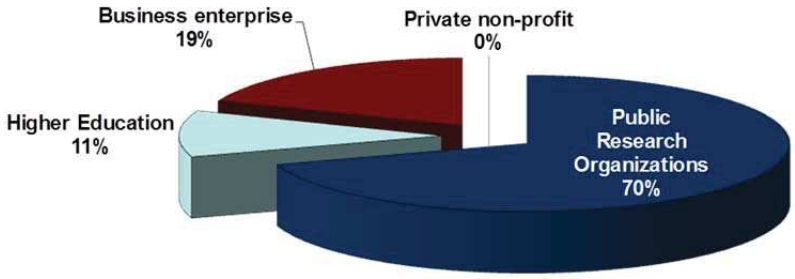

Fig 2. Gross Domestic Expenditure on R&D by sector of performance.
Source: Research and Development Strategy of the RM.

Therefore, science and innovation from Moldova operates today under dry enough, from the previous period. R&D activity in 2013 was conducted in 64 units, including 40 institutes and research centers, 15 higher education institutions and 9 - other units. Of the total activity of CD units, 53 units or 82.8% are in state ownership. The 2013 total expenses for research and development in the public sector accounted for about 0.35% of GDP, which is less than half the average indicator for EU countries (0.75%).

Unfortunately, but in 2013 and 2014 funding situation of science and innovation has degraded from the previous period, and the most favorable value of the indicator can be seen in the statistics of 2009, which were recorded R&D expenditure of around 0, 7% of GDP. The increasing importance of innovation policy for the economy is reflected in the structure and tasks of the ministry. It has a department for technological development and competitiveness, and several subordinated institutions:

- National Institute for Standardization and Metrology,
- The Organization for the Development of the SME Sector of the Republic of Moldova,

• The Moldovan Investment and Export Promotion Organization.

Overall, the Moldovan innovation governance is highly centralized. Policy formulation and priority setting, as well as policy implementation and evaluation are concentrated in the academy. The centralized system ensures continuity of the funding stream and provides stable priorities for pursuing long-term research. There is an obvious risk that such an innovation system is not very efficient and slow to respond to emerging topics. Furthermore, co-operation between public and private research institutions depends fully on the academy's actions. The low level of participation of the private sector in the governance of the academy, and in innovation activity in general, means that the academy has only limited feedback from companies on the effectiveness and relevance of its activities and policies [3].

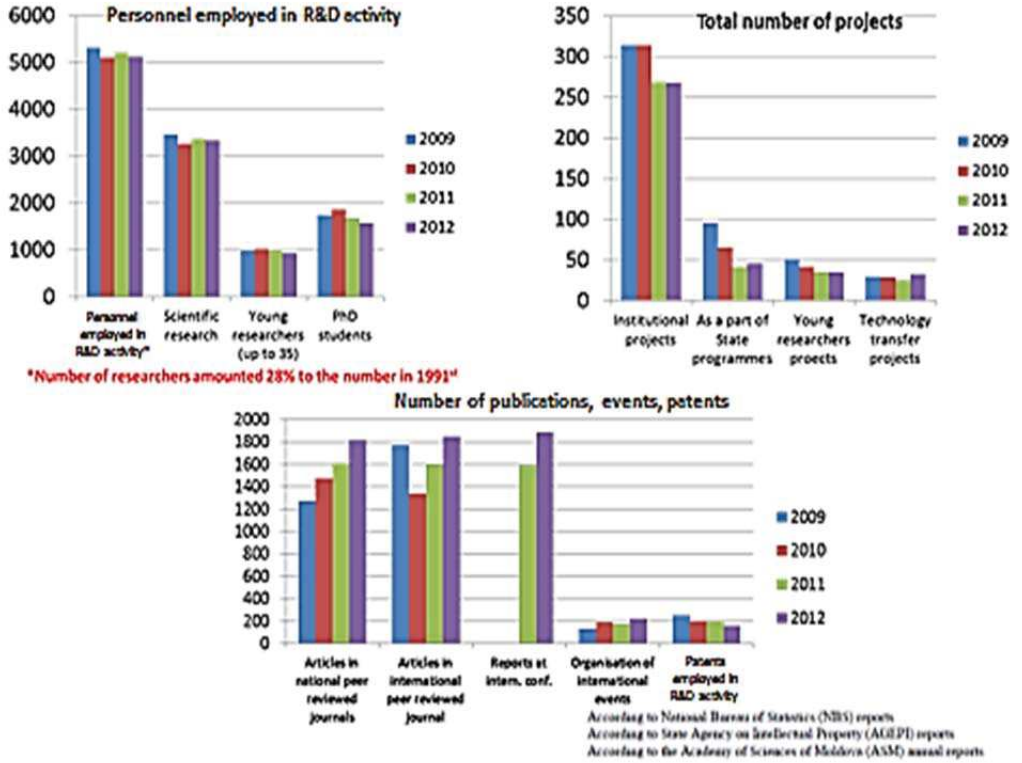

Fig. 2 Research indicators of National Innovation system in RM.

Source: Mini Country Report/Republic of Moldova. INNO Policy Trend Chart with ERAWATCH (2011-2012).

Weaknesses of R&D sphere

However, the practice of entrepreneurial activities in Moldova during the past two decades has not given any real grounds for conclusions of this kind. Moreover, the absence of a mature competitive environment, the significant level of monopolization of a number of sectors, ineffective anti-monopoly activity of the State have provided an open playing field for

excessively profitable entrepreneurial activity, without the need to make additional risky investments of capital in innovation development.

Thus, the developing of the innovation sphere was influenced by a lot of factors and preconditions that almost of the time stalled the modernization and promotion the role of innovative ideas in Moldova.

- *Weak link of relationship between science and business*

When Moldova received its independence the link between scientific research and real sector of economy have not existed. In one hand scientific discoveries were not responsible to the laws governing the economic sector. In another - enterprises have been focused on receiving the wanted results without involving some innovation ideas. The practice of conducting joint research and development began to develop only in recent years.

- *Absence of a clear understanding of development priorities research and innovation policy at both the national and regional level*

Incompleteness of the legal framework, particularly normative legal acts regulating the innovation cycle as a completed process. In reality, in all these normative acts, the terms related to the innovation field were defined confused and the priorities were not put in the right way so, all these factors formed a nonfunctional system.

- *Lack of business innovation funding mechanism, including the procedure for the allocation and distribution of budgetary and extra-budgetary funds, borrowed and borrowed*

Wasn't developed an effective state program for supporting the innovational initiatives, more than this, wasn't named a responsible institution for developing this sphere. In this case, were not clear what to do if you have an innovational idea, which public institution can help and how it can do it.

- *Low developed National innovation market*

In absence of foreign or national support, companies aren't ready to invest its profit in developing the research activities in interested fields in order to obtain some innovations that can be used in future.

- *Low receptivity of the real sector of the economy to innovate, mainly due to lack of their own financial resources and skill gaps.*

Another big problem that affected the developing of the innovational sphere in Moldova is the fact that companies are not ready to accept the importance of innovations in growing and modernization of economy.

All these factors have stalled the development of innovational sphere in Moldova.Modernization of the system was initiated in 2004, when was adopted the Code of the Republic of Moldova on Science and Innovation. This Normative act changed the construction of the system and initiated a new way of developing the innovative system in our country. The most important things that were changed when the code enter in to the force were that Academy of Science was named as the responsible institution for developing the research and innovational system, also were created some new institutions, like Agency for Innovation and Technology Transfer Agency on Intellectual Property and National Council

for Accreditation and Attestation, that were directly involved in innovation developing the system.

Technology transfer projects

These data include all expenditure of research organisations accredited with the Moldovan National Council for Accreditation and Attestation, and which receive funding from the state budget. Data do not include R&D expenditure from general university funds and cover only a rather limited share of private R&D funding (only co-funding of private business in innovation and technology transfer projects supported by the Agency for Innovation and Technology Transfer (AITT).

Gross Domestic Expenditure on R&D (GERD) does therefore not give the whole picture of R&D funding and is underestimated. Most of R&D (70.0% in 2011) is performed in the governmental sector (institutes of ASM and branch institutes of ministries), while the business enterprise and higher education sectors perform significantly less (19.0% and 11.0% in 2011).

Recent trends show a strengthening of the role of R&D in higher education institutions, improvements of the innovation infrastructure (e.g. via recently established technoparks and innovation incubators) and measures to enhance business R&D. AITT monitor's projects aimed at the development of collaboration and cooperation between business and science and implementing a program of grants for the development of innovative SMEs. Modern business characterized by lack of long - standing tradition of innovation activity funding and disconnecting between accomplishments that are achieved in the laboratory and successful innovations emerging in the product and consumer marketplace.

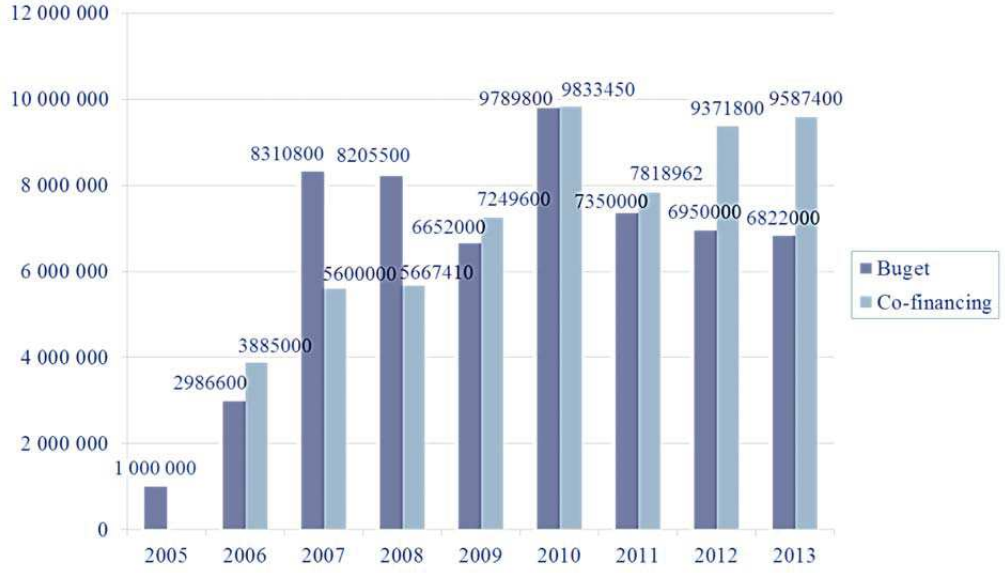

Fig. 3. Innovation and technology projects funding and co-financing, MDL.
Source: [4].

Projects are selected competitively and supported for a two-year period. Public and not for profit research organizations as well as companies are funded in this measure, whereby 50% of the project cost must be co-funded either in cash or in-kind. Innovation and Technology Transfer Projects should facilitate the implementation and transfer to business of research results, inventions, new technologies, equipment, agricultural varieties, pharmaceuticals, and other intellectual property.

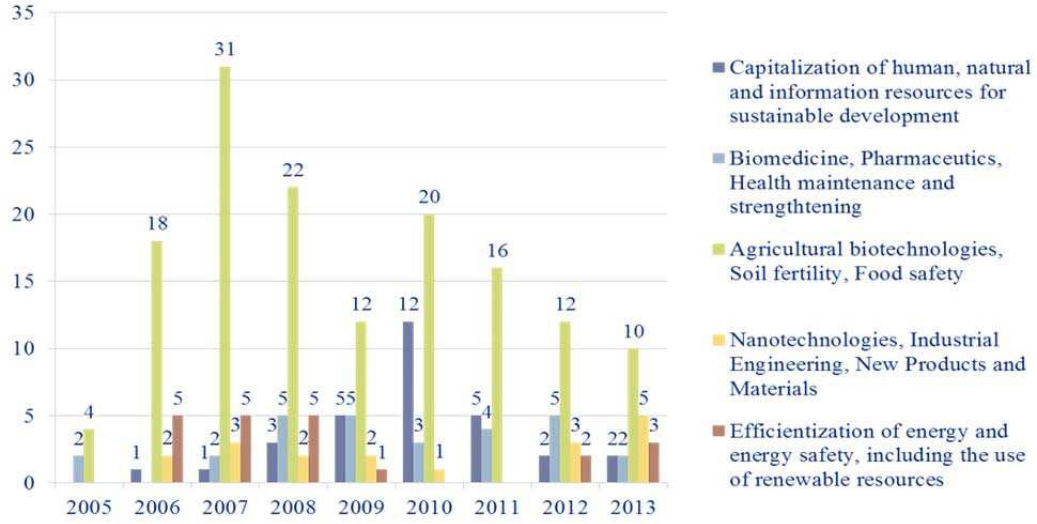

Fig. 4. Evolution of Innovation and Technology transfer projects by strategic directions.

Source: [4].

Following the adoption by the Parliament of Moldova "Law on Scientific technological parks and innovation incubators" were established Science and Technology Park" Academica "and innovative incubator" Inovatorul ". Now in the Republic of Moldova there are 3 science and technology parks and 6 innovative incubators. AITT through a network of incubators implement:

- the state policy in the sphere of innovation and technology transfer;
- elaboration of suggestions on the improvement of legal framework in the sphere of Innovation and Technology Transfer (ITT);
- determining the volume of financial resources for implementing programs and projects in the sphere of ITT;
- coordinating the process of creating infrastructure in the sphere of ITT.

Shefer and Frenkel [5] have shown that the proximity of an incubator to a university research center is great importance especially in the life science fields. Therefore, this program helps to commercialize the discoveries of scientists and at the same time to introduce innovative products and processes in the enterprises. The entrepreneur's share plays a big role by the successful realization. This keeps the entrepreneur motivated and strongly involved in the company the entrepreneur has the technological know- how needed for developing the company.

Specializing in a small number of activities has no positive impact on an incubator's ability to obtain additional private funding, compared with diversified incubators. Projects within the incubators located in the peripheral regions (Belti, Comrat) require more funding, compared with projects located in the central region - capital Chisinau. The average budget of a project located in peripheral incubator is smaller than that of projects located in the capital. Public funding for projects in the periphery is very less, compared with the projects located in central region.

Innovation Incubator "InnoCenter" - the initiator and leader of the regional innovation development

Usually, the state takes the initiative to establish a regional network of economic development. Unification business, educational institutions and civil society (business service providers) results support the development of research institutions (actors of innovation development) research institutes and centers at universities, innovation incubators, technology parks, research laboratories, etc. If the research structures are the result of a symbiotic (partner) relations of business, government and educational institutions, in this model they will take the dominant position.

Model of innovative infrastructure Gagauzia with the inclusion of its basic elements - "Innovation and Education Cluster." In Comrat State University has set up structures to support scientific innovation activities: Innovation Incubator, Center for Information Technology, Center for Continuing Education, Business Center. Center, the core of IEC - Innovation Incubator will be the as an advisory body to create between the various actors and stakeholders the necessary connections. They may include the organization of seminars, conferences, group discussions, lectures while ensuring participation of the University, the relevant stakeholders both local and national industry, research institutions, civil society and the government. Since 2012 Inovation incubator InnoCenter implements 3 project residents, as well as developing the infrastructure both inside the university and outside its borders - in close cooperation with the main actors of the regional innovation space.

In the framework of IEC can be tested new disciplines and technology training with stakeholders, as well as students and teachers. These innovative schools can combine not only the members of the cluster, but also regional lyceums libraries, community centers, and research. They will provide ability to quickly develop, test, and collect data of new approaches and products to promote fundamental and application research. Close connection with partners, employers will provide the market demand of programs, teaching methods and trained specialists.

Conclusions and recommendations. Education in general and its innovativeness particularly are the driving force in the country development. Organizations benefits of joining of in the cluster due to synergetic effect are obvious. Symbiosis entrepreneurs, government agencies, educational institutions and business service providers in the region with the Centre - Comrat State University allows to establish exchange flows of innovative information, inventions and finished products and technologies between all the structures of the cluster and further distribute them to the whole region and beyond. Should be allocated following main challenges facing the InnoClaster [9]:

1. Creating a unified informational and educational environment between members the IOC: harmonization of curricula, the creation of resource centers, the development of scientific and innovation (the development of doctoral studies), assistance in obtaining patents and registration of innovative technologies, the growth of the number of publications in reviewed journals.

2. Forming a IEC partnership strategy with commercial, non-profit and governmental structures: prediction of demand for professional staff in order to execute the order for specialists, the signing of agreements on joint research with business representatives, the organization of work on the grant support of research priorities and shortening their commercialization, modernization of laboratories and the discovery of small innovative enterprises in the departments of and the training of innovative professionals, the introduction of R & D in the region enterprises;

3. Integration into the world educational space: the organization of the practice in foreign universities and enterprises, conducting and participating in conferences, competitions, contests, projects, etc., implementation of programs, "double degrees".

4. Creating a single center of research and ecosystem development in the region, implementation and active use of science in business operations.

At the national level is required: the creation of an independent Science and Innovation Department as part of government, which take over the functions of public policy development in the area of science, the development of science, public order and control over the compliance the actual scientific achievements the government order, the formation of the state program for cooperation between business and science institutions including extensive information on business developments, the priority needs of the state in development of scientific activity, the development of incentives to implement of science in business, and the creation of high-tech industries in the priority areas.

Moldova's economics demonstrate highly polarized development with large regional disparities. In Chisinau, in capital we see the main “pole of growth” of regional concentration of population, GDP, industrial production and services, volume of investments, quantity of innovation structures [6]. However, it needs to create peripherals centers of growth on the North and South of RM threw development of objects of innovation infrastructure.

The capacity of the business enterprise sector to implement innovations is another important challenge. In order to these, it is necessary to stimulate knowledge absorption capacity of industry with its focus on technology-based products for increasing of the export potential. It can be done through the quality assurance and standardization of the legislation of RM in the field of technology transfer.

The necessary attention to this matter and to practical implementation of scientific results will make possible to create the connection between research and innovation with real economy. Time and funds available to enterprises are limited when ideas need to developed further to products. There is necessary to bridging the gap between fundamental research and product development. This could be done by implementing tools that can foster joint research by enterprises and research institutions or universities.

References:

1. Radosevi S. (1998) "The Transformation of National Systems of Innovation in Eastern Europe: Between Restructuring and Erosion, "Industrial and Corporate Change, Oxford University Press, vol. 7(1), pages 77-108.

2. World Bank national accounts data, and OECD National Accounts data files. URL: http://data.worldbank.org/indicator/NY.GDP.PCAP.KD.ZG/

3. Levitskaia A. Regional development of the Republic of Moldova: problems and prospects. EURAS Academic Journal. Volume 1, N3, Istanbul/Turkey 2013 p.84-90.

4. Agency for Innovation and Technology Transfer. Raportul de activitate pentru anul 2013.

5. Shefer D., Frenkel.A. (2002). An Evaluation of the Israeli Technological Incubator Program and Its Projects.

6. Dezvoltarea regională și două realități paralele. Analiza distribuției geografice a creșterii economice în Republica Moldova. Morcotîlo I. Chișinău, 2014.

7. Research and Development Strategy of the RM. URL: http://www.asm.md /galerie/ StrategieCD.pdf

8. Mini Country Report/Republic of Moldova. INNO Policy Trend Chart with ERAWATCH (2011-2012).

9. Levitskaia A. Innovation and Education Cluster as a Variety of Regional Networks of Innovation Development. Revista/Journal „ECONOMICA" nr. 2(84) 2013. Editura ASEM, Chişinău-2013, p.14-24.

THE IMPACT OF PROJECT MARKETING ON THE PROJECT'S FINALITY

Oxana SAVCIUC[1], Lucia CASAP[2]

In the last years we assist at the level of the Republic of Moldova and also at international level at a trend to offer financial support with a special focus on project-based funding. Once with the appearance and development of the project concept, other related concepts are being developed such as project management or newly, we can also speak about the projects marketing. Until recently, the product marketing was intensely discussed; concepts such as services marketing appeared afterwards, but also the specific marketing for various branches, such as agromarketing, political marketing, etc. Given that fact that the projects are a product / service itself, at the moment, more and more often projects marketing is discussed.

Although many people believe that marketing is not really a ethical tool to stimulate product or service purchasing or consuming, should be emphasized that, namely this interpretation in the wrong way, generates the opposite effect of social benefit that should be brought by marketing.

Developing the concept of projects marketing and highlighting the necessary aspects to be aware at the time of writing project proposals can help accelerate the economic development of the Republic of Moldova, enhance the country's competitiveness at the international level and implicitly, European Integration.

In lasts years it can be observed that there has been a growing trend of offering funds on project bases. Perhaps this is argued by the projects essence to organize human, material and financial resources, in a specifically way to realize a work in a field, with determined characteristics, cost and time restrictions, following a standard life cycle to achieve beneficial changes defined by **quantitative and qualitative targets** (Project Management Association Romania, 2002). Thus, the financial resources are oriented to achieve a goal, in a certain period of time with a certain amount of resources.

Such organization of activities and resources are highly attractive to the donors, taken into account the advance knowledge of the actions to be taken, the necessary time for their achievement and the required financial resources.

[1] Associate Prof. PhD, Academy of Economic Studies of Moldova
[2] PhD. Student, Academy of Economic Studies of Moldova

Such organization of activities and resources are highly attractive to the donors, taken into account the advance knowledge of the actions to be taken, the necessary time for their achievement and the required financial resources.

Projects are of several types. They may differ depending on the complexity, funding source, field, duration etc. The main classifications of projects are (McCollum&Bănacu, 2005):

1. By their complexity:
- integrated or independent complex projects;
- simple projects;
2. By their financial support source:
- projects with public financing;
- projects with private financing;
- projects with mix financing;
3. By financing duration time:
- short-term projects;
- medium-term projects;
- long-term projects;
4. By project consequences:
- construction projects;
- product projects;
- information projects;
- human resources development etc.
5. By branch of activity:
- education projects;
- health projects;
- agriculture projects;
- public administration projects;
- environmental projects etc.

To these classifications can be added many other. However, it is necessary to be specified and such classifications as:

6. By the final goal:
- For producing social changes;
- For producing economical changes;
- For producing socio-economical changes;
7. By the origin of funding sources:
- With local funding;
- With external funding;
- With combined funding.

Each project is characterized by a life cycle. Thus, in the figure below are shown the main steps through which a project is running from contest announcement, to results evaluation.

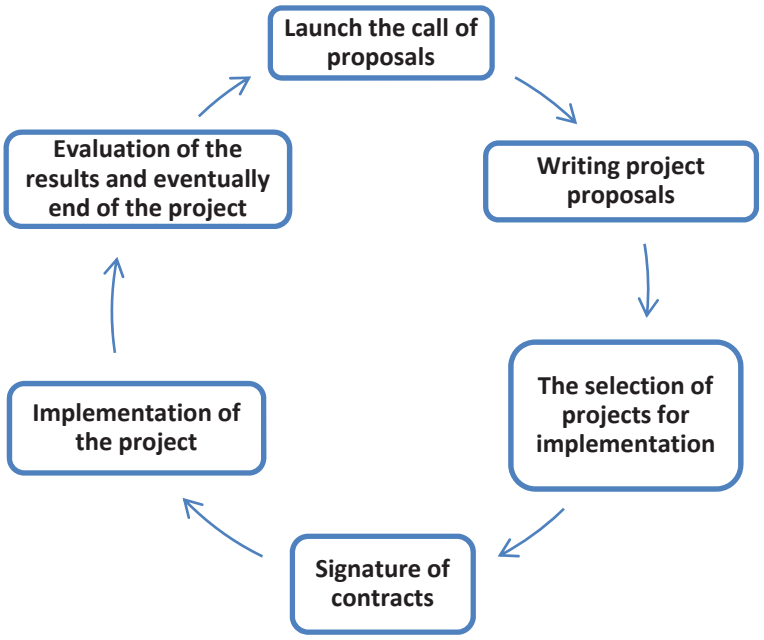

Figure 1: The project life cycle

It should be noted that, depending on the field, or project type, some steps are omitted, or contrary, there are intermediary stages.

As is well known, the project success depends on several factors. Among them, the most important are: successful planning of the project time, appropriate estimation of financial resources, the implementation team and project management etc.

According to Ph. Kotler, any project depends on three factors (Kotler & Dubois, 1994):

1. Time - time requirement as it is reflected by the initial project planning;
2. Money - the project budget based on the cost of required resources;
3. Project Objectives.

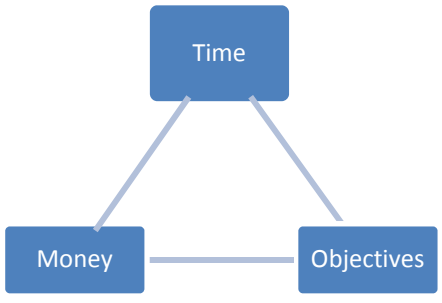

Figure 2: The project dependencies factors

4. According to the author, these terms define project "triangle", and the change of any of them leads to the change of other two. Although the importance of these three factors is considered equal to the aggregate level, depending on the type of individual project, one factor is predominant, and management style and toolbox is chosen according to the dominant factor.

5. It should be noted that there are many projects that, although they had a well defined objective, financial resources and time well planned and a good management, have not reached maximum potential they had. It is worth mentioning that in the case of an inappropriate staff, an ineffective communication / promotion or it lack, a successful project cannot be achieved.

6. If until recently was known the concept of project management, which **defines all the activities of planning, organizing, monitoring and controlling** the elements of a project in order to achieve the project **objectives** based on the criteria: **field, cost, time, quality** (McCollum & Bănacu, 2005), currently, more appropriate is to approach the projects and from the marketing perspective.

7. The concept of projects marketing is relatively new, less known, studied and limited from the point of view of implementation. Researchers in the field of marketing define **the concept of projects marketing** as a set of activities that take place before winning a contract. They analyze projects marketing as marketing activity related to the large projects such as construction or power plants (Cleland & Gareis, 2006).

8. This new project approach seems to be less popular and marginalized as well by the project managers. Because of the lack of extensive research in this field and promotion of the concept to a large scale, the projects marketing approach is one that remains at the concept level and untapped at the real capacity and usefulness.

Thus experts in the field seem to be divided into two groups: those who consider project marketing as a broader concept than project management and those who consider that it incorporates more specific activities than the project management.

In their paper ”Project marketing implementation and its link with project management and project portfolio management” (Lecoeuvre & Koninika, 2009), Lecoeuvre Laurence and Koninika Patel analyzes the positions of these **two groups of researchers**.

According to the paper, to the first group of authors formed by researchers in the field of marketing (Cova & Salle, 2005), (Cova et al., 2002), (Skaates & Tikkanen, 2003), (Tikkanen et al., 2007), (Lecoeuvre-Soudain & Deshayes, 2006), (Blomquist & Wilson, 2007), (Cova & Hoskins, 1997), they consider that project marketing incorporates four major phases:

1. Pre-project marketing: At this phase, project does not exist yet, but the supplier anticipates rules and the action range (competitors, market, etc.), identifies targets and keeps in touch with the client;

2. Marketing at the start of the project: Supplier starts with a co-construction of rules beside and within the network of influential relationships;

3. Ongoing Project Marketing: The supplier, client, and subcontractors proceed with renegotiation, modifications, follow-up, and meetings following one another with constant relationship exchanges until the end of the project;

4. Marketing intended to create the conditions of a future project: Based on the process master of ongoing project, this corresponds to the 'possible periods in which there are no projects" and to International Project Marketing's studies about "sleeping relationships" and enables to manage discontinuity in project business in preparing future projects.

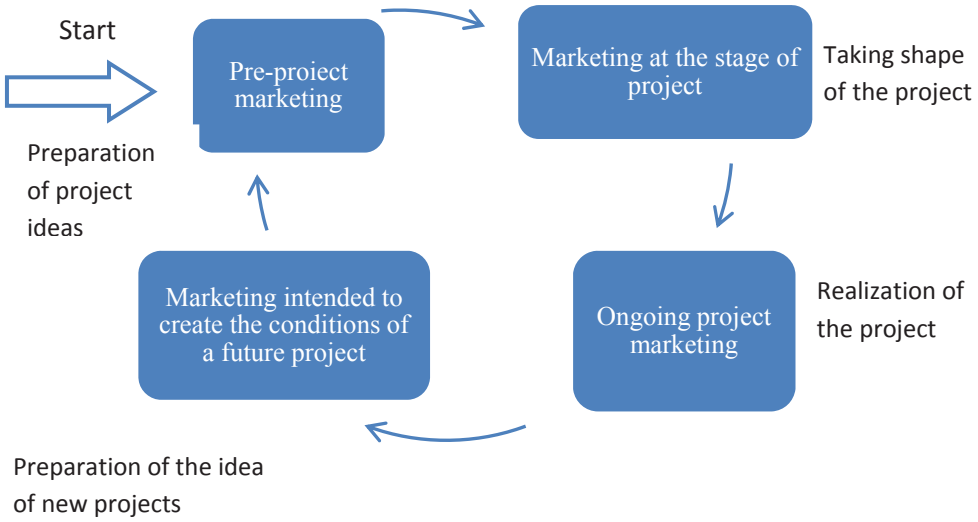

Figure 3: Phases in the Project Marketing Process

It is noteworthy that this group of authors considers that once the project management is solving organizational and management problems, project marketing is solving sales and marketing problems.

They define a project strictly from the marketing perspective stating that a project is a complex transaction covering a package of products, services and works, specifically designed to create capital assets that produce benefits for a buyer over an extended period of time (Cova & Salle, 2005). This group of researchers reveals as basic aim of the project marketing – the projects acquisition. However, the project marketing is an ongoing process that lasts and during the projects running. Thus, the function of project marketing cannot be delimited only to the projects acquisition.

A **second group of researchers**, is formed from project managers: International Project Management Association (IPMA), Project Management Body of Knowledge (PMBok), PRINCE2, (Cleland & Gareis, 2006), (Gareis, 2002), (Turner, 2008), (Turner, 2002). They are considering that the project management is a process and project is a social construction. This group of researchers perceive the project marketing as the process that

provide adequate attention from management to minimize conflicts within the projects and ensuring appropriate relations with relevant environment. Thus, this group defines project marketing rather as communication activities with relevant project environments and business management and incorporates the project marketing function in charge of the project manager.

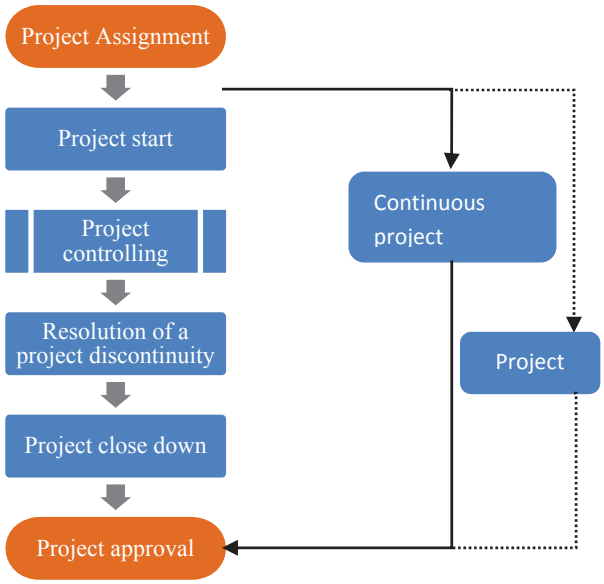

Figure 4: Project Management Process

Analyzing the two approaches to marketing projects we can conclude that, although the first group of researchers incorporates in project marketing both the pre-project and project phase, they include in the project marketing and the phase of conditions creations for the future projects. Or this phase is not related to the project marketing directly, but rather to the marketing activity of the company. Such approach is probably appropriate for companies working on a project basis, but what about the projects that appears sporadically, depending on the needs of solving problems? This concerns in particular the social projects. For this case, the second group of researchers approach is more appropriate, but it does not include in the project marketing the preliminary stage of project acquisition or initiation.

The exclusion from the project marketing of the preliminary phase of the project acquisition would mean a huge mistake. So, many projects fail to be valued at full capacity, particularly because of the rupture created by the delimitation of the pre-project stage by the direct realization of the project.

To solve the dilemmas in the visions of the two groups of researchers, is proposed to present the project marketing as an intermediate vision of the two above described, where marketing activity begins with identification of the potential projects and ends with the project completion.

In support of this vision comes the analysis of project marketing from the perspective of a unique good / service. This approach draws a parallel between the project and the product or service and identifies its components in terms of the 5P: product, price, place, promotion and personnel. Through this approach, the project marketing activity is no longer only about communication and promotion, but is focused on all components of a project.

For further description of this vision it is necessary to highlighting current shortcomings of the marketing interpretation.

Thus, widely we can find approaches where marketing is the set of actions for the goods or services promotion and sales.

However, marketing has a much wider range of tasks. According to McCarthy's approach, marketing is focused on four components, or mix to those 4Ps (McCarthy, 1964): product, price, place, promotion, purpose of which is to meet the needs of a customer or group of customers. Later, the concept was expanded in services at 5P, 7P or 9P etc.

Further, to describe the project marketing will be considered the 5P concept from the service sector, which to 4P from the case of tangible, include for services the fifth "P", the personnel, which directly influences the quality of provided services.

Making a parallel between a good or service marketing and project marketing, we can then determine the following relationships:

The component	The product/service	Project
Product	An item that meets the needs of the consumer.	The idea itself / project aimed at resolving the problem or satisfying the need.
Price	The amount that a customer pays for the product / service.	Project implementation cost (wages, time, direct expenditures for activities etc.).
Placement	Provision of the product/ service in a place accessible to the customer.	Area where the project is implemented.
Promotion	All media tools used to communicate with customers / potential customers about the characteristics of the good or service.	All activities related to communication and promotion of the idea among decision makers, people involved in implementation, but also the general public.
Personnel	The people involved in the production of good / service delivery.	The persons directly involved in the implementation of the idea, and policy makers.

Figure 5: The correlation between the 5P concept for services marketing and project marketing

According to the information presented in the figure above, the concept of project marketing include both, the project proposal writing, by defining the objectives, activities,

project duration, budget, venue etc., and the stage of the project implementation, through promotion and personnel involved. Analyzing the Figure 1, the project life cycle stages in which mainly is involved the project management, is observed the initiation of management activity by signing contracts, and active involvement in the implementation and completion of the projects. Although in some cases, the project proposal writing is an integral part of project management, this stage is often in case of individual projects a separate step, and management activity is discontinuous from the other three mentioned above.

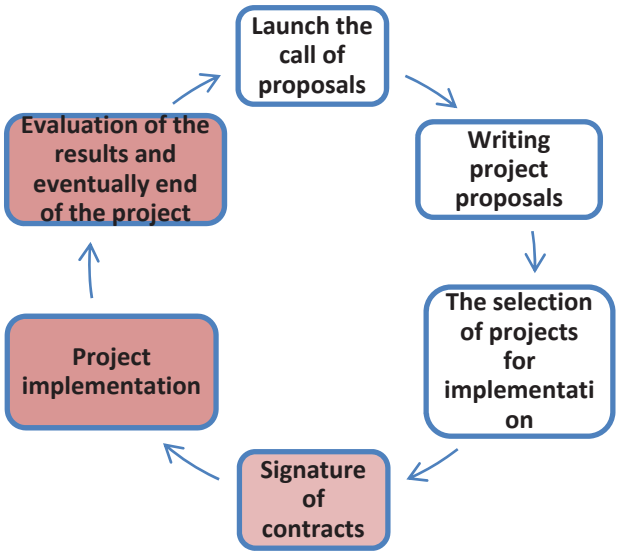

Figure 6: Phases involving project management in the project life cycle

The project marketing approach would mean involvement of marketing activities at all stages described above. Thus, at the stage of **launching of the call of proposals**, through **research** will be analyzed both, funders requests and the real situation in the field. Through this dual approach, responsible for writing such projects ensures full understanding of the context and ownership information for project design (product), the necessary financial resources (price) and human (personal) and area of implementation (placement) as well as in case of identification of specific situations may make recommendations and adjustments for project proposal. Also, to develop a solid project proposal, it is required a thorough knowledge of potential competitors, so at the project selection stage is needed to ensure the competitiveness of the submitted proposal.

At the stage of **writing projects** are defined issues such as **product** concept (idea itself and solutions to solve the problem / to satisfy the need), **price** (which is the value of the project, including personnel costs, capital investments, current expenditure, etc.), **placement** (where the project will take place, which geographical areas will cover, which fields etc.). Also, for some projects, at this stage is determined **the personnel** to be involved

in the project. It is noteworthy that in many projects, particularly in soft fields, this component constitutes a major value in project selection by the lender. However, in determining the personnel involved at this stage usually it is spoken about key people, other participants in the project following to be established at the stage of implementation.

The mixes of these four components are the **evaluation** criteria for project funders. Also, since the project selection stage until **the end stage of the project lifecycle** – evaluation and end, a great emphasis is on communication and **promotion**. So, will be ensured project promotion not only among beneficiaries, and decision makers, but also among all groups of involved people. This component has a particular focus on ensuring the success of project implementation and potential future projects acquisition. The insurance of information transparency and promotion of the achievements are those elements which enhance the product image created at the initial stage.

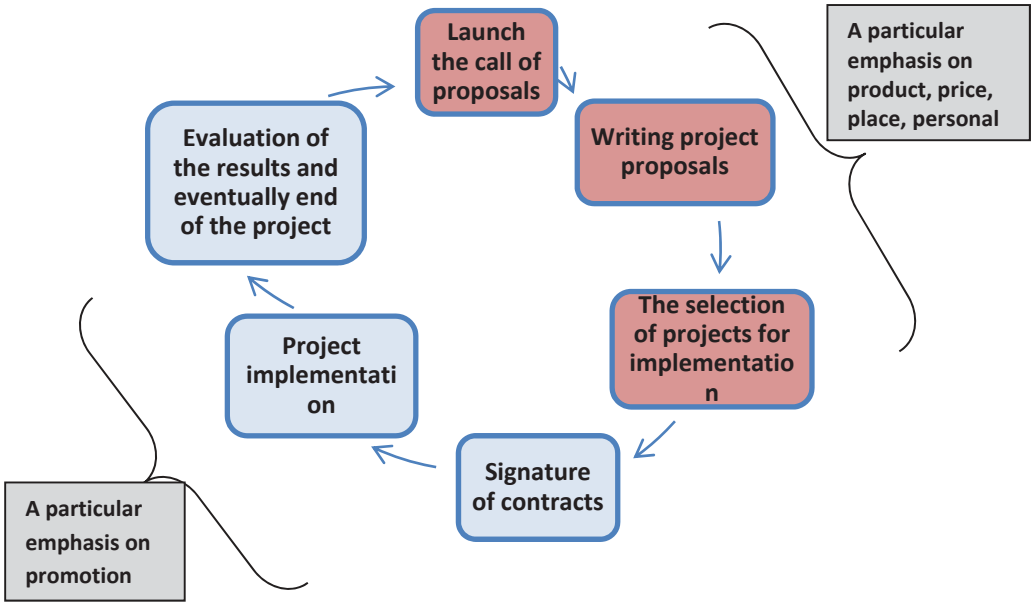

Figure 7: Phases involving project marketing in the project life cycle

With this new approach of the projects from a marketing perspective a continuity of the proposal elaboration process and its direct implementation process is ensured.

Viewing a project from management perspective only limits the success of the project, reducing it to the efficiency and not necessarily efficacy.

Most often, project marketing is involuntary assured involuntary by people responsible for both, developing the project proposal and project implementation; the combination of elements into a whole being realized involuntarily in these cases. However, the substantiation of a new projects approach – that of the project marketing and its implementation in all projects will contribute to increasing the number of successfully

completed projects and thus to economic and social progress that they propose it themselves.

Bibliography

Blomquist, T. & Wilson, T., 2007. Project marketing in multi-project organizations: A comparison of IS/IT and engineering firms. *Industrial Marketing Management 36 (2)*, pp.206-18.

Cleland, D. & Gareis, R., 2006. *Global Project Management Handbook: Planning, Organizing & Controlling International Projects*. London: McGraw-Hill.

Cova, B., Ghauri, P. & Salle, R., 2002. *Project marketing-Beyond competitive bidding*. Chichester: John Wiley & Sons Ltd.

Cova, B. & Hoskins, S., 1997. A twin-track networking approach to project marketing. *European Management Journal 15 (5)*, p.546–556.

Cova, B. & Salle, R., 2005. Six key points to merge project marketing into project management. *International Journal of Project Management*, p.354–359.

Gareis, R., 2002. Professional Project Portfolio Management. In *IPMA World Congress*. Berlin, 2002.

Kotler, P.D.B., 1994. *Marketing management*. Paris: Public Union.

Kotler, P. & Dubois, B., 1994. *Marketing management*. Paris: Public Union.

Lecoeuvre, L. & Koninika, P., 2009. Project Marketing Implementation and Its Link with Project Management and Project Portfolio Management. *Communications of the IBIMA, 10*, pp.50-63.

Lecoeuvre-Soudain, L. & Deshayes, P., 2006. From Marketing to Project Management. *Project Management Journal 37 (5)*, pp.103-12.

McCarthy, J.E., 1964. *Basic Marketing. A Managerial Approach*. Homewood: IL: Irwin.

McCollum, J.K. & Bănacu, C.S., 2005. *Management de proiect*. București: Editura Universitară.

Project Management Association Romania, 2002. *Managementul proiectelor-glosar, editia I*. România: Economică.

Skaates, M.A. & Tikkanen, H., 2003. International Project Marketing: An Introduction to the INPM Approach. *International Journal of Project Management, 21*, pp.503-10.

Tikkanen, H., Kujala, J. & Artto, K., 2007. The Marketing Strategy of a project-based firm: The Four Portfolios Framework. *Industrial Marketing Management 36 (2)*, pp.194-205.

Turner, R., 2002. The Handbook of Project-Based Management 1998. In R.K., M.-H.Y. *Case study research, Design and Methods, Third Edition – Applied Social Research Methods Series Volume 5*. London: Sage Publications.

Turner, R., 2008. Gower Handbook of Project Management., 2008. Ashgate.

SOME ASPECTS OF ON-LINE STUDYING PROCESS IN HIGHER EDUCATION INSTITUTIONS FROM MOLDOVA.

Valentina TÎRŞU, drd, lector USM

Abstract

Higher education institutions in Moldova go through a difficult transition period requested by implementing the principles of the Bologna Process, which lead to the restructuring of the national university education.

The work includes a study of implementing e-learning in higher education institutions in Moldova. The results presented are obtained from the investigation conducted at Moldova State University on the quality of higher education. The platform MOODLE is growing. The importance of developing Moodle is significant and allows improving the quality of higher education. We believe that Moodle is an effective tool to facilitate the integration of young professionals in the labor market.

Key-words**:** e-learning; learning process; information technologies; educational platform MOODLE

1. Introduction

Education reform in Moldova began in 1995 with the approval of the new Education Law. After a period of 20 years there are outlined new tasks that would boost local education development in harmony with European countries' education systems to meet the new challenges of the time.

When referring to higher educational institutions (HEI) from Moldova, undergoing a difficult transition period, requested by implementing the principles of the Bologna Process at the moment, the great challenge that launches a new concept of academic education is competitiveness at national and international level. We can mention that higher education in Moldova faces serious problems:

1. Relevance labor market studies.
2. Unperformed laboratories in terms of hardware and software equipment that does not meet today's requirements.
3. Unsystematic collaboration (ad-hoc) with companies in the business and private sector.
4. Poor promotion of specialties at municipal and national level.
5. Most teachers have no opportunities for retraining.
6. The low rate of youth among teachers.
7. Faculties do not implement at maximum within informational technologies for distance educational the national level.

8. Advanced students, especially college graduates in the field of study obtained in most cases in the traditions of the former planned economies are of unable advanced specialization . Slightly working with students in research.

9. The low level of interconnection between higher education, scientific applied research and economic environment.

10. Insufficient participation of universities in international projects and programs.

11. Lack of job internships.

12. The universities do not attract the teaching staff on the best candidates, partly because salaries are too low compared to the salaries from business sector in the country.

For 2014, the employment rate of people aged 15-24 was 27.77 % compared to 47.13 % employment rate of working age population (16-56 / 61 years). And youth unemployment rate was 10.23 % higher than the unemployment rate in the general population - 4.03 % (Figure 1).

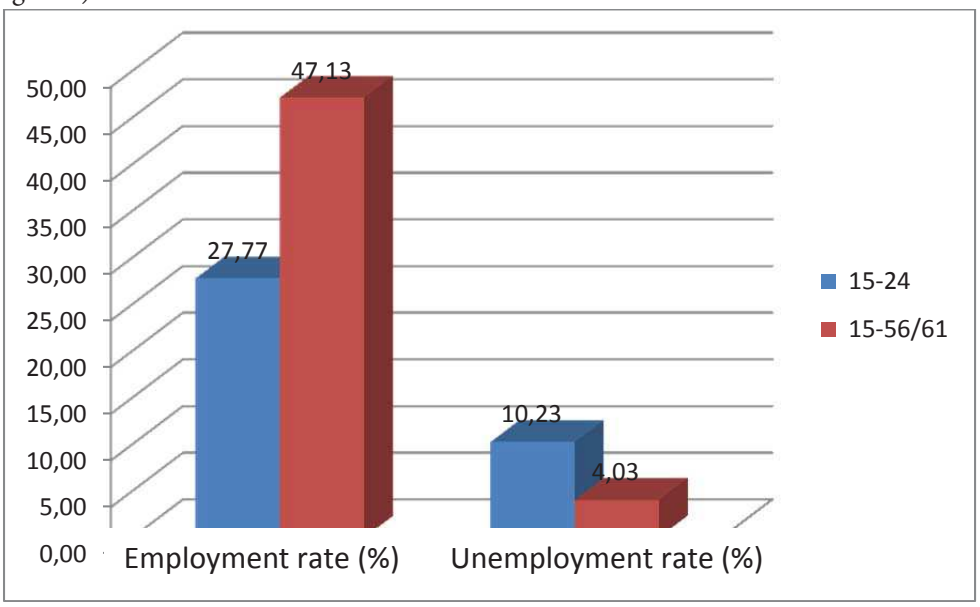

Figure 1. Rates of employment and unemployment for 2014

Source: made by the author based National Bureau of Statistics[1]

Often, young people with higher education and vocational training cannot find a job due to lack of work experience. Business representatives believe that education graduates do not meet the needs of professionals in terms of quality. The lack of sufficient qualified staff cause additional expenses for staff training from the employer, which are then reflected in cost of products, their quality and delivery time market. All these effects erode the competitiveness of local products on regional and international level.

The data presented above confirm the discrepancy between the quality of services offered by higher education institutions in the country and labor market requirements. Human capital which would allow creation of premises out of the crisis, resulting from an

ongoing and effective process of education and training. For this reason, the Moldovan Government has recognized education as a priority sector for the country's future, a catalyst for economic and social development. In 2014 was adopted Education Development Strategy for the years 2014-2020 "Education-2020", which close the university system to European standards in the process of Bologna. It is based on the development of the economical qualitative growth as a means to reduce poverty and contribute to building a prosperous state with high level of life of citizens.

Effective implementation of the priorities established in Strategy of Moldova 2020 can be successfully achieved only through the intelligent use of information technology .

Involvement of informational technology in education, which have become central elements of new methods of conducting studies on electronic media, influenced the emergence of new models of distance education, which can be classified and approved according to purpose, demand for education and resources [3].

2. Experimental research

At Present there are used a variety of platforms that support distance learning, among which we can mention: MOODLE, ILIAS, ATutor, AEL, Claroline, HyperEdu, NetSuport School Pro, Logicampus, TYPO3, SAKAI etc.

In Moldova there are successfully used MOODLE platforms, ILIAS, Claroline (in colleges and universities), AEL Siveco (in schools, high schools, colleges). For example, in September 2014 e-Learning platform MOODLE had 36 implementations, including Moldova State University (MSU), Academy of Economic Studies of Moldova (ASEM), Technical University of Moldova (UTM) Pedagogical College A. Russo in Orhei etc. From 36 private implementations – 18 are private [4]. In the Academy of Sciences of Moldova (ASM) it is implemented e-Learning platform Claroline [5]. In the International University of Moldova (ULIM) and in the Military Institute of Moldova is implemented educational platform ILIAS [6]. In some schools and colleges enjoys popularity author platform AEL [7].

Platform Modular Object-Oriented Learning Environment (MOODLE) [8] represents a software package for producing Internet-based courses and web sites. It is a global development project designed to support a social constructionist framework of education.

Since the launch (the first official version appeared in 2002) e-Learning platform MOODLE is evolving, continuous reaching September 2014 to version 2.7.2. Platform interface is translated into 82 languages (http://en.wikipedia.org/wiki/Moodle).

For the last few years, this platform has been actively connected and higher education institutions in Moldova: Technical University, Academy of Economic Studies of Moldova, Agricultural University, State University of Moldova etc. who participated in the project TEMPUS [8] in order to create an electronic network involving inter-university education and universities from Belgium, Spain, France, Italy and Romania.

USM MOODLE system can be found at http://moodle.usm.md. Since October 2011, this institution is created with establishing the infrastructure of the Moodle server for managing educational programs in the MOODLE and allocated a special portal. Teacher

training activity in the field of using the MOODLE Platform and the creation of on-line courses started in academic year 2012-2013, which is still continue.

If in 2014 there were 145 created courses, in January 2015 the number of the courses increased to 218, which is in increasing of 60%. From 13 faculties that are in the MSU, on the MOODLE Platform there are presented only 8 faculties. At present in this process of studying are engaged actively about 86 teachers. An active involvement is seen at Economic Studies and Mathematics and Informatics Faculties, which 38 finished courses, followed by the Faculty of Foreign languages with 37 courses, etc. Also teachers participate actively of the importance of the use educational platform MOODLE in the studying process.

Figure 2. Web page of the course ICT

Source: made by the author

Placed on Moodle courses are used in the training process. Thus, in the school year 2014/2015 was created and placed the course "Informational Technologies of Communication" for students of the Ist year – licensed, faculty Economical Studies. This course includes 90 hours, 30 hours lecture and 60 hours laboratory rated by 5 credit. During

the first half of the course enrolled over 170 students study at the polling day and low frequency.

The teaching material is divided into 14 modules (subjects) according to the curriculum approved at the meeting chair "Accounting and Economic Informatics". Each theme includes three sections: theoretical concepts, laboratory work and evaluation issues (Figure 2). Emphasis is placed on developed during activities involving the exchange of ideas and formation of new knowledge. More resources are available to students, for example, online books, web pages, files of any type.

During of the use Moodle has been noticed the improvement of the communication between teacher and students on studied course material lecture, students were interactive with pleasure collaborating and participating in group discussions. The course ended with the final evaluation - exam. In order to analyze the impact of IT use upon students' grades were compared percentage marks obtained by students during the last three years of study: 2012/2013 - 97 students, 2013/2014 - 112 students, 2014/2015 - 90 students (Table 1). In total at this sample survey were 299 students.

Table 1 .

Grades taken by students on academic years

Years of studying / Grades	2014/2015	2013/2014	2012/2013
1 ÷ 4	6	13	11
5 ÷ 6	24	47	39
7 ÷ 8	42	41	37
9 ÷ 10	18	11	10
Total	**90**	**112**	**97**
	Share notes (%)		
1 ÷ 4	6,67	11,61	11,34
5 ÷ 6	26,67	41,96	40,21
7 ÷ 8	46,67	36,61	38,14
9 ÷ 10	20,00	9,82	10,31
Total	**100**	**100**	**100**

Source: realized by the author

After analyzing the results we can conclude that IT influenced positively the students' knowledge: share notes 9 and 10 for students enrolled in the academic year 2014/2015 has increased more than twice , while the number of grades from 1-6 has decreased twice. A positive dynamic of 10 % represents 7 and 8.

This argument is confirmed by the students' success - in 2014/2013 academic year from students enrolled in the course only 9.8 % were obtained 10 and 9 compared with 20 % of

students enrolled for the academic year 2014/2015 . This difference is because of the material placed on the platform to the student and can be studied at their own pace. They have to know just to think logically and to locate the information they need. There can be revisions, summaries, attractive animated scheme leading to faster remembering of the essential information.

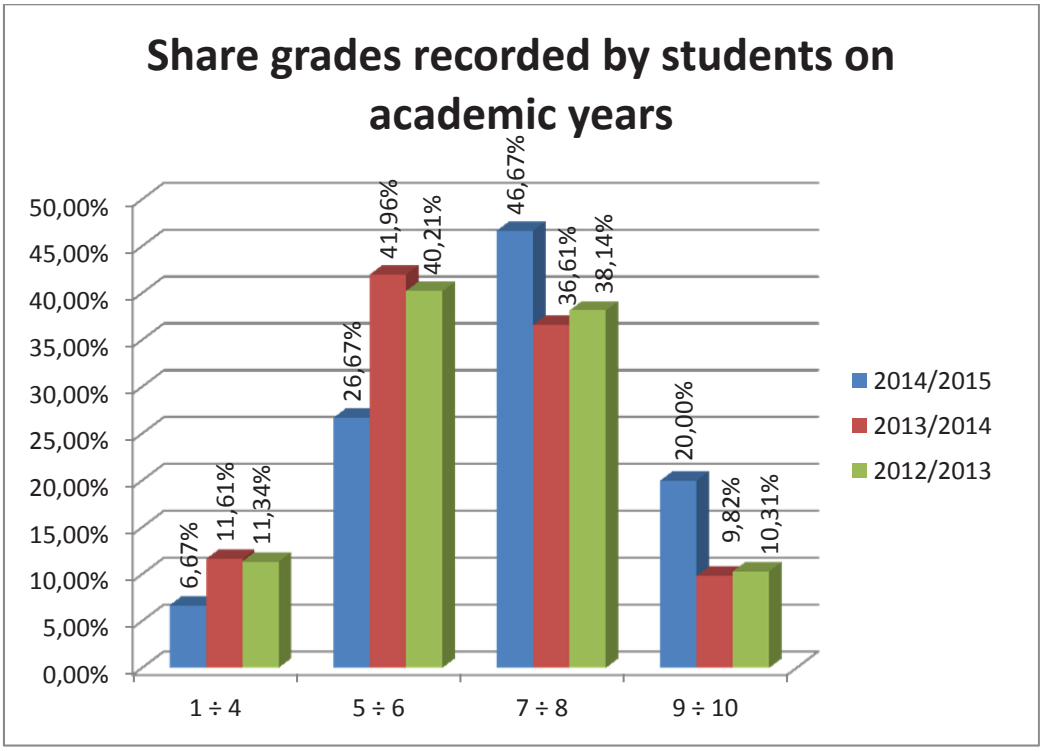

Figure 3. Share of grades taken by students on academic years (%)

Source: made by the author

Platforms that support distance education are the most modern way of training, being at the same time, much more open and more accessible than all traditional ways of presenting the courses. E-learning courses are characterized by interactivity and dynamism, combining animation , sound and video footage, so that learners attention remains alive throughout the course .

3. Conclusions

1. Moodle allows the creation and implementation of interactive training courses, which have significant advantages compared to traditional forms of learning and development of this type of education has gained a particular importance to the education system in Moldova, under the impact of the following processes:

- Continuing economic reforms, which advances toward education requirements?
- Formation of new needs of the population for new content and technology education;
- Political changes that promote the growth of international relations, including in education;
- Appearance, the rapid development of new and better means of information exchange among participants in the educational process;
- Increasing international integration in education, with increased competition in global markets of educational services;
- A flexible and appropriate reaction to the needs of society;
- Implementation of the constitutional right to education of every citizen.

2. Involvement of the modern information technologies in education has become an integral part of the educational system at all levels. The most active, information technologies, are involved in the training of undergraduate and postgraduate open at distance practiced throughout life.

3. Using the computer, the Internet and the Web, by students in the processes of self-training create the conditions necessary to obtain the skills and competencies required in the labor market.

4. Analysis of the most popular e-Learning platform at global and national level allow us to mention that Moodle is a platform that is successful and has gained extensive implementation in several institutions in the country.

5. The system Moodle is the environments of presentation, development and management of electronic courses. This allows increasing the quality of education by:

- Create online courses;
- Managing the training process;
- Compliance with the requirements of European education;
- Training of much more competent specialists and competitive on labor market;
- Extending the professional skills of teachers;
- Promote the image of the university.

6. It follows to notice that higher education institutions are trying to create their own informatics systems, which, naturally, take data and produce reports of different formats. Partial automation, unevenness of the results and insufficiency of resources (technical, technological and financial) for the maintenance and development of these systems cause a number of shortcomings in the work of academic institutions in collaboration with the Ministry of Education of the Republic of Moldova, the most important being:

- Lack of a unified system for admission to study;
- Inability of qualitative and quantitative estimation of data on education;
- Lack of effective means of qualitative and quantitative analysis of data related to education;
- Low efficiency in transmitting reports to the Ministry of Education by universities lack of strict evidence of fixed assets of universities;
- Inaccurate forecasts and strategic planning at national and even institutional level;

- The risk of bias and incompleteness of collected data;
- Bias and incompleteness of collected data;
- Etc.

REFERENCES:

1. National Bureau of Statistics. www.statistica.md

2. Government of the Republic of Moldova. www.gov.md

3. V. Tîrşu , S. Tututnaru - Aspects of implementation of ICT in professional skills required in the labor market . International Scientific Conference "Competitiveness and innovation in the knowledge economy" , 26 to 27 September 2014 , Chişinău .

4. Moodle.org. Moodle open source community - based tools for learning, . https://Moodle.org/

5. Claroline.net. Claroline-Learning management system (LMS).

http : //www.claroline . net /

6. Ilias.de.Ilias - open source e- Learning.

http://www.ilias.de/docu/ilias.php?baseClass= ilrepositorygui & reloadpublic = 1 & cmd = frameset & ref_id = 1

7. AEL. ELearning system. http://www.advancedelearning.com/

8. The ICT sector in Moldova, 2012 White Paper policy.

ACHIEVEMENTS AND CHALLENGES OF RESEARCH AND DEVELOPMENT ACTIVITY AS ONE OF THE PILLARS OF KNOWLEDGE TRIANGLE IN THE REPUBLIC OF MOLDOVA

Dr. Rodica CRUDU, assoc. prof., ASEM

Abstract.

In a very short period, economic globalization has changed the world economic order, creating new challenges but also new possibilities. Moldova can not be competitive in this new context, unless it becomes more innovative and responds more efficiently to the consumer needs and preferences. Taking in consideration the remittances and consumption as a result, are unable to fuel long-term economic growth of Moldova, we need a new paradigm of development that would increase based smart investment, innovation and competitiveness. During the 20 years of reform in Moldova, state policies have undergone into an essential metamorphosis: priorities have evolved gradually from fundamental science and military necessities to industrial and key technologies. Currently, it outlines a new stage, focusing on innovation and societal needs as a whole. An analysis of the sources of growth in Moldova in a classical representation of the production function Cob-Douglas suggests a very alarming conclusion - without a serious effort to change the paradigm of development, growth potential in the next 10 years is limited to a up to 4, 5% to 5% per year.

Keywords: Research and development, researchers, expenditures, research institutions, knowledge triangle

As a way to increase the stock of production, capital and knowledge about its use, economic growth paradigm would imply attracting foreign and local investment, strengthening research and development and the development of export industries. On the other hand, the speed, scale and consistent approach to the broad spectrum of proposed reforms are also important.

This paradigm of economic growth must place in the center of the Knowledge Triangle.

The knowledge triangle refers to the interaction between, education, research and innovation, as the key-drivers of a knowledge-based society. In the European Union, it also refers to an attempt to better link together these key concepts, with research and innovation already highlighted by the development of the Lisbon Strategy. The Competitiveness Council within the EU treats the concept of the knowledge triangle as the need to improve the effects of investments in the three sides of the triangle, and namely: education, research and innovation, by assuring juridical, institutional and financial support for continuous and productive interaction between the actors of each field of the triangle.[1]

[1] The Technopolitan. Knowledge Triangle Activities and Strategies in the Nordics. July 2012 - N° 09. Available at: http://www.technopolis-group.com/wp content/uploads/2014/02/ Technopolitan9.pdf

More and more countries are aware of the importance of building viable mechanisms of Knowledge Triangle functioning. More than this, Knowledge Triangle is a priority in the formation of the globally – innovational society on the base of development and integration of the three elements (education, research, innovation) and capital investments in human resources, development of professional skills and supporting scientific research, as well as ensuring the modernization of education systems etc. ., so that they become relevant to the needs of a global economy based on knowledge.

The abstract scheme of the Knowledge Triangle underlines the essential interdependence between Knowledge Triangle actors (education-research- innovation) for the competitive development of the country and the transfer of knowledge to the society and the economy.(Figure 1)

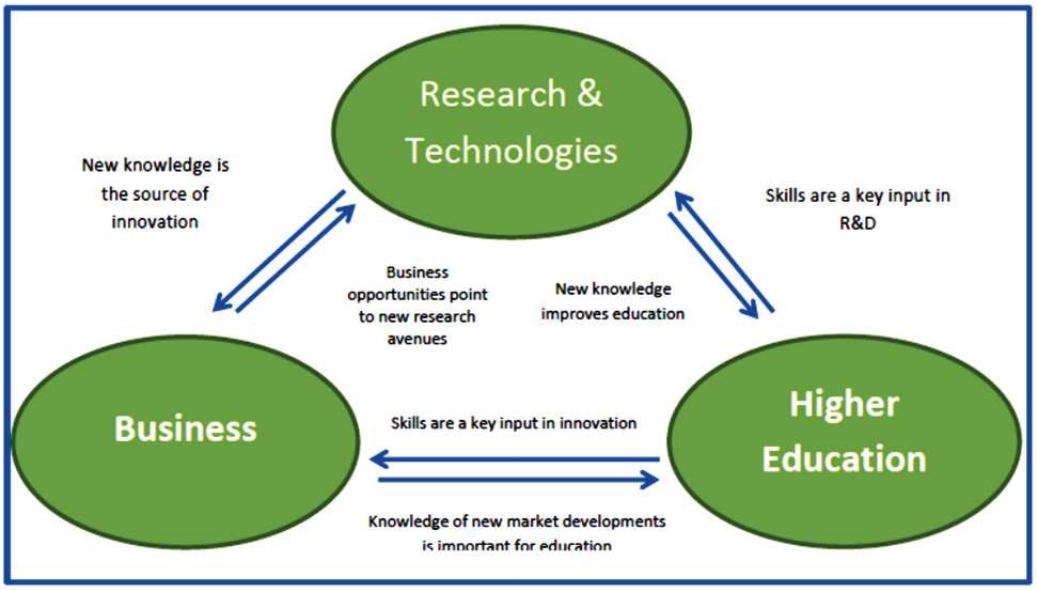

Figure 1. The abstract scheme of the Knowledge Triangle

Source: European Institute of Innovation and Technology (EIT). CATALYSING INNOVATION IN THE KNOWLEDGE TRIANGLE. Practices from the EIT Knowledge and Innovation Communities. Available at: http://eit.europa.eu/sites/default/files/EIT_publication_Final.pdf

The interaction between KT actors is performed on 3 channels, each of which is bidirectional:

1. *Report / interaction between research and higher education.* In this relationship, the functions of the actors involved in the research are the transmission of new knowledge and research results of the process of higher education, development and provision of the scientific-methodological knowledge and methods of their application. The role of stakeholders in education is to define qualifications for researchers to identify areas of research for graduate students as well as coordinate their research projects etc.

2. *The relationship / interaction between research and innovation*. In this relationship are multiple actors, each with distinct functions.

For example, research should provide businesses the newest invention, methodical and scientific knowledge (know-how) for their use and provide services and expertise in various fields etc. In turn, companies define the research directions, determine the economic parameters of the application of research results, and apply in practice those research results which are expected to be profitable etc. On the other hand, institutions which promote technology transfer, act as an intermediary between research and real economy. However, business support organizations create and ensure the necessary conditions for developing a healthy business environment and provide legal and economic enterprises, especially those newly created.

3. *Report / interaction between higher education and innovation.* In this relationship, the private sector (businesses) make academic requirements for professional skills and social future specialists and managers and universities integrate them into the academic curriculum and prepare young professionals and managers in accordance with modern requirements of the labor market and the real economy. The University also contributes to entrepreneurial culture development, work with institutions to promote technology transfer and participate in communication platform (cluster) of students, scientists and business representatives.

The specifics of the channels described above, highlight the fact that Knowledge Triangle replaces the traditional one-way flow of information from research to education and from educators to students, by a two-way circular motion between the three corners of a triangle that, besides research and education, also includes innovation, which is the "poor relation" of many universities.

In this context, it is clear that the activity of each separate KT element cannot ensure its functionality and subsequently, beneficial in establishing a knowledge-based economy at the national level. Only ensuring conditions for development of all sides of the knowledge triangle can achieve reliable growth that will visibly reduce the gap between our country and European economies, and Moldova will become a competitive and innovative country in Europe.

The knowledge triangle has all the capabilities to introduce an effective contribution to the progressive development of the Moldovan society. Also, this triangle is a key to ensuring research process based on excellence, integrated into the international research and to satisfy the growing needs of society and the economy.

Each component of this "knowledge triangle" will enhance the level of knowledge, increase productive stock of capital, economic development by attracting investments, developing export industries, promoting the knowledge society, including the strengthening of R & D through the transfer of the innovation technologically which is oriented to a better efficiency and competitiveness.

Also, the knowledge triangle helps create necessary conditions in order to achieve innovative products in the real sector of economy - key –element to the establishment in Moldova of a knowledge-based society and economy.

The current knowledge triangle in Moldova is marked by the legacy of a system of research, development and innovation like a Soviet-centralized type .The massive exodus of skilled labor, low capacity of the internal market, low production capacity, diversity of business constraints etc. determines the relatively low performance of each component of the knowledge triangle (KT) in Moldova. Moreover, its defective functionality is determined by the weak interaction between the sides KT.

Due to different constraints the present paper is focusing the research and development activity in Republic of Moldova, as one of the pillars of the knowledge triangle in Republic of Moldova, the one that is continuing the education process towards innovation.

In order to assess the situation in this field (R&D), four framework factors are analyzed: institutional organisation, legislative framework, labour force and financing.

In this context, we consider appropriate to identify the main actors involved in the construction of the KC in Moldova, especially in the field of R & D.

The research activity in Moldova is administered almost entirely by the Academy of Sciences of Moldova (ASM) together with its executive body - the Supreme Council for Science and Technological Development and other agencies and institutions subordinated to the Center for Financing basic and applied research, International Projects Center (ICC); Agency for Innovation and Technology Transfer (AITT); Consultative Council of Expertise (CCE). Also, the research is conducted in 66 institutions, including institutes and research centers (including 19 research institutes subordinated by the ASM), 15 higher education institutions accredited by the National Accreditation and Attestation and 11 institutions of other type.

However, in organization, the management and carrying out the research and development, ASM follows the partnership agreement between the Government and Academy of Sciences of Moldova.

Moldovan innovative policy was designed, modeled according to the Soviet research and innovation style, in which the Academy of Sciences of Moldova (ASM) have extended political rights[1]. Over time, it has undergone a series of reforms. In 1992 (30 October) it has adopted a new statute for ASM which established that it is "a state institution, the highest scientific institution in the country" and is responsible for the implementation and coordination within its terms of policy in the fundamental research field. On 29 July 1999, Law no. 557 on state policy in the sphere of research and development, later was diagnosed with some "leaks" that aimed possibility of co-financing by the state of research and development undertaken by companies and the financing of research in higher education institutions . Given these shortcomings, and also the role of politics , the 1999 law failed to reach the goal proposed by the authorities ("stimulating the development of the sphere of research - development through diversification of ownership and legal forms of organization subjects of research and development ").Thus in 2004, the state policy in the field of research and development has been fundamentally revised and the previous laws were repealed and

[1] Statutul provizoriu al Academiei de Ştiinţe a RSMM din 12 decembrie 1990, aprobat de Guvernul RSSM la Adunarea Generală a Academiei

was adopted by Law no. 259 of 15 July 2004, the Code on science and innovation that the ASM has become the main authority responsible for all stages of policy components (development, implementation, monitoring, reporting) and determining research priorities. Almost all public financing programs in the field of research - development - innovation are managed by ASM in its executive body, the Supreme Council for Science and Technological Development, and its management agencies and institutions: Center for Fundamental and Applied Research Funding; Center for International Projects; Agency for Innovation and Technology Transfer. Expert Advisory Board provides assessment for these three funding agencies. Together with the 19 research institutes under its supervision, ASM is the leading research organization in the country.

Priority directions of development of research-development field in Moldova are set by the Moldovan Parliament. Parliament adopts legislation regulating the organization and operation of science and innovation; approves strategic directions of science and innovation; approves the funds to be allocated for science and innovation and ratifies international treaties on cooperation in science and innovation sphere.

The analysis of Title II, Chapter IV, Article 69 (on the "rights of central specialized bodies and other authorities") of the Code on science and innovation allows us to conclude that the ministries, departments and other authorities have limited powers in this area, even if the code specified that they participate in promoting the state policy in science and innovation; develop proposals on strategic directions of activity in science and innovation etc.

The regulatory framework of research can hardly be separated from that of the innovation activity. In spite of this, it has experienced a considerable reform in recent years. Table 1 refers to the most important legislative and normative acts regulating the research, development and innovation in Moldova.

Table 1.

The main laws governing the research, development and innovation in Republic of Moldova

N/o	Law
1	Code on Science and Innovation of the Republic of Moldova, Code no. 259 of 15.07.2004;
2	Partnership Agreement between Government and Academy of Sciences of Moldova for 2013, GD. 714 of 09.12.2013;
3	Law on scientific-technological parks and innovation incubators no. 138-XVI from 21.06.2007;
4	Law on Information and State Information Resources, nr. 467-XV of 21.11.2003
5	Law on State Agency for Intellectual Property no. 114 of July 3, 2014
6	Law on Protection of Industrial Designs No. 161-XVI (adopted on 12.07.2007, in force from 01.12.2007)
7	Law regarding the protection of marks Act. 38-XVI (adopted on 29.02.2008, in force from 06.09.2008)

8.	Law regarding Plant Variety Protection Act no. 39-XVI (adopted on 29.02.2008, in force from 06.09.2008)
9	Law regarding the protection of inventions. 50-XVI (adopted on 07.03.2008, in force from 10.04.2008)
10	Law on Copyright and Related Rights No. 139 (adopted on 02.07.2010, in force from 01.01.2011)

Source: Prepared by the author based on official sites of ASM, AITT, Agency etc.

In addition to the laws listed in Table 1 were developed and adopted a number of development strategies, including:

• *Innovative Strategy for the period 2013-2020 Moldova "Innovations Competitiveness"* approved by Government Decision no. 952 of 27 November 2013 - (innovation strategy), developed by the Ministry of Economy and approved by the Government in September 2013. It provides five general objectives: adopting a model of open governance of research - innovation (R & I); allowing the formation of entrepreneurship and innovation skills; orientation towards innovation companies; applying knowledge to solve problems overall societal; stimulate demand for innovative products and services etc .;

• *Strategy for Research and Development of the Republic of Moldova until 2020* (R & D Strategy) drafted under the guidance of ASM and approved by the Government in December 2013, aims investments in research and development to rise to 1% GDP by 2020;

In both strategies are not clearly identified thematic priorities (for example, research and development strategy, priorities coincide with the six societal challenges of Horizon 2020);

• *National Strategy for Information Society Development "Digital Moldova 2020"* (September 2013) aims to create a foundation for the development and widespread use of the potential of information technology and electronic communications by public institutions, the business community and society generally, the optimal intervention of the state;

• *The national strategy on intellectual property until 2020* - designed to strengthen the legal and institutional framework conducive to the creation, protection, management and use of the full potential of intellectual property (IP), which should become a fundamental development of a sustainable economy based on knowledge, innovation and a source of national wealth for Moldova.

Also, there was developed a concept for the Development of Industrial Clusters in the Republic of Moldova, approved in August 2013[2]. It seeks the following potential effects on research - innovation (R & I): increasing demand for services research - development (R & D) from businesses, increase skill levels of researchers, promoting technology transfer, development of research centers in branch ensuring scientific institutions access to new sources of financing, etc.

The ability of research institutions depends on the quality of equipment, quality and management researchers in the field. Since 2005, many research institutions have received

[2] Hotărîrea Guvernului Republicii Moldova nr.614 din 20.08.2013 cu privire la „ Concepția dezvoltării clusteriale a sectorului industrial al Republicii Moldova ”.

funding for renovation and equipping of new laboratories equipment. However, in most cases it went rather on the renovation of existing equipment rather than purchasing new equipment. The Court of Auditors has found a number of serious violations on the spending of financial resources earmarked for the purchase of scientific equipment (eg. The equipment being paid for several projects at the same time or the money was used for other purposes).

In 2014, R & D activity was conducted in 66 institutions, including 40 institutes and research centers, 15 higher education institutions and 11 other institutions. Of the institutions, about 77% are state institutions, which are less compared to 2013 when their share was 83%.

At the end of 2014, conducting research institutions worked 5038 people (of which 51.4% women), which is more by 1.1% compared to 2013. Of the total number of employees, 70 percent have worked full time.

According to the National Bureau of Statistics (NBS) of all employees, 3935 persons had higher education (78.1%), 376 people - specialized secondary education (7.5%), and 727 people had different level of preparation (14 ,4%). The categories of occupations, the majority of employees in R & D was composed of researchers (65.8%), followed by auxiliary staff (15.0%), other categories of employees who were executing related functions of the institution's work in general (13, 6%) and technicians (5.6%).[3] (Table 2)

The downward trend of researchers in Moldova is caused by massive outflow of labor abroad, caused by the poor economic situation and low salaries of staff employed in R & D field. Moreover, in addition to low salaries that encouraged professional researchers to go abroad, they do not motivate young scientists to continue their research career.

Table 2.

Employees in research and development by category of occupations, in 2013-2014

	Persons				Structure - % -			
	2013		2014		2013		2014	
	Total	Incl. women	Total	including women	Total	including women	Total	including women
Employees - total	**4981**	**2592**	**5038**	**2588**	**100,0**	**100,0**	**100,0**	**100,0**
researchers	3250	1559	3315	1586	65,2	60,1	65,8	61,3
technicians	304	231	282	205	6,1	8,9	5,6	7,9
auxiliary staff	750	386	758	402	15,1	14,9	15,0	15,5
Other categories	677	416	683	395	13,6	16,0	13,6	15,3

Source: National Bureau of Statistics. Research and development in 2014. Available at: http://www.statistica.md/newsview.php?l=ro&idc=168&id=4728

[3] Biroul Național de Statistică. *Activitatea de cercetare-dezvoltare în anul 2014*. Disponibilă la: http://www.statistica.md/newsview.php?l=ro&idc=168&id=4728

Although the situation in the area of remuneration of researchers slightly improved (average salary of a researcher in 2013 was 3870 lei[4]), analysis of the structure of researchers by age in 2014 highlights the fact that 43% of researchers over the age of 54 years, more than one third belong to researchers aged 35-54 years (34.8%) and 22.2% are young researchers (aged up to 35 years). At the same time, every fifth student was aged over 64 years. (Figure 2).

Data related to gender desegregation reveals that in 2014 in averaged the ratio of male and female researchers were 100 to 92, the equal proportion as in the previous year. According to the NBS, the biggest share of researchers were involved in the field of natural sciences (36.1%), followed by those in the social sciences with a share of 15.0%. In comparison with 2013, the structure of researchers per scientific fields has changed, in particular, lessened the share of those from the humanities (1.7 p.p.) and simultaneously the share of researchers in the social sciences increased (2.4 p.p.).

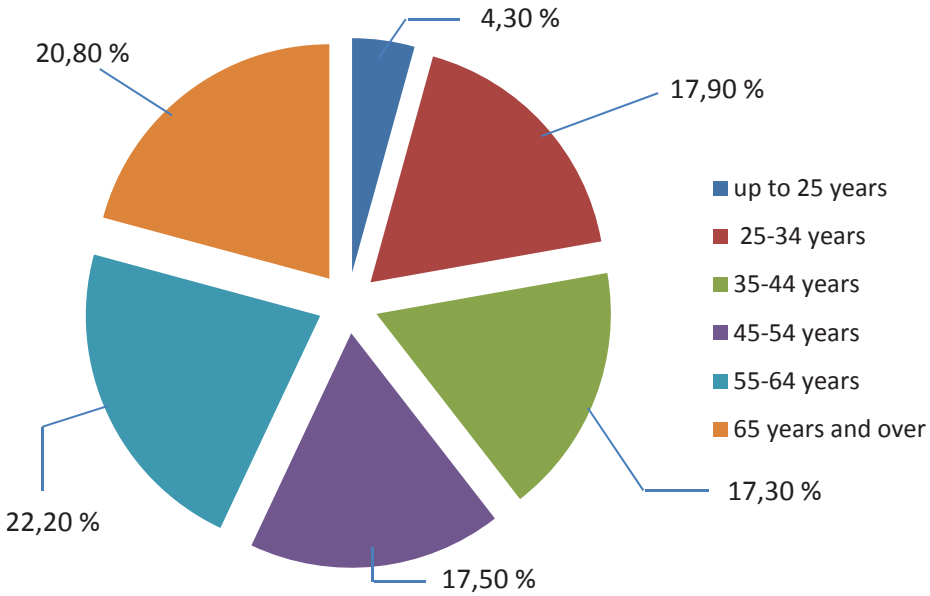

Figure 2. Structure of researchers by groups of age, 2014

Source: Elaborated by theauthor according tothe data of the National Bureau of Statistics. Research and Development Activity 2014 year, available at: http://www.statistica.md/newsview.php?l=ro&idc=168&id=4728

Although in 2011-2014 the funding value in the sphere of science and innovation was increasing, this amount has not been able to full stop the exodus of scientists from science, the renewal of technical-material base and as well to bring back the status of the scientific and innovation activity. Moreover, this financing as a share of GDP is decreasing in the last years

[4] AȘM. Raport privind activitatea CSȘDT și rezultatele științifice principale obținute în sfera științei și inovării în anul 2014 și în perioada 2011–2014. Available at: http://asm.md/administrator/fisiere/rapoarte/f172.pdf, p. 28

(Figure 2), constituting 0.35% of GDP in 2014. This performance is much lower than the average performance of the EU countries, which aim through the Europe 2020 strategy to allocate 3% of GDP for the research-innovation sphere. (Figure 3)

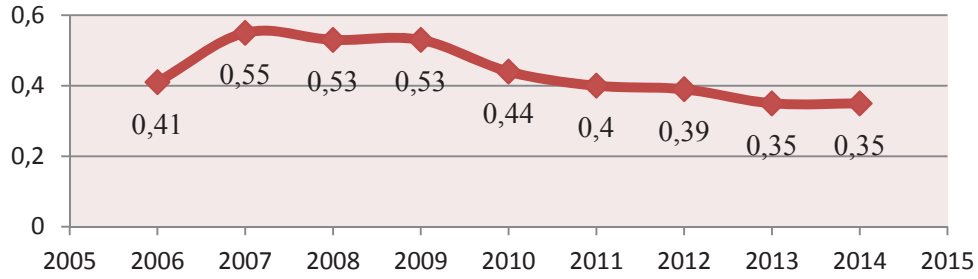

Figure 3. Dynamics of the share of R&D expendituresin the GDP.

Source: Elaborated by the author according to the data of WB. *World Development Indicators*. Available at: http://data.worldbank.org/indicator/GB.XPD.RSDV. GD.ZS and AŞM. *Activity report of Supreme Council for Science and Technological Development and main scientific results obtained in science and innovation in 2014 and in 2011-2014.* Available at:http://asm.md/administrator/ fisiere/rapoarte/f172.pdf

According to the NBS, current expenditure structure per components reveals predominance for staff expenditures - about 72% or 278.8 million lei (with 32.3 million more than in 2013). Administrative expenses accounted for 2.5 million less and constituted 63.7 million lei. "Other" expenses accounted for 45.8 million lei or 17.8 million more than in 2013. (Table 3)

Capital expenditure constituted 26.9 million lei, thus increasing by 11.5 million or by 1.7 times compared to 2013.Allocation of the expenses aimed mainly for the equipping of the institutions/units that conduct R&D activities accounted for the amount of 24, 6 million lei, increasing by 1.8 times compared to 2013. [5]

Capital investments are very important in the research process, whether this involves the acquisition of new equipment and technology, which can therefore increase the return on the investment. But these charges reported to the needs are quite modest even though they constitute more than 90% of the total capital expenditures and represent 27.7% of total expenditure on R &D. (Table 3)

The Science and innovation funds were used for both ,maintenance and development of scientific institutions in the fields of health, agriculture, education, culture, as well as for the development of state programs, staff training etc. According to ASM data starting with 2011 to 2024, for research and development, from the state budget were allocated from 1185.8 ml. lei to 986.3 ml. lei, which represented 83.2% of total funding. (Table 4)

[5]NBS. Research and Development activity 2014.
Available at: http://www.statistica.md/newsview.php?l=ro&idc=168&id=4728

Table 3.

Structure of R&D public expenditures

	2011	2012	2013	2014
Total expenditure (mln. MDL)	333,5	368,2	356	415,2
Research activity (current expenditure) (mln. MDL)	312,9	368,2	340,7	388,3
• Training of scientific staff	70,1 %	71,2 %	72,4 %	71,8 %
• Material expenditures	20,0 %	18,6 %	19,4 %	16,4 %
• Other current expenditures	9,9 %	10,2 %	8,2 %	11,8 %
Research activity (capital expenditure) (mln. MDL)	20,6	14,1	15,4	26,9
• Capital expenditure on equipment	92,7 %	97,2 %	86,4 %	91,4 %
• Other capital expenditures	7,3 %	2,8 %	13,6 %	8,6 %

Source: Adapted by the author according to the data National Bureau of Statistics. Available at: http://www.statistica.md/newsview.php?l=ro& idc=168&id=4728

From the total funding amount for basic researches were allocated 316.9 ml. Lei or 26.7 percent of the total funding for scientific research and - 669.4 ml. Lei or 56.5 percent for applied researches[6]. (Table 4)

Science and innovation financing activities, according to the priority of science development directions, that were approved by Parliament Decision no. 150 on 14 June 2013 are performing in the institutional and competitive system: for institutional projects, state programs, projects for young researchers, topics and bilateral projects, as well as projects of innovation and technology transfer that have been selected through competition, subsidies for publishing monographs, subsidies for the organization of scientific conferences and PhD scholarships etc ..

According to the Academy of Science from Moldova the public funds in 2014 have been allocated to the following strategic directions: "Materials technologies and innovative products" - 97.0 ml. Lei (36.6%); "Biotechnology" - 70.6 ml. Lei (26.4%); "National Heritage and the development of society" - 52 ml. Lei (19.4%); "Biomedicine and Health" - 41 ml. Lei (15.3%); "Energy efficiency and use of renewable energy" -6.8 ml. Lei (2.5%)

Despite these strategic directions, in Moldova most policy measures in the research and development fields are general and the procedures and financial instruments, assessment, monitoring and reporting are identical for all the thematic priorities. Of all the financing instruments for research and development, only the state programs are thematically

[6]ASM report on the SCSTD activity and the mai scientific results obtained in the research and innovation sphere in 2014 ,and 2011-2014.Chişinău, 2015, p. 37. Available at: http://asm.md/admin istrator/fisiere/rapoarte/f172.pdf

concentrated. [7] However, the topics of the programs are kept rather broadly and the financial support allocated for this measure is modest.

It is also appropriate to note that the tendency in the recent years was to increase the share of institutional funding to the detriment of other funding instruments. In 2014, over 90% of public funds were distributed for institutional projects. (Table 4)

Table 4.

The dynamic execution of basic expenditures on priority areas of R&D activity in 2011-2014 (ml. lei)

Types of researches	Executed				Total
	2011	2012	2013	2014	
Basic scientific research	**74,5**	**77,2**	**76,4**	**88,8**	**316,9**
Institutional projects	69,5	73,8	72,5	84,8	300,6
State Programs	0,6	0,6	0,5	0,4	2,1
Projects for young researchers	1,4	0,9	1,1	1,5	4,9
Themes and bilateral projects	3	1,9	2,3	2,1	9,3
Applied Scientific Research	**164,3**	**171,1**	**157,1**	**176,9**	**669,4**
Institutional projects	138	147,6	142,6	157,9	586,1
State Programs	7,5	6,9	1,6	3,2	19,2
Projects for young researchers	2,1	2,1	1,9	1,5	7,6
Themes and bilateral projects	3,6	2,5	3,8	4,4	14,3
Technology Transfer Projects	8,6	8	7	9,9	33,5
Other expenses	4,5	4	0,2	–	8,7
Total scientific research	**238,8**	**248,3**	**233,5**	**265,7**	**986,3**
Staff training	13,1	14,6	2,6	2,7	33
Institutions and activities for science and innovation unassigned to other groups	20,6	31,5	37,5	43,4	133
Administrative bodies	5,8	6,6	7,1	7,7	27,2
Total basic expenses	278,3	301	280,7	319,5 1	179,5
Capital investments	3	3,2	–	–	6,2
Total science and innovation	**281,3**	**304,2**	**280,7**	**319,5 1**	**185,7**

Source: ASM. *Activity report of Supreme Council for Science and Technological Development and main scientific results obtained in science and innovation in 2014 and in 2011-2014.* Available at: http://asm.md/administrator/fisiere/rapoarte/f172.pdf

[7] Cuciureanu G. ERAWATCH Country Reports 2013: Moldova 2014, p. 10-11. Available at: http://erawatch.jrc.ec.europa.eu/erawatch/export/sites/default/galleries/generic_files/file_0527.pdf

According to the legislation, universities are directly dependent on the Supreme Council for Science and Technological Development and institutional projects, in the creation and funding of research activities.

Under the Partnership Agreement, are listed the following as SCSTD duties: distribution of budgetary allocations according to the strategic directions of science and innovation; organization and elaboration of state programs, scientific and international scientific-technical programs and mechanisms for achieving them; development of monitoring mechanism ,stimulation of the state programs realization results in science and innovation, as well as those of products' markets creation for the same sphere; promote innovation and technology transfer activity. SCSTD structure consists of 17 members, from which only three are represented by the university sector. In addition to these three members, only two are from the ASM (National Council for Accreditation and Attestation and State Agency for Intellectual Property). So ASM concentrates on 12 SCSTD members out of the total 17.

Unlike institutions subordinated to ASM those eligible for full funding of projects from the state budget, state universities can only claim to membership profile, allowing them to receive partial funding from the state budget based on competition, however private universities can claim only the membership affiliate, which enables them to benefit from budget financing up to 40% of the total amount of the winning project. In recent years, the share of expenditure on research, development and innovation in the GDP fell from 0.7% in 2008 to 0, 35% (385 ml. Lei) in 2014[8].

At first glance, these schemes appear to be competitive, but analysis of the results and their effects on the economic development of the whole country shows that these are insignificant. According to studies performed by Popa A., "the main form of promotion of the state policy in science and innovation, under the Code are state programs. Despite the importance offered to them, due to the lack of funds allocation, they haven't become the main tool state policy implementation. ".[9] According to the same author, around 8% of the total allocations for RDI are based on funding state programs. Experience of other countries shows another situation in this respect. In most of the countries with a developed and modern RDI sphere -the funding on state programs basis exceed net the funding on institutional one in some cases even reaching the ratio of 70/30% on institutional basis being funded only those military institutions or unique in its field.

The most important conclusion of the author parallel to the issue of research and innovation funding in Moldova is that ASM distributes funds without a clear strategy in this area. Though, the lack of a set of indicators that evaluate research results and their impact on achieving national objectives makes the financing efficiency to be considered as rather low, accompanied by the risk that the budgetary resources being directed to the activities of none national priorities.

---

[8] ASM report on the SCSTD activity and the mai scientific results obtained in the research and innovation sphere in 2014 ,and 2011-2014
Available at: http://asm.md/administrator/fisiere/rapoarte/f172.pdf, p. 36

[9] Popa A., Prohnitchi V., *Cercetare, Dezvoltare şi Inovare în Republica Moldova probleme şi opţiuni*. Expert Grup, Chişinău 2011

However, because of high political costs, and due to the difficulties that the universities in taking research responsibilities may deal with, the decentralization of RDI sphere seems to be an early model for Moldova at this stage. Still, in the long term, this could be the best solution, assuming that universities cardinally improve their quality of educational services and strengthen their management capacities of research programs.[10]

An important feature of the efficiency of spending on R & D is their dependence upon the implementing institutions. Motivation and financial opportunities for research and innovation activities range from public to private institutions. While the private sector in Moldova is more market oriented, on increasing the productivity, reducing production costs and increasing the applicability of innovation, the financial possibilities of the private sector are usually relatively low or nonexistent. International experience, however, shows that basic research is performed in public institutions and universities while the applied research is often carried out by the private sector.

Consequently, the access of private sector to the public R & D is very important. This statement is quite important in the context that Moldovan private sector access to the public R&D funds is limited.

In the last decades, the trend in the developed economies is to encourage public research and development organizations to engage more in applied research, usually in cooperation with private companies. These collaborations provide additional potential sources of funding for public research and development organizations. But to catalyze the emergence and development of such partnerships is needed to create more favorable conditions in different directions, such as the judiciary system , the status of organizations, tax system, intellectual property protection system etc. Although direct financing of the private sector is not a common practice in the EU, it can be used to set aside the market failure of R & D activity in Moldova. Conversely Moldovan legislation limits private companies' access to public funds for research and development.

As a response to the criticism concerning the system of financing research and innovation activities in Moldova in 2012 was created the Centre for Financing Basic and Applied Research. This center was created as a division of Academy of Studies from Moldova and the objective of its creation was to improve the competitive allocation of public funds for R & D and to separate the financing from the political and executive bodies within the ASM. But we should mention that this center is still a subdivision within ASM and since its creation essential changes in the funding of research activities weren't seen.

The European experience shows that cluster networking, in which interact production enterprises, educational institutions and state institutions, enhance technological performance and productivity, this way contributing to the enterprises competitiveness, market expansion and increases the field visibility. But in Moldova, majority of companies do not conduct research and technological development due to the increased level of financial risk, though this does not mean that in the near future (for 5-6 years) it's going to be the same.

[10] Popa A., Prohnitchi V., *Cercetare, Dezvoltare şi Inovare în Republica Moldova probleme şi opţiuni*. Expert Grup, Chişinău 2011, p. 12-13

In this regard, as a fundamental support comes Moldovan Innovative Strategy for the period 2013-2020 "Innovation for Competitiveness". Innovative Strategy provides that "The State will support companies that are committed to their own resources for developing new technology perspective." In this context, the intellectual potential of researchers, inventors, engineers, patent services workers etc. will be very demanded by the business sector, which will lead to its rapid development and make those vocations attractive for youth.

Also, innovative strategy states that the current legal framework governing the work of entrepreneurs and the financial tools that will promote small and medium business activity should be brought in line with the requirements and objectives set by our state.

In conclusion, we note that in 5-6 years the need of ensuring the development and growth of Moldova will serve as the basis for consolidation of major forces which are part of the knowledge link. The organizations involved in the process of necessary reports realization for the knowledge link development will contribute to the:

- *Restructuration and reorganization of existing institutional structures of universities and research entities* - such structural reforms would allow the increase of the global competitiveness of universities; the development of strong research environments, the boost of business ties, the insurance and support of better cohesion in academic performance with the EU;
- *Improvement of universities financing conditions*. Key factors for the success of research funding systems are a mix of appropriate framework conditions. Most European universities are publicly funded. This source remains the most important funding flow for universities from Moldova. However, using multiple sources of funding could lead to greater stability and greater autonomy for universities.
- *Promoting competitive funding models*. Worldwide funding is a key concern for universities. To get a better quality research is necessary to develop concepts and clear mechanisms for selection. In this context, the emphasis on performance and establishment of appropriate indicators are important for the success of research funding.
- *Support for researchers throughout their careers, focusing on creating good framework conditions.* Creating an attractive market, open and sustainable labor market for researchers.
- *Ensure better interaction among research, innovation and higher education.* In a society based on knowledge, research should not be isolated nor innovation or education. It is important to better integrate aspects of higher education, research and innovation in the national strategies;
- *Removal of deficiencies of the regulatory framework.* Real impediment in the conduction of both research and innovation activities by all stakeholders at all the levels.
- *Development and implementation of coherent and comprehensive strategies and policies in the field of "brain circulation».* Due to their age, many of researchers retire, and the need for young researchers is increasing. RM should strengthen its capacity to attract and train young researchers and provide competitive research careers nationally and internationally. Also, to attract the best researchers from abroad;

➢ *Ensuring a closer interaction between universities and non-academic sector.* Universities must start working with a wide range of private and public sector partners, to increase the amount of private money invested in research. Major benefits could come from the transfer of research knowledge into new businesses, services and policies.

References

European Institute of Innovation and Technology (EIT). CATALYSING INNOVATION IN THE KNOWLEDGE TRIANGLE. Practices from the EIT Knowledge and Innovation Communities. Available at: http://eit.europa.eu/sites/default/files/EIT_publication_Final.pdf

The Technopolitan. Knowledge Triangle Activities and Strategies in the Nordics. July 2012 - N° 09. Available at: http://www.technopolis-group.com/wp content/uploads/2014/02/ Technopolitan9.pdf

Popa A., Prohnitchi V., *Cercetare, Dezvoltare și Inovare în Republica Moldova: probleme și opțiuni*. Expert Grup, Chișinău 2011.

Statutul provizoriu al Academiei de Ştiințe a RSMM din 12 decembrie 1990, aprobat de Guvernul RSSM la Adunarea Generală a Academiei

Hotărîrea Guvernului Republicii Moldova nr.614 din 20.08.2013 cu privire la „ Concepția dezvoltării clusteriale a sectorului industrial al Republicii Moldova ”.

National Bureau of Statistics. Research and development in 2014. Available at: http://www.statistica.md/newsview.php?l=ro&idc=168&id=4728

ASM. *Activity report of Supreme Council for Science and Technological Development and main scientific results obtained in science and innovation in 2014 and in 2011-2014.* Available at: http://asm.md/administrator/fisiere/ rapoarte/f172.pdf

Cuciureanu G. ERAWATCH Country Reports 2013: Moldova 2014, p. 10-11. Available at: http://erawatch.jrc.ec.europa.eu/erawatch/export/sites/default/ galleries/generic_files/ file_0527.pdf