



## ECONOMIC MECHANISMS OF INFLUENCE ON THE DEVELOPMENT OF HUMAN CAPITAL TRAINED IN RESEARCH

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**Abstract:** In the XXI century were launched processes that significantly have changed the vector of world economic development and the economy of new type (innovation economy) in which the fundamental role is played by knowledge and "production of knowledge" has turned into a source of new business model and economic growth. The paper explores the premises of creating entrepreneurial universities as part of the triple spiral of knowledge (university-business-state). A special role is given to analyzing the impact of research and innovation on the development of human capital because on the long term, education and innovation systems represent the most powerful engines of economic development.

Carrying out the applicative analysis allow us to make a contribution to increasing the visibility and international recognition of the research potential of Republic of Moldova, to strengthening the material for the elaboration of comparative studies, to improve the perception on the effectiveness of investment in research and development. The problem of equity-effectiveness ratio and cost-benefit ratio emerges when analyzing poignancy forms of research funding (state/private, national/international) because the consequences are profound and long-term with impact on resources and the quality of the human factor. Efficiency refers to the optimal allocation of resources which generates the greatest national income. Equity aims to reduce social and economic differences between individuals.

The paper presents the major scientific research projects carried out within Alecu Russo Balti State University, being analyzed their influence on the quality of training for academics involved in research. A qualitative and relevant higher education enables students to acquire the skills, knowledge and transferable competences they need in order to succeed after graduation to integrate on the labor market.

**Key words:** research, innovation, entrepreneurial university, human capital, data envelopment analysis, economic efficiency.

### 1. INTRODUCTION

The science fate doesn't concern only a small proportion of people, however it affects directly and

systematically our daily lives.

It is not only because almost all objects we have to interact continuously show the result of scientific discoveries and inventions used in technological processes, but also because all human activities are directly or indirectly affected by the science and technology evolution. Current and future jobs are or not, depending on progression and the scientific and technological progress.

Research and technological development increase labor productivity, developing competitiveness and ultimately leading to benefit is shown as part of a World Bank study, on the example of two countries, Ghana and South Korea [6].

In the second half of the twentieth century these two countries had similar levels of economic development, but due to knowledge production and accumulation, Gross Domestic Product (GDP) of South Korea (\$ 1.378 trillion) exceeded several times the GDP of Ghana (\$ 37.54 Billion). This rapid growth occurred despite the geopolitical uncertainty and lack of natural resources, (figure 1). Currently, South Korea is a big exporter of products such as semiconductors, automobiles, telecommunications equipment and ships.

Three lessons we can learn from this example:

- it is necessary a strong and consolidated state, focused on development through market orientation;
- in the absence of natural resources, the gravity center can be oriented towards human capital, focusing not on quantity studies, but on their quality. This fact will boost a rapid industrialization, modernization and recovering of technological gaps and will place a greater emphasis on innovation.
- digital skills and informational technologies are the basis of economical performances. Countries that do not invest in new technologies and in training and development of its human capital risk to remain behind.

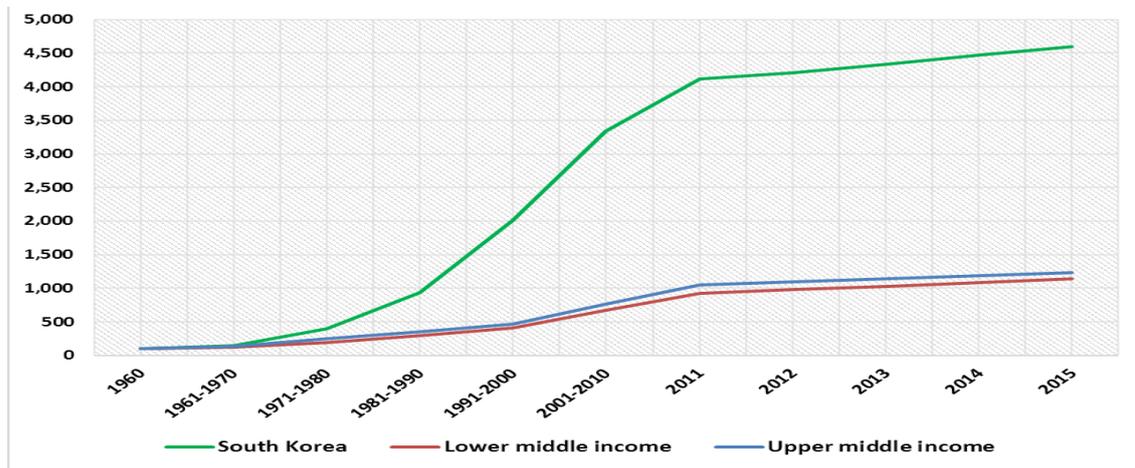


Fig. 1. Growth of GDP in South Korea (1960-2015), [6]

## 2. CONCEPTUAL ANALYSIS OF THE INTERDEPENDENCIES

The innovation has always been an engine of economic and social development, which is felt even more during the XXI century, with appearing of a new economy type - innovation economy, which main element is production of knowledge and implicit training new staff involved in national and world economy. The knowledge economy includes necessarily the presence of an excellent human capital trained in research.

Therefore, there is an interdependence relationship between the words: human capital, knowledge, research -development, innovation and economic growth.

On how vast and multidimensional are the concepts mentioned above, on so voluminous is the list of

scientific works. I conducted a literature study using bibliometric methods on Google Scholar database and GoogleTrends in order to create an image of this volume of articles

Google Scholar shows that only in the last decade there were written at least 49,500 articles, patents and books that approach the problem of innovations, while in the last 30 years this figure was only of 66,000. Google Scholar is the most extensive collection of publications; it includes all databases used in academia as well as JSTOR, EconLit, Business Source Premier, WileyBlackwell etc.

Since 2004, when the search tool Google Trends appeared, people have continuously shown interest in the above concepts. Further we will analyze how it is presented the situation regarding: human capital, R & D, innovation and knowledge, (figure 2).

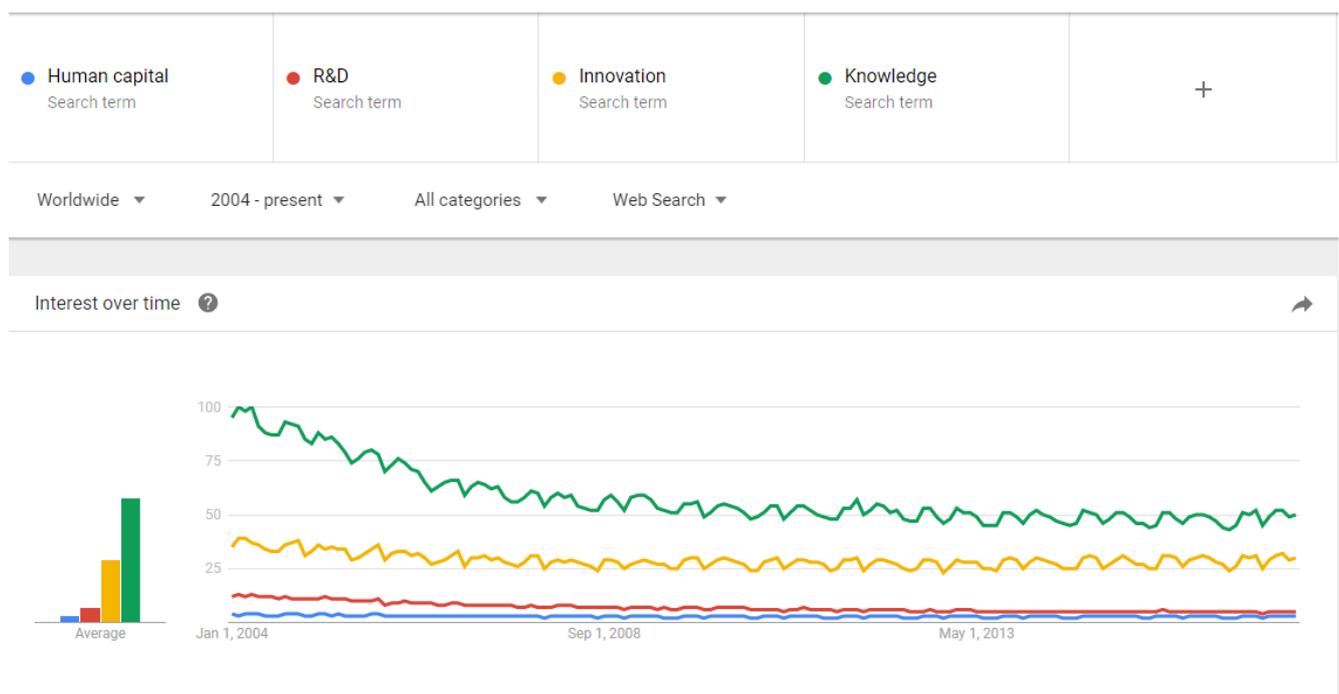


Fig. 2. Evolution of interest to the theme of human capital, R & D, innovation and knowledge, [5]

Internet users have shown interest for all four concepts, and especially, innovation and knowledge, with an initial coefficient of popularity of 38 and respectively 100%. Currently, the popularity of Knowledge searches had a double decrease, constituting only 54%, while interest for innovations slightly decreased and was of 31 %.

It should be noted that most searches come from the cities of Europe, Asia and America.

Having analyzed the regional distribution of searches for each concept, we find the following situations:

A) For human capital, (figure 3):

There is a very high concentration in many developing countries, particularly in southern Africa and Asia at the regional level. The greatest interest is recorded in Zimbabwe, Nigeria, Ghana and Kenya.

Derived concepts searched by Internet users are:

center, r&d job, technology r&d, r&d management, enterprise r&d, r&d investment, r&d project, r&d system, etc.

C) for innovations, (figure 5):

Just as in previous cases, the major interest in relation to this concept is manifested mainly in African and Asian countries, such as Kenya, Singapore, Ghana, Tanzania. In case, we refer to the European area, then we could highlight: Denmark, Great Britain, Germany and Ireland. Republica Moldova is placed on the level 0 according to this criteria, because there was no sufficient increase in the searches volume in order to perform this analysis. Such countries as Romania, Russia and Ukraine are placed respectively on the levels of 8%, 7% and 6%.

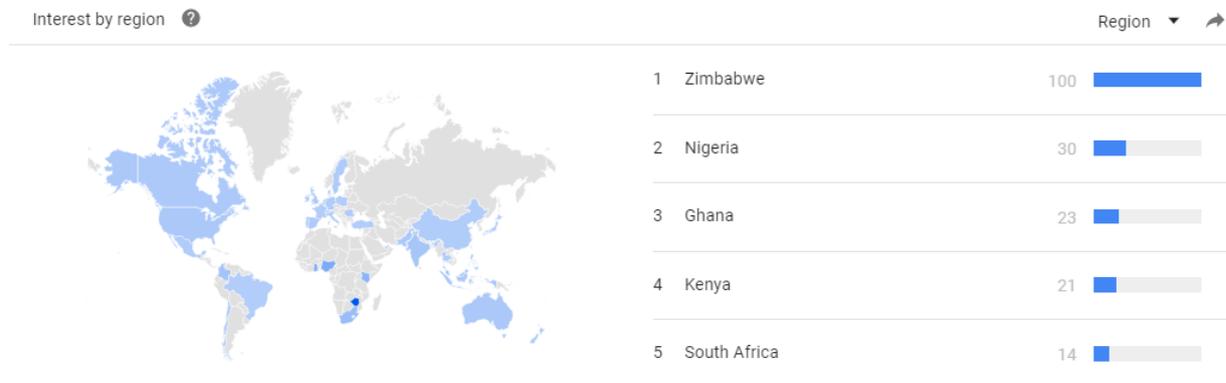


Fig. 3. Regional interest concerning human capital and derived concepts, [5]

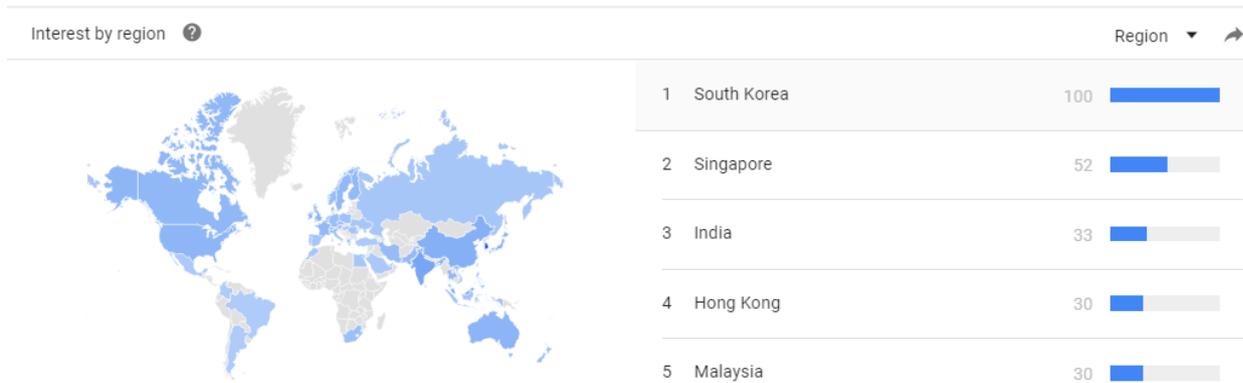


Fig. 4. Regional interest regarding R&D and derived concepts, [5]

management of human capital, human resources, developing human capital, theory of human capital, investments in human capital, etc.

B) for Research & Development (R & D), (figure 4):

It is manifested interest for this concept particularly in Southeast Asia, America and Canada. In this context, we should mention that leaders in searching are: South Korea - 100 %, followed by Singapore, India, Hong Kong and Malaysia. European countries such as Belgium, Ireland, Denmark, United Kingdom

show interest in related searches for this concept about 20 %.

Derived concepts searched by Internet users are: r&d  
Derived concepts looked for by Internet users are: technology, innovation center, management innovation, product innovation, innovation strategy, process innovation, etc.

D) for knowledge, (figure 6):

The geographical search area extends on all the continents, with an increased interest in Asia and

Africa, due to the wider meaning of this concept. In top searches are Zimbabwe, Ethiopia, India, Nepal, Pakistan, Ghana, Nigeria, Kenya. Analyzing the list of derived words that are in the top of searches, we can assume, it is about the meaning of self- and life knowledge in Hindu religion, less about scientific knowledge in its European approach (eg triangle of knowledge).

Derived concepts sought by Internet users are: knowledge management, knowledge center, etc.

Albert Einstein said: "Not everything that counts - can be measured, not everything that can be measured - counts" In this context, we could support the idea, also arguing it by the fact that the popularity of

120% of the EU average, among them we can list in decreasing order: Austria, Belgium, Ireland, France, Luxembourg, Slovenia and UK.

- Group of moderate innovators includes countries with an innovative performance of 50% -90% of the EU average, such as Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia,

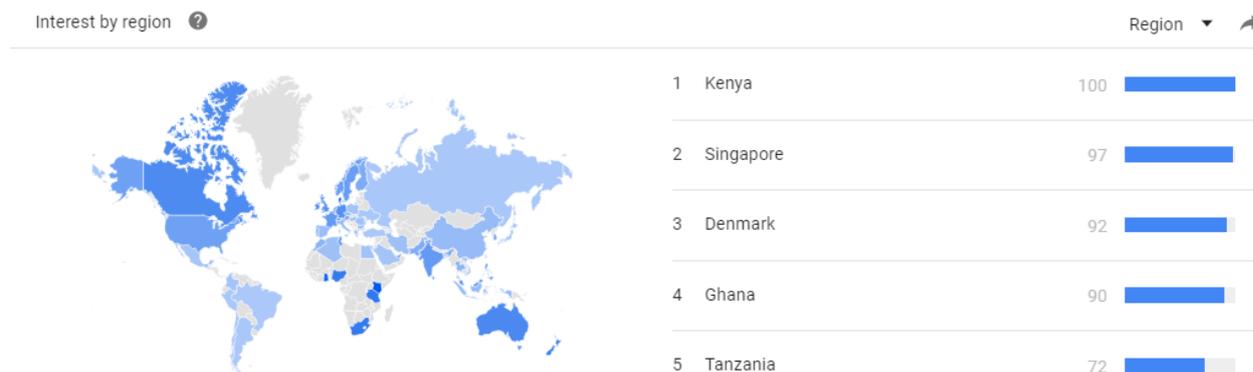


Fig. 5. Regional interest concerning innovations and derived concepts [5]

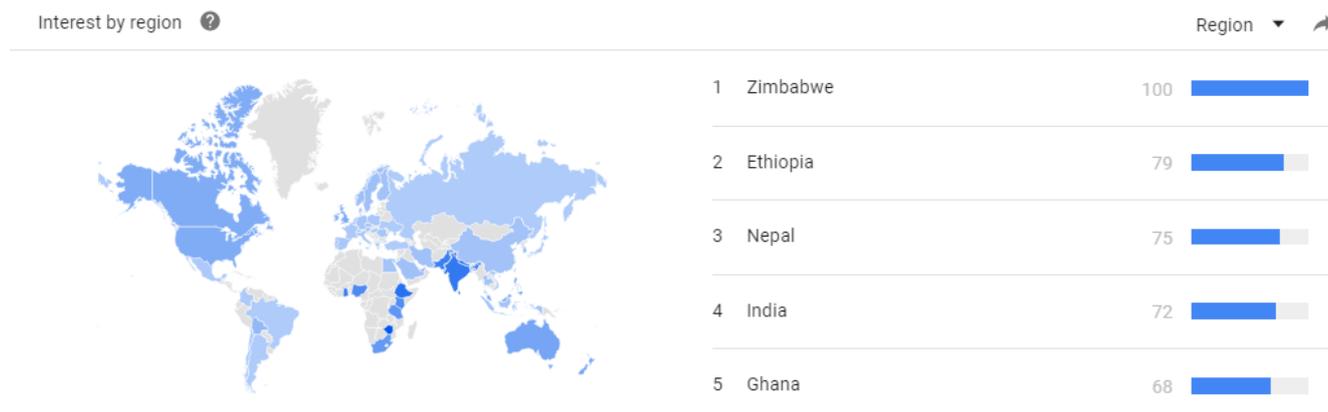


Fig. 6. Regional interest regarding knowledge and derived concepts, [5]

highlighted concepts and their regional distribution reflect only a part of their scientific importance. To be more convincing, we'll come with practical approaches from different countries experience regarding the innovation and knowledge economy, and we'll analyze their impact on human resources development at national and institutional level.

### 3. APPROACHES REGARDING KNOWLEDGE AND INNOVATION IN EUROPEAN UNION

The performance of innovative national systems in EU is measured using a composite indicator of 25 dimensions. Based on these assessments, the EU countries are classified into four broad categories:

- Group of innovation leaders includes countries which innovative performance is ahead of the EU average with 20%. These ones are: Denmark, Finland, Germany and Sweden.

- Group of great innovators includes countries with an innovative performance of between 90% and Lithuania, Malta, Poland, Portugal, Slovakia and Spain.

- Group of modest innovators includes countries as Bulgaria and Romania which record an innovative performance below 50% of the EU average.

Classification of countries into 4 categories is reflected in the figure 7:

Innovations' design, development and implementation are a direct function of the creation, assimilation and use of new knowledge. Therefore, a

country that invests in its human resources will have economic effects. Spending on education and training are justifiable in terms of positive generated externalities.

It is necessary to emphasize that innovation processes do not consist only from searching of new solutions

and receiving new knowledge, but at the same time it is necessary to assure transmission and assimilation by its effective consumers, and vice versa - to speak from consumer to producer about new knowledge and new problems arising and currently are outstanding.

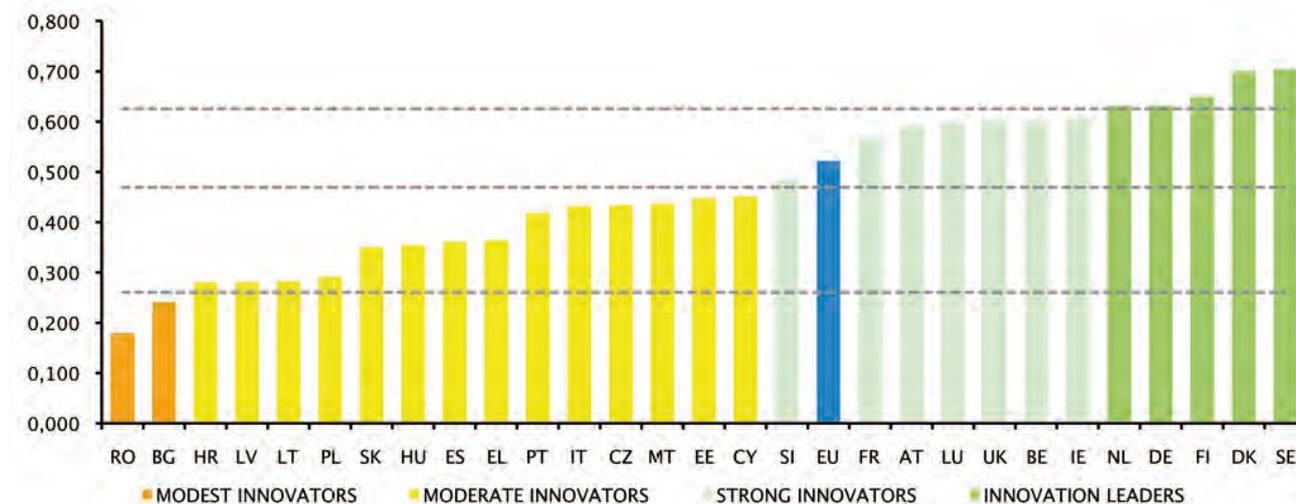


Fig. 7. Innovational performance of EU countries, [3]

This chain of human activity with an impact on present and future, involves solving of two main goals: firstly, it is the purchase of new techniques and technologies, and in secondly, knowledge transmitting or acquisition. If the first goal is provided by the market (being developed by supply and demand), then the second one can occur as immaterial: patents, licenses, dissemination and uptake of new knowledge in congresses, conferences, symposiums and fairs of innovation and invention.

The ability to assimilate knowledge is, above all, learning, acquiring of theoretical knowledge and finding their practical utility. Strategic peculiarity of these processes is the need for significant investments (time, material and financial ones), having no certainty that they will be recovered over a period of time.

Sectoral technological changes are caused by an increase of informational flow, at EU level. Information inputs are able to generate financial support for companies, innovations and create a favorable environment for business relations.

The process of transmitting knowledge is an absolutely natural process for the modern society. Its essence lies in the fact that the knowledge transmission and skills training and obtaining by any individual can be performed in any institution, state or private (as a form of property), which in their turn, after training, begin with professional educational institutions till to high education. Results of the pioneering institutions can be used by other institutions, companies or organizations without compensation costs for obtaining such kind of

knowledge. Such a situation is possible due to the fact that innovation and knowledge are interdependent rather than competing. Thus, one of the conditions for economic growth of EU countries is knowledge.

The formation of new abilities and the free movement of informational flow within a cluster is one of the most important factors for its positioning on an innovative development. According to Peter Drucker: "The process, when applying knowledge to solve tasks which we already know how to address them is called efficiency. When we learn to apply knowledge to solve new tasks - it's innovation".

Knowledge are immeasurable, as they depend on the situation, branch, employees, potential consumers' level of knowledge. Analyzing innovation processes in terms of development and implementation of new technologies are distinguished two types:

- codified knowledge (real) - that are obtained basing on past experience;

- uncodified knowledge (unused) - not yet recognized.

In separate cases, new knowledge can be sublimated due to their innovative and unusual character. In this context, M. Polanyi said: "We know more than we are able to verbalize."

Dynamic model of organizational knowledge creation is the result of interaction between multiple parties. Four different models of conversion knowledge are to be distinguished:

- from unreal in real knowledge - outsourcing model. It is based on coding.

- from real to unreal knowledge - internalisation model. This model is based on experiential learning model.

Procedural and operational knowledge occur as a result of this process.

- from unreal to unreal knowledge - socialization model. It is a process of exchange and creation of new unreal knowledge.

- from real to real knowledge - model combination. It is the process of unification various blocks of real knowledge in order to create a systemic knowledge.

A noteworthy aspect from the European practice is the successful implementation of the concept of entrepreneurial university. The elements of this concept are: university, state and business. In practice, it is reflected by the fact that universities, along with academic and research function, fulfill an entrepreneurial function, too. New companies are created within university incubators, the state has a regulatory role, in special cases also a financier one. Thus, universities create a new model of training specialists, focused on the one hand, to prepare an innovators' generation, and on the other hand, the production of innovative ideas and products for different sectors of the economy.

It is to note that the term entrepreneurial university was introduced into scientific circulation by B. Klark in 1998. He formulated the main features:

- strengthening core of academic management;
- expanding relations with various community stakeholders;
- diversification of funding sources;
- stimulating the entrepreneurship of faculties and departments;
- entrepreneurial culture.

For example, in Germany, regional innovative systems can be conventionally divided into two groups:

- 1) areas with a high innovative potential;
- 2) territories with a moderate innovative potential – oriented to technology transfer and tendencies to create technological enterprises.

A good example is the land Baden-Württemberg, where are focused 14 institutes of fundamental research, 14 institutes of applied research, more than 60 research centers of industrial companies, 9 universities, 39 technical colleges, etc.

German Ministry of Innovation, Science and Research has created 16 clusters based on five areas: energy, health care, logistics, innovative materials and technologies, knowledge-based services. The activity of each cluster is led by a manager, as for its results, they are evaluated by a national commission.

#### 4. RESEARCH POTENTIAL OF REPUBLIC MOLDOVA

According to the Research and Development Strategy of Moldova until 2020, implementation of the

"knowledge triangle" - education-research-innovation is an imperative for the country development. Economic development paradigm requires attracting investments, developing export industries, promotion of the knowledge society, inclusive throughout strengthening research and development activities, innovation and technology transfer, aimed to efficiency and competitiveness [11].

In 2015, the activity of R & D Moldova was unfolded in 65 units, including 40 institutes and research centers, 15 high education institutions and 10 - other units.

The key factor of R & D is the human one, which, according to the situation of the end of 2015 totaled 5033, 51.8% of those are women.

After all employees' training level, 3990 persons had high education (79.3%), 392 people - specialized secondary education (7.8%), and 651 people - another level of education (12.9%).

The structure of researchers by age group, (figure 8), shows that those between 55-64 years (21.4%) and those who were aged over 64 years (20.3%).

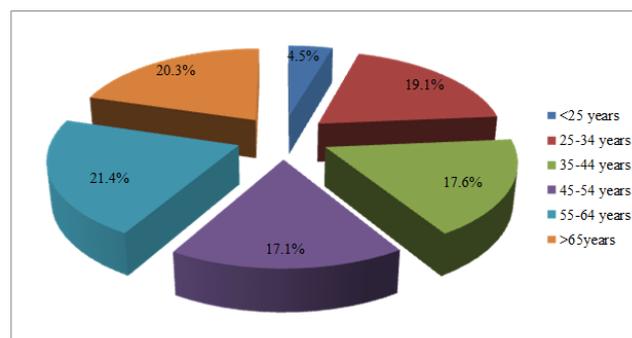


Fig. 8. Structure of researchers according the age, 2015, [10]

Researchers' distribution by scientific areas reveals a predominance of natural sciences (34.6% of total researchers), being followed by engineering and technological sciences with a share of 16.4%. Women researchers are under-represented in the natural sciences and those of engineering and technology, respectively, with a percentage of 49.2% and 29.0%, while 61.4% were from social sciences.

In 2015, the number of researchers with PhDs was up with 1.0% overall, while for women this increase for women was of 5.0%. Gender distribution of researchers with PhDs reflects a slight imbalance between the share of women - 48.6% and men - 51.4%. However, the researchers' number with scientific degree of PhD women represent only 20%.

In 2015, spending on R & D performed by units with business in this area amounted to 451.0 million lei, 424.3 million lei of which, or 94.1% are current

expenses, and is 26.7 million lei, (or 5,9%) are expenses related to capital costs. About 85% of total expenditure were made in units with state ownership. Were spent on the R & D, with more than 8.6% as in 2014.

In the total current expenditures prevail personal expenses - 320.6 million lei (with 41.8 million or 15% more than in 2014). However, administrative expenses amounted with 4.3 million lei and accounted 68.0 million. Other current costs amounted to 35.8 million lei or with 10.0 million less than in 2014, (figure 9).

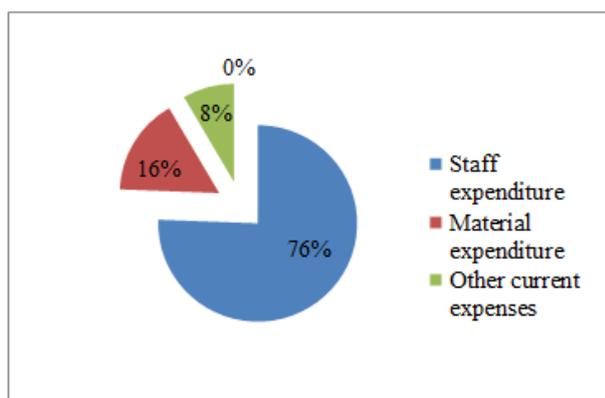


Fig. 9. Structure of current expenses on components (2015), [10]

Depending on the scientific structure, current expenses are as follows: natural sciences - 34.0%, engineering and technology - 25.5%, agriculture - 14.9%, health - 10.0%, social - 8.8% and humanities - 6.9%.

According to Gheorghe Cuciureanu harmonization of doctorate in Moldova with European trends could occur by following [1]:

- 1) Increasing the number of PhD students in order to ensure the economic and social scientific staff: increase by at least 3-4 times of graduates' number and a minimum proportion of 20% of MA or 3-4% of total students to be established;
- 2) A balanced preparation by specialty and doctoral institutions, according to scientific fields competitiveness; need for country economy, taking into account potential competitive advantages; new areas where from it can be quickly advanced etc .;
- 3) Organizing of doctoral schools in partnership with universities and research institutes, involving the business sector;
- 4) International Partnership useful in terms of reduced local research capacities (equipment, technology, etc.) adhering to existing structures or setting up research consortia and doctoral schools;
- 5) supporting the mobility of research;

6) Ensure of a stable financial framework and incentive for doctoral students: increasing allowances for a person PhD; introducing doctoral projects; external private funding.

Ten years ago, in EU countries, share of investment in R&D in GDP was amounted to 1.9%, with a tendency to reach 3% in 2020. In Moldova, the proposed target for 2020 is 1.5%, that represents only a half of the European target.

To characterize the scientific research on technical and engineering field, we'll analyse the component of R & D in three large institutions as are: Technical University of Moldova, State University "Alecu Russo" and Institute of Engineering and Computer Science of the Academy of Sciences from Moldova.

#### 4.1 Technical University of Moldova (TUM)

In 2016, TUM has 28 ongoing research projects: basic scientific research - 5; applied scientific research - 7; projects under state programs - 1; independent projects for young researchers - 2; projects of financing conferences - 2; projects editing scientific monographs - 1; international bilateral projects (Romania, Belarus, Ukraine) - 6; international projects - 4 [9].

The distribution of projects on research centers was as follows:

- 1) Mechanical and Energy Engineering Center - 6;
- 2) Center for Civil Engineering, Economics and Management - 2;
- 3) Center Electronics, Information and Communication - 13;
- 4) Center of technological processes in food and light industry - 7.

Human potential trained are totally - 206 people, including: researchers - 149 engineers - 41 technicians - 16. Staff with scientific degree includes 22 PhDs and 67 doctors.

Research results from 2016 were presented in 197 publications, including:

- a) 94 international publications:
  - articles in journals with impact factor - 26;
  - articles in international collections - 27;
  - theses of international conferences - 31;
  - articles in other international journals - 9;
  - chapters in international monographs - 1.
- b) 103 national publications:
  - articles in national collections - 52;
  - articles in national journals category A, B and C - 28;
  - national conferences sentence - 20;
  - national chapters in monographs - 1;
  - articles in other national magazines - 2.

Patent activity in 2016 include 13 positive decision of granting the patent and 5 patent applications.

In 2016 were publicly presented 11 dissertations, among them: 6 - in technical sciences, 2 - in physical sciences, 3 - in economics.

Under international invention exhibition were obtained: gold medals - 40; silver medals - 5; bronze medals - 3; special awards - 9; mention diploma - 20. During the year there were organized and held 14 international conferences, symposia, exhibitions, work-shops.

#### **4.2 State University „Alec Russo” from Balti (SUARB)**

In 2016, the State University "Alec Russo" has realised researches in 3 projects regarding the field of technical and engineering sciences: 2 institutional projects, 1 project for young researchers [8].

The research works were carried out in 2 scientific laboratories.

Totally, 21 people were trained in the research, including researchers – 12, PhD. Hab. – 4, PhDs - 4, PhD - 3.

During 2016 research results were presented in 41 publications, including 1 monograph published abroad; 1 article published in other national magazines; 1 article in national collections; 4 articles in other magazines published abroad; 3 works staff (1 manual, 1 guide, 1 lecture notes); 29 communications theses in congresses, conferences, symposia. One scientific paper has been submitted for publication in international journals.

Participation in of inventions exhibitions: medals: gold - 10; diplomas - 12.

In 2016 there were published 2 editions of the journal "Physics and technique: processes, models, experiments".

Scientific events: On June 15 to 18, State University "Alec Russo" was coorganiser of the event: International Scientific Conference "ModTech 2016", event held in Iasi, Romania. On June 30-July 1, 2016 State University "Alec Russo" was coorganiser of the: International Conference of unconventional Technologies, ICNcT 2016, 18th Edition, held in the Technical University of Moldova.

In 2016 a PhD thesis in physics was publicly defended (Hirbu Arefa, D.Sc. scientific advisor., PhD. Hab, Prof. Topala Pavel) and reached the rank of associate professor teaching science (Rusnac Vladislav).

During 2016 employees of the State University "Alec Russo" were part of the international project TEMPUS-1-2013-1-544 197-IT-TEMPUS-JPHES Technological Transfer Network (TecTNet) of the EU program TEMPUS.

During implementing of the project, there were obtained the following results:

1. Master Program "Management of Innovation and Technology Transfer". The master program is pilot

from more points of view. Thus, it is for the first time in Moldova when a master program is designed and conducted in a TEMPUS project. Another aspect worth to be mentioned is the fact that it has been approved by the Ministry of Education as a master program conducted jointly by the 4 universities of the country - project beneficiary TecTNet. Staff of the master's program consists of experienced specialists from Moldova and EU. One advantage for students enrolled in master course is the possibility to benefit from a training course at one of EU universities - project partner.

2. Cooperation between universities and enterprises. In order to strengthen links between universities and the business sector and to stimulate private investment in innovation activities, in March, respectively, in June 2014 two seminars focused on cooperation between universities and businesses were organized in Chisinau. The seminars had the aim addressing various aspects of innovation and technology transfer, presentation of TecTNet project activities and providing a platform for exchange of information, experience and knowledge on the management of technology transfer from research to business development. Over 200 persons have participated at two workshops representing academia and the business community with the opportunity to interact and establish contacts.

3. Establishment of Technology Transfer Offices. Taking into account that the existence of an adequate infrastructure and qualified personnel are the basic elements for a successful technology transfer, the project has envisaged the creation of specialized units in Moldovan universities. These persons were registered as master of a ongoing master program, and at the end of the course they received a traineeship in the units responsible for technology transfer from European universities. Thus, Moldovan universities will have not only equipped offices, but also qualified staff with European experience in the field.

Each of the four universities selected two persons from its administrative staff, who were employed in the new-created Offices of Technology Transfer (OTT).

Involving academics in research projects has a positive impact on research and stimulates interest in exploring new areas of science. Participation in international conferences, study visits, researches and academic mobility are just some of the opportunities for benefiting of human resources involved in researches. Training and retraining of teachers creates prerequisites for professional prestige to a higher level, which enables students, as educators, to gain abilities, knowledge and transferable skills in order to integrate themselves successfully into the labor market.

### 4.3 Institute of electronic engineering and nanotechnologies „D. Ghițu” (IEEN)

During 2016, in the Institute of Electronic Engineering and Nanotechnologies "D.Ghițu", works of scientific research and innovation were unfolded in the strategic direction 16.02 / 18.02 "Materials, technologies and innovative products" throughout 2 basic research projects, 3 applied research projects, 1 joint research project between ASM and CNC from Italy; 1 joint research project between ASM and FRFC from Belarus; 1 joint project between ASM and ANCSI from Romania; 3 projects within the program "STCU & ASM: joint initiatives of research and development ", 1 project of technology transfer [7].

Jointly with IFA, USM and UTM the institute publishes scientific Moldavian Journal of the Physical Sciences and the scientific teaching journal Physics and modern technologies.

The results of researches realised by employees of the institute in 2016 were presented in 152 scientific papers: theses – 97, articles: revues ISI – 29, national magazines – 8, other international journals - 6 and international / national collections – 5, chapters in international monographs - , international monographs – 2, electronic publications - 2.

On December 31, 2016 60 scientists were working in the Institute, 10 of them with scientific degree of PhD and 27 with PhDs in science, 10 of scientific researchers are under the age of 35 years.

In 2016, the Section al patent, in common with the Institute personnel have presented for AGEPI 11 patent applications and have obtained 7 patents of invention.

At the same time, IIEEN collaborators' remarkable results were awarded with diplomas and mentions in various exhibitions and competitions both national and international:

- Award "Dumitru Ghițu" of the Academy of Science in engineering field - Acad. Ion TIGHINEANU.
- honorific title PERSON OF THE YEAR ninth edition in the nomination "Inventor of the Year" - Acad. Ion TIGHINEANU.
- Medal "Dimitrie Cantemir" - Dr. hab., Prof. Albina NIKOLAEVA.
- Diploma of Honor of the Romanian Academy - m. cor. Anatolie SIDORENKO.
- Honorary Diploma of the Joint Institute for Nuclear Research in Dubna - m. cor. Anatolie SIDORENKO.
- Doctor Honoris Causa of the Technical University of Moldova - Acad. Valeriu CANȚER.
- laureate diploma "Academician Dumitru Ghițu" of young researchers' scientific achievements of IEEN "D.Ghițu" awarded Mr. dr. Roman MORARI for excellent results obtained in 2016.
- 4 gold medals, 1 silver medal, 3 certificates of excellence.

### 5. GENERALISATION OF RESULTS

To measure the level of performance in scientific research recorded during 2016 by these three specialized institutions, we will bring together the obtained indicators in a summary table:

In total, there were carried out 46 research projects during 2016: 28 in TUM, 6 in SUARB and 12 in IEEN.

Referring to separate indicators, in terms of publications TUM ranks on the first place with 197 works, IEEN – with 152 works and SUARB with 41 works. Regarding distinctions TUM is placed on the first place, on the second one – SUARB, and finally - IEEN. At the chapter of dissertations: TUM - 11 and SUARB and IEEN - by one.

Referring to the degree of involvement of human potential in research projects, it would seem that universities have the preeminence of 7.4 and respectively 7, while only IEEN with 5, but in reality it is not like this, because universities have human personnel who doesn't work in projects of any kind, that's why they were not included from the start as staff working in research.

Table 1. Indicators of performance in scientific research

Indicators	TUM	SUARB	IEEN
Research projects	28	3	12
Value of projects (thousand lei)	6873.9	465.9	10600.7
Human potential trained in research	206	21	60
National and international publications	197	41	152
Patents	13	-	7
Medals, prizes, diplomas, awards	77	22	15
Supported dissertations	11	1	1
Involvement of human potential in research projects	7.4	7	5
Value of projects / Human potential trained in research (thousand lei)	33.4	22.2	176.7
Publications / Researcher	0.96	1.95	2.53
Patents / Research	0.06	-	0.12
Medals, awards, etc / Researcher	0.37	1.05	0.25

If we refer to the indicator of project value / human potential, on the leading place IEEN is put, because its income entirely is derived from research, while universities provide educational services and of course this one, is the main income source,

allowances accorded to such kind of activity do not appear in the summary table (it is confidential information of universities).

When we refer to indicators such publications / researcher, of course it is normal that IEEN is on the leading place with an indicator of 2.53, which work is directly focused on new knowledge, while universities combine obtaining of new knowledge with their application in training of new generations of specialists, that's why USARB indicator is 1.95, while TUM has only 0.95.

The indicator number of patents or patent applications per researcher, IEEN is presented the most performant, absolutely normal fact for an institution based only on research activity. Referring to medals, awards / researcher when firstly is placed SUARB with an indicator of 1.05, TUM – with 0.37 and finally IEEN- with 0.25. The last result could be explained by the fact that academics are more active both as participants and as innovative and scientific work events organizers also for scientific activity are granted awards or prizes.

## 6. CONCLUSIONS

From the obtained and processed by authors' analysis of the information we could conclude the following:

- human capital and its education level are the main source of development of a sustainable economy based on new technical inventions and innovations;
- developing a competitive economy is possible only if that it is invested consistently in research and training of specialists;
- effectiveness of human resources' training for research and development (for Moldova) is quite reduced, as the number of doctoral graduates and their structure is not increasing in favor of natural sciences and engineering.

In order to improve the activity of university research it should be introduced quality indicators aiming the structure for areas of interest:

- promoting projects or R&D organizations dealing with problems regarding the private sector through financial and non-financial incentives;
- establishment of models to measure the impact of R&D institutions on the private sector, such as quantification of patents and copyrights used by enterprises;
- creating entrepreneurial universities;
- organizing networks transfer requirements for innovation and innovation capacities between R&D centers and private sector.

From the results of the analysis of the achievements of different types of institutions in the field of research-innovation and the transfer of new knowledge, it is necessary to collaborate more deeply

in all fields, especially those in the Republic of Moldova.

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