

# **SYNERGETICAL PARADIGM OF RESEARCH AND INNOVATION SYSTEM IN REPUBLIC OF MOLDOVA IN CONDITION OF EUROPEAN INTEGRATION**

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**Gheorghe DUCA \***, **Anatol ROTARU \*\***, **Oleg BUJOR \*\***  
\*Academia de Științe a Moldovei,  
\*\*Universitatea de Stat din Moldova

## **The world we are living**

**T**he modern society faces a large set of global problems. The mankind lives in the world which is becoming more and more complicated the world in which basic parameters get exponential perspectives.

The modern society is characterized by nonlinear growth of the volume of information and communications, because of what, the fragmentariness perception of the world appeared, in correlation with a stressful state in the society, crises at the level of the person and social groups, intensity in interethnic and religion relations grows more and more, the terrorism is developing, as well as social intensity grows and there is an ecological degradation. The system of society becomes essentially balanced-off. It is very sensitive to small internal and external impacts.

The system of economic relations undergoes essential qualitative changes, on the state and on global levels. These changes seem to be far away from the end. Real economic processes become more and more complicated. There is an intensive process of globalization. Under influence of never-ending technical innovations the modern life varies very quickly. We are witnesses of increase of the general instability of world development.

Achievements in a classical and nonclassical science have led to ecological accident: environmental contamination, infringements in ecosystem, change of a climate. There is a threat of demographic crises.

## **The characteristic of modern society. Global dynamics**

According to URY USA predictions (concerning global development till 2015) it is mark that in next 10 years about half of global population will face the challenge of water shortage. Geopolitic and ideologist S. Hantichton suppose that XXI century will become collide era for civilization.

In the past the main method of scientific research was the analysis where all parameters were separated and dismembered. In difficult systems – subsystems, processes or factors were marked and evaluated in separation from all the rest. It has led to differentiation in sciences, to creation of the new branches of knowledge. However in the society and in technical science appeared some problems, for which it is necessary not only the analysis apply but also the synthesis apply – association of methods, knowledge, ideas from different areas (a sight at a problem (object) as a whole).

The synergetic became one of the most successful and actively developed approaches of such type. It investigates occurrence in systems of new qualities which their subsystems do not possess.

**Synergetic is an interdisciplinary science explaining the formation and self-organization of patterns and structures in open systems far from thermodynamic equilibrium.** It is founded by Hermann Haken, inspired by the laser theory.

Self-organization requires a ‘macroscopic’ system, consisting of many nonlinearly interacting subsystems. Depending on the external control parameters (environment, energy-fluxes) self-organization takes place.

### **Order-parameter concept**

Essential in synergetic is the order-parameter concept which was originally introduced in the Ginzburg-Landau theory in order to describe phase-transitions in thermodynamics. The order parameter concept is generalized by Haken to the “enslaving-principle” saying that the dynamics of fast-relaxing (stable) modes is completely determined by the ‘slow’ dynamics of as a rule only a few ‘order-parameters’ (unstable modes). The order parameters can be interpreted as the amplitudes of the unstable modes determining the macroscopic pattern.

**As a consequence, self-organization means an enormous reduction of degrees of freedom (entropy) of the system which**

**macroscopically reveals an increase of ‘order’ (pattern-formation). This far-reaching macroscopic order is independent of the details of the microscopic interactions of the subsystems. This supposedly explains the self-organization of patterns in so many different systems in physics, chemistry, biology and even social systems.**

### **Synergetic in social systems**

In science management, synergetic was first applied to deliberative structures by Stafford Beer, this method is based so specifically on geodesic dome design that only fixed numbers of persons, determined by geodesic chord factors, can take part in the process at each deliberation stage. Beer’s earlier work was briefly applied by the government of Salvador Allende in Chile in the early 1970s. This was Project Cybersyn- a portmanteau word from “Cybernetic synergy”. The approach is applied today as a series of related management methods. All of these seek some macroscopic order of priorities by taking some path of integrating diverse positions or attitudes to some problem, making the synergetic assumption that priorities will converge under the constraint of viability.

There are similar themes in the work especially of Jay Forrester and Donella Meadows who sought leverage on social and management problems by seeking out an emerging macroscopic order. Under synergetic assumptions, this could often be reliably found by determining the points of greatest resistance to change by an older or inertial macroscopic order. The twelve leverage points of Meadows apply the order parameter concept but without making the assumption of “enslaving” lower-leverage points to the higher-leverage. A similar view is expressed in the deep framing theory of linguist George Lakoff, in which basic conceptual metaphors partly but do not completely determine the actions of their users.

As in all social sciences, conscious goals, choices, free will, self-interest and self-awareness prevent any control groups or strictly predictive models from applying to human problems as they do in natural sciences. In Meadows’ leverage model the leverage of self-organization is explicitly below that of goal-setting, and much below that of mindsets and the ability to change them. The synergetic assumptions apply mostly to the lower leverage factors, while the higher leverage factors follow principles more like Lakoff’s. However, the basic relationship remains: fast-relaxing (stable) modes are at least partly determined or

strongly biased by the 'slow' dynamics of only a few parameters. Lakoff argued in his Moral Politics that there could be as few as one basic metaphor (state as parent) determining a vast range of political choices and policy making patterns.

Among the numerous applications of the **mathematical methods and concepts** of Synergetic are:

- Physics: formation of spatio-temporal patterns in lasers, nonlinear optics, semi-conductors, hydrodynamics, plasmas, geophysics, meteorology, astrophysics;
- Chemistry: formation of macroscopic spatio-temporal patterns, such as in the Belousov-Zhabotinsky reaction;
- Biology: models of evolution and development, bimolecular evolution (Eigen-Schuster theory), morphogenesis (e.g. Gierer-Meinhardt model), growth of plants and animals, movement science (coordination between limbs and transitions between movement patterns), quadrupedal gait transitions;
- Medicine: brain activities, heartbeat, blood circulation;
- Cognitive Science: e.g. pattern recognition, motor control, switching among coordination states (e.g. Haken-Kelso-Bunz Model);
- Computers: self-organization, synergetic computers, attractor networks;
- Psychology: including psycho-physics, psycho-therapy (indirect control of human behavior by changing control parameters by material or immaterial interventions);
- Sociology: dynamics of groups, collective formation of order parameters governing human behavior including formation of public opinion etc.;
- Economy: e.g. Schumpeter cycle, competition between companies, synergy effects;
- Ecology: competition between species, impact of climate, development of forests, etc.;
- Philosophy: the concept of self-organization, strong vs. weak emergence;
- Epistemology: establishment of paradigms in the sense of Thomas S. Kuhn;
- Control theory: indirect control via control parameters;
- Electrical network theory: activity patterns, stability;
- Language theory: origin of meaning;
- Information theory: compression and inflation of information,

change of information in self-organization processes;

- Management theory: indirect control of processes, corporate identity, "social climate" etc. as order parameters;

Neuroscience: brain activity patterns, instability and switching associated with phase transitions in sensorimotor function.

In a number of cases, such as laser physics, nonlinear quantum optics, plasma physics, the variables are the electric and magnetic field strengths and atomic quantities such as dipole moments and occupation numbers of atomic levels. In many cases, a mesoscopic approach is used in which many atoms or molecules are lumped together in a volume element that is large enough so that average methods can be used, but small enough so that spatio-temporal variations of locally different parts are suitably covered. Such local averages e.g. population densities or matter densities, local fluxes etc. may be used as variables in most fields. Also estimated quantities such as amount of pain experienced by a subject may be used as variables.

### Equations of motion

The dynamics is described by evolution equations for the variables under consideration, i.e. the temporal change of the relevant variables is determined by the present state of the system. In general, the equations are stochastic, nonlinear, partial differential or integrodifferential equations that contain fluctuations of the Stratonovich type. Quite often they stem either from the elimination of the coupling of the system to external reservoirs or the elimination of internal variables. Thereby also terms for couplings of the system with the outside such as fluxes into the system or energy dissipation may be taken into account.

### Method of solution

A general solution of the evolution equations which has also to take into account initial and boundary conditions is, of course, impossible. However, the following technique has been very successful in the whole range of Synergetic: for given value of the control parameter or a set of control parameters we start from the assumption that the solution on or possibly close to an attractor is known. This may be a fixed point attractor, a limit cycle attractor, a torus, or a chaotic attractor.

Then the stability of the solution is checked when one or several control parameters are changed which in the conventional approach used in Synergetic is done by linear stability theory. The solutions of

the linear stability problem essentially are of exponential nature according to spectral theory. The exponentially increasing or neutral solutions characterize the “unstable modes”.

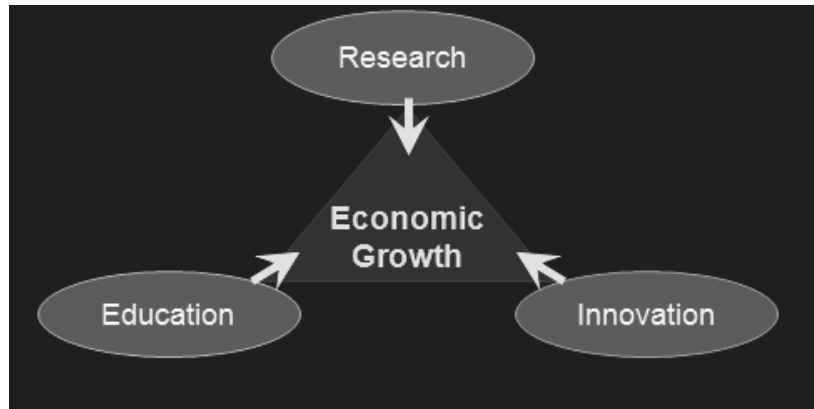
Their amplitudes or phases become, in the fully nonlinear treatment, which takes also fluctuations into account, the order parameters. The equations of motions are then transformed to these new variables, amplitudes and phases defining order parameters, and the still stable modes. Then, taking into account the fluctuations, the damped (stable) modes are eliminated (slaving principle). The resulting equations for the order parameters are in general low dimensional and are of the Langevin equation type, however with nonlinearities. They may be converted into Fokker-Planck equations.

In present time, in Republic of Moldova different internal changes are taking place, during which evaluates:

- Social and economic life;
- Political system;
- The basic characteristics of external borders (quick increase of their transperance), etc.

Despite the fact that what the Republic of Moldova is orientated to the knowledge and science, in last 20 years in Republic significant decrease the level of knowledge and cognitive resource. Many modern technologies in electrical industry and electronic industry were lost.

The same things happen in other domains of national economy.



***Knowledge-based society is a society based on people, their knowledge, skills, creativity, initiative.***

The innovative activity is practically reduced to a minimum. There is serious lack of professionalism in such domains as physics, mathematics, chemistry, biology, etc. The number of scientists was substantially reduced. The prestige of science decreased.

That's way the investments in science are one of the most profitable investments for our country.

Republic of Moldova should orient its vector of development to the “society based on knowledge” which is the basic direction of development for the modern society.

The radical and quick reorientation of social and economic policy of the country is needed, based on the development of all components of the cognitive process: creation of knowledge, dissemination and storage of knowledge, etc. At present stage, new world outlook revolution is necessary for mankind, revolution in the science is necessary. Now there is a search of an exit from the global crisis, based on achievements of a modern science including such as Synergetic, the Science about complex, the nonlinear science. The science and education in the beginning of the third millennium become fundamental factors of development of Mankind. They will define an exit from global and local crises, will determine the standards of well-being, health, well-being of stability, safety of system of world development. The states which will not provide conditions for a sufficient level of steady development of a science and education with reliability will lead their citizens on poor existence and will become sources of development instability.

The present stage of development of a science is characterized by new interpretation not only of methodology of scientific researches, but also search of new organizational-administrative paradigms, increase of the management efficiency and the organization and self-organizing of scientific activity with the purpose of its submission to problems of social and economic development, acceleration of implementation process of scientific know ledges and technologies, transition to the high technology and educational economy, to constant increase of culture of the population.

Being self organized system, the science develops according to cyclic laws, consistently passing through zones of bifurcation and sites of monotonous development. Taking into account nonlinearity and non-equilibrium of systems of a science and education, revealing parameters of the order, stability, the analysis of occurrence of chaos in the given systems is important. The synergetic approach demands a com-

plex approach to evaluation of determining factors of a science, their cumulative transformation and modernization according to national specificity. At the present stage of development the system of a science and education in Republic of Moldova collides with set of problems and determined first of all chronic lack of financing. The low prestige of scientific activity and unpopularity of a scientist work in a society define unwillingness of the most talented youth to go in a science. Ageing of the scientific staff, outflow of minds abroad, as well as sharp lack of the modern equipment is acute problems for the Moldavian science. At the same time, transformations of scientific - innovative sphere of Moldova as well as other ex-Soviet countries, in the given period, have also some positive aspects: the science became more open and democratic. The international scientific and technical cooperation has repeatedly grown. Have disappeared ideological and slacken administrative methods of regulation of scientific activity. It is commissioned plurality of sources of financing, competitiveness, selective measures of support of the best scientists.

At the present stage the choice of a national scientific and technical policy cannot occur without correlation with globalization of economy, the finance and sciences. In conditions of transition to market system creation of essentially new scientific and technical policy is necessary in the field of a science and techniques which should be accompanied by studying of its condition in the given concrete conditions making comparison with the experience of the advanced countries.

#### **How the investigations take place?**

The various literature concerning the bases of synergetics and the theory of different self-organizing systems has been studied. The information file of the bibliography on synergetics, including synergetics of social and economic systems has been made. Problems concerning self-organising in complex hierarchical systems have been studied. It was revealed, the role of organising and self-organising in such type of systems, including key and basic parameters which determine conditions and dynamics of synergetic systems. Problems concerning stability and instability of complex social and economic systems (caused by internal and external interactions) have been studied.

In case of instability synergetic systems evolve in compound way, and in case of particular parameters evolve in chaotic way, that can become the reason of disintegration of corresponding structures. Origin

of dynamic chaos results from numerous bifurcations in system. Criteria of dynamic chaos and the transition scenario to chaotic behavior of systems have been defined. Problems concerning alternation of processes of hierarchicalisation and dishierarchicalisation, formation and disintegration of structures have been studied.

The theory of casualties occurrence in development of complex social and economic systems and the theory of risk and its management has been studied.

Issues concerning synergetics and global problems of mankind have been examined. It is shown, that the synergetics is new synthesis of the modern science. Issues concerning synergetics as a tool of social and economic development have been revealed, a technique of the synergetic analysis of complex systems, features of modeling of social and economic systems have been studied.

Some basic mathematical models have been studied, including their application in research activities of social and economic processes, social crises and collapses in the modern society, synergetic approaches to management of complex social and economic systems, issues concerning synergetic management and synergetic financial management, issues concerning forecasting of complex social and economic systems and their feature have been studied.

Theoretical aspects of synergetic approach to management of nonequilibrium social and economic system, issues concerning synergetic of social evolution, entropy and the market, some problems of risk management and a sustainable development of social and economic systems, issues concerning forecasting and dynamics of difficult socially-technological systems, their stability and system of limiting-critical indicators of their development, the problems of order occurrence of their chaos have been studied.

Globalization processes in the postindustrial world, problems of the developed and developing countries was studied.

Issues concerning science as a synergetic system have been studied. It is shown that the science in essence is difficult, nonequilibrium, opened, nonlinear synergetic system. Issues concerning self-organising and organising of the science have been revealed; the scientific policy and the problems concerning the development of the science have been studied as well as, the objectives of scientific policy. The problems concerning formation of essentially new national synergetic model of science, science issues in XXI century and its obligations in

the face of society, problems of scientific and technical progress management, and development of the strategy of a scientific and technical policy have been revealed.

Issues concerning formation of structural elements of scientific institutions system, formation of the academic, university and applied-research scientific institutions, issues concerning formation of private scientific institutions have been studied.

Issues and problems of interaction of the academic, high school and applied-research science have been studied. Also, the synergetic aspects of such interactions have been revealed.

The international scientific and technical relations, the maintenance and aspects of scientific and technical international cooperation have been studied. Key parameters of science development - order parameters have been revealed. Possibilities of mathematical modeling in organisation and forecasting of the science development have been studied. Issues of a supply with information of a science, the organisation and management of a science in a context of world experience, questions of features of management by a science in reforms, questions of a choice and realisation of priorities of scientific and technical development have been studied. The partial comparative analysis of the organisation and self-organising of a science of some countries is just done.

The work concerning elaboration of metodologo-methodical, analytical, organizational, information-technological document to estimate efficiency of the international cooperation in the field of a science, technology and innovations is just started.

The work concerning metodologo-methodical, analytical, organizational, information-technological criteria elaboration for an estimation of the international cooperation potential in the field of the science, technology and innovations is just begun.

The analysis of situation in scientific and technical sphere from the date of Republic of Moldova declaration of independence is just made.

Priority directions of research and elaborations in Republic Moldova, issues concerning financial policy in the field of a science, questions of scientific and technical examination was studied. Various models of development and functioning for the purpose of new synergetic model offer were investigated.

Necessity of creation of a new science - sociology of synergetic was proved. Issues concerning management and self-organising in the

course of science reform, synergetic aspects of risk management, a science role in the modern world and globalization processes, global problems of a science at the present stage were studied.

The data file about legislative maintenance of a science in Republic of Moldova from the date of declaration till now has been made till now.

The legislation concerning scientific, technical and innovative activity was studied: laws, parliament decisions, governmental and presidential regulations. The sequence and development of standard-legal base of functioning science, issues concerning legal maintenance of the scientific and technical policy, aspects concerning standard-legal maintenance of intellectual property have been revealed. It was studied the possibility of development and perfection of legislative base in research sphere in the line of its harmonization with the world legislation.

Interaction between the science subsystem as synergetic system and the state, system of higher education, the industry, business and a civil society have been studied.

It was shown that all these structures are synergetic systems: difficult, nonlinear, nonequilibrium and opened, having possibility to exchange among themselves with energy, substance and the information.

It was shown that science and higher education subsystems are backbone, providing sustainable development of the state.

Especially, we can mark, the issue concerning integration of the science, higher education and the industry. Mechanisms and forms of integration of the science and higher education have been proposed on the base of creation of educational-scientific and educational-scientific-and-production complexes. The role of Academy of Sciences in national system of the science has been studied.

The role and science place in a modern society and problems of their mutual relations, problems of the state and civil society at the present stage, problems of strategic management in the course of integration of a science, higher education and the industry have been studied.

Issues concerning interaction of a science and economy, structural and functional aspects of a transitional economy, global problems, quality of a life and science were revealed. The strategic role of higher education and the science in the modern world was revealed.

Organizational problems of interaction of the academic, high school

and branch sciences were analyzed and revealed, synergetic effects of this interaction was shown. Some issues concerning science and private business were studied.

The stage-by-stage analysis of scientific potential of Republic Moldova from the date of declaration of independence is just started. The policy of development of scientific and technical potential has been analyzed.

The main characteristics of parameters and structural basic indicators of conditions and development of scientific and technical potential have been revealed. Problems of effective reproduction maintenance concerning scientific and scientific-pedagogical staff have been studied. The work concerning database formation about scientific and technical potential in some countries of Europe, USA, CIS and others, for the purpose of the comparative analysis of scientific and technical potentials is just begun.

The basic characteristics of scientific and technical potential and its basic components have been revealed: staff, material and technical basis, informational and organizational components.

Problems concerning development of personnel provision for innovative activity were revealed, the reasons was established and the counteraction measures for scientific outflow was offered, questions of youth attraction in a science, questions of stability of scientific and technical potential was analyzed.

Issues concerning professional training of the top skills personnel by the means of doctoral studies and postdoctoral studies were studied. The structure of the system of a professional training and its development, questions of financing and structure of financing of a professional training was examined.

Market structurization was made: on the base of market size; on the base of geographical position; on the base of the functioning mechanism; on the base of degree of a saturation, etc. The basic markets of Republic Moldova have been revealed. Classification of the markets has been made. The basic functions of the market have been revealed.

### **State policy in the field of science and innovations**

Let's note that state scientifically-technological and innovative policy – is an integral part of social and economic policy of Republic of Moldova.

Main objectives of state scientifically-technological and innovative

policy are:

- Maintenance of economic, social and cultural development of the country due to an effective utilization of intellectual capacities of the society;
- Perfection of scientific, scientifically-technical and innovative potentials as major factors of socially and economic progress;
- Achievement of high intellectual level of the society orientated on improvement of life quality.

State policy in the field of science and innovations as a strategic priority:

(1) Support of research - development, stimulation of a stable innovation climate represents a strategic priority in the socio-economical development of the Republic of Moldova.

(2) State policy in the field of science and innovations is a component part of social-economic policy of the Republic of Moldova and establishes the objectives, principles and mechanism of the activity in this field.

(3) The state jointly with the scientific community elaborates the policy in the field of science and innovations and promotes it by ensuring its normative, organizational and socio-economic base, contributing by measures and means to the realization of different activities in the field of science and innovations.

(4) The state determines the scope, principles and mechanisms of the activity in the field of science and innovations, mode of attraction of investors, ensuring it's organizational and socio-economic base.

(5) The state stimulates the activity in the field of science and innovation, ensures its material-technical support, and creates favorable conditions for absorption of innovations.

(6) State policy in the field of science and innovations is carried out by the scientific community in the person of the Academy of Sciences in accordance with the economic, financial and scientific-technical policy.

### **The goals and tasks of state policy in the field of science and innovations**

The basic goal of the state policy in the field of science and innovations is a stable socio-economic and human development in the Republic of Moldova, based on maximum stimulation and use of scientific, scientific-technical and technological potential, oriented to creation

and commercialization of competitive and ecological pure produces, services, processes.

The tasks of the state policy in the field of science and innovations are:

a) complex integration of fundamental and applied researches within the innovation activity from all fields of economic, social, cultural, political and informational life of the Republic of Moldova;

b) development and efficient use of scientific and technological potential;

c) insurance of progressive structural reformation of the field of production of goods and services, increasing their efficiency and competitiveness;

d) protection of the environment, monuments of natural and historic heritage, rational use of natural resources, saving and developing biological and cultural diversity;

e) protection and development of informational resources of the country;

f) consolidation of the interconnection between science and education.

#### **Basic principles of state policy in the field of science and innovations**

State policy in the field of science and innovations is carried out on the basis of the following basic principles:

a) recognition of science and innovations as basis of the social-economic development of the Republic of Moldova;

b) organization of the activity on the strategic directions of development of the activity in the field of science and innovations in accordance with the socio-economic, cultural and educational priorities of the country, trends of development of the world science;

c) rational character of the integration of the national fields of science and innovations into world and regional circulation on the basis of the principles of cooperation and specialization;

d) concentration of the means allocated from the state and other resources on strategic directions of field of science and innovations;

e) adjustment of activity in the field of science and innovations to social-economic, cultural and educational necessities of society;

f) evaluation and selection of state programs and projects in the field of science and innovations on a competitive basis;

g) use and development of scientific, scientific-technical and scientific-technological potential, creation of the infrastructure of the field of science and innovations;

h) transformation of objects of intellectual property into competitive products, services, processes on the internal and external markets;

i) promotion of a favorable financial, tax and customs policy in the field of science and innovations;

j) insurance of partnership relations between science, education, production and financial fields;

k) conformity of the activity in the field of science and innovations to international norms and principles;

l) insurance of transparency in the process of realization of state policy in the field of science and innovations;

m) granting rights on well-founded risk of activity from the field of science and innovations.

#### **Strategic directions of the activity in the field of science and innovations:**

(1) State policy in the field of science and innovations envisages concentration of resources and organization of the activity on strategic directions of the field of science and innovations.

(2) Strategic directions of science and innovations are identified taking into consideration current trends at the world level, of the national potential and necessities of the social social-economic development of the country.

#### **State programs in the field of science and innovations:**

(1) State program in the field of science and innovations represents a complex of projects in this field and a form of realization of state policy in the field of science and innovations.

(2) State programs in the field of science and innovations are developed by the Government and scientific community in the person of the Academy of Sciences in accordance with the strategic directions of activity in this field. The list of state programs is included in the Partnership Agreement.

(3) After the realization of the expertise and competitive selection, carried out by the Supreme Council for science and technological development, in the state programs in the field of innovations and transfer of technologies the projects for innovation and transfer of technologies,



proposed by organizations performing this activity, are included.

(4) State programs in the field of science and innovations are financed partially or integrally from the state budget in accordance with the results of the contest organized by the Academy of Sciences.

#### **Projects in the field of science and innovations:**

(1) Project in the field of science and innovations is a complex of activities, interconnected through performers, terms and resources, which are realized by organization in the field of science and innovations regarding the solution of a problem (achieving of a common goal) and is aimed to:

a) development of fundamental and applied knowledge and of their application methods;

b) development of infrastructure of the field science innovations, improvement of laboratory, electronic and diagnostic equipment, poly-graphic and publishing equipment;

c) improvement of technical-economic parameters of applied technologies and/or manufactures produces (executed works, performed services) with the purpose to ensure their competitiveness on the world market;

d) creation and/or assimilation of technologies and/or new types of produces (works, services), which are results of the implementation of an object of intellectual property (patent, industrial design, topography of integrated circuits, know-how etc.), for which the manufacturer has necessary documents (certificate, patent etc.) or license issued by the owner of the object of intellectual property, or which must be elaborated for the first time in the Republic of Moldova and/or are more competitive, possessing technical-economical significantly better parameters and increase the national scientific-technical and technological level.

(2) Projects, as a rule, are a component part of a program in the field of science and innovations executed by organizations, performing respective activity.

(3) Projects shall meet the following requirements:

a) to be oriented to solve the most important problems of social-economic development of the state and correspond to strategic directions of development of science and innovations, stated in the Partnership Agreement;

b) to contain scientific or technological novelty and correspond to professional level;

c) to be scientifically and financially founded, to define the expected results and methods of their transparent monitoring.

#### **Order of selection and registration of projects in the field of science and innovations:**

Projects and their performers is selected through a contest, which is publicly announced by the Supreme Council for science and technological development, on the basis of the expertise carried out by independent experts along with representatives of the scientific community, in accordance with the regulation approved by the Academy of Sciences.

Projects in the field of science and innovations included in programs or self-independent projects are published in the Official Monitor of the Republic of Moldova after their approval by the Academy of Sciences and are introduced in the State register of the projects in the field of science and innovations (hereinafter - State register).

State registration of projects in the field of science and innovations are carried out in the terms approved by the Academy of Sciences.

The Academy of Sciences issues a certificate to the organization in the field of science and innovations, which confirms the state registration of the project.

Certificate of state registration of the project in the field of science and innovations is valid for a period stated in the respective program. After the expiration of this period, state registration of an unperformed project and respective record from the State register become invalid. This information is published by the Academy of Sciences.

#### **Objects of activity in the field of science and innovations are:**

a) programs, projects, with the final goal of obtaining new knowledge in the field of fundamental and applied science, creation of competitive new or improved produces, services, processes;

b) results of the activity in the field of science and innovations, confirmed by scientific publications, author patents, which constitute the objects of intellectual property;

c) organizational and technological processes with the production, administrative, commercial character that contributes to the modernization of the structure and to the improvement of the quality of produces, services, processes;

d) infrastructure of the field of science and innovations.

### **State guarantees in the field of science and innovations:**

The state, in accordance with the legislation in force, guarantees support to subjects of the activity in the field of science and innovations, in regard to:

- a) programs and projects in the field of science and innovations, directed to the implementation of the state policy in this field;
- b) creation and development of the infrastructure in the field of science and innovations;
- c) training, advanced re-training and improvement the skills of the personnel;
- d) patenting abroad inventions and industrial design, which are a part of domestic produces exported or being prepared for exportation;
- e) certain types of activity by means of allocation of subsidies;
- f) guarantees for the realization of their obligations in regard to domestic and foreign creditors and investors;
- g) creation of some domestic produces that are competitive on the world market, by means of tariff and non-tariff regulation;
- h) tax and customs exemptions;
- i) giving the right to use state-owned property, including objects of intellectual property;
- j) insurance of intellectual property protection;
- k) insurance free access to information, its dissemination in accordance with the legislation in force;
- l) international cooperation in the field of science and innovations.

### **Personnel policy in the field of science and innovations**

Personnel policy is a strategic component of state policy in the field of science and innovations. It presupposes the increase of scientific and intellectual potential of the society, development of creative spirit, propaganda of scientific culture, increasing prestige of work in the field of science and innovations by means of its stimulation with regard to achieved results, complexity and quality of the performed works.

### **Tax and customs exemptions**

Tax and customs exemptions for the performance of activities in the field of science and innovations are given in accordance with tax and customs law in force.

### **Implementation of state policy in the field of science and innovations. Functions and powers of public authorities in the field of science and innovations**

Functions of public authorities in carrying out state policy in the field of science and innovations. The state through public authorities guarantees functioning and development of the field of science and innovations by means of:

- a) assurance of normative, organizational and social-economic basis for performance and stimulation of the activity in the field of science and innovations;
- b) stable growing financing of the development of the potential in the field of science and innovations and stimulation of creation of its modern infrastructure;
- c) promotion of a favorable financial, tax and customs policy in the field of science and innovations;
- d) support of activity in the field of science and innovations by means of programs and projects in strategic directions of this activity;
- e) creation of conditions for preservation, development and use of scientific, scientific-technical and technological potential;
- f) assurance of training, improvement and advanced training for persons of high qualification from organizations in the field of science and innovations;
- g) realization of interaction between science, education, production and financial fields;
- h) efficient utilization of market mechanisms for broadening the activity in the field of science and innovations;
- i) support of entrepreneurs in the field of science and innovations;
- j) development of the infrastructure in the field of science and innovations;
- k) protection of intellectual property, other interests of subjects of activity in the field of science and innovations;
- l) legal assurance of transfer of intellectual property, certification of competitive products, services, processes;
- m) information assurance of the subjects of the activity in the field of science and innovations according to the legislation in force;
- n) promotion of measures for intensification of international cooperation in the field of science and innovations;
- o) social protection and remuneration of the personnel in the field of science and innovations according to their qualification and skills.

## **Normative-legal maintenance of scientific and innovative activity in Republic Moldova**

At the present stage of social development a science, innovations and education turn to the most fundamental spheres of human activity which are closely connected with other areas of a social and economic life.

Economic and political changes in Republic of Moldova from the date of declaration of independence, cyclic political, economic and structural crises were essentially reflected on the Moldavian science, its organizations, mutual relations with the state and the society, legal maintenance of scientific and innovative activity. Legal maintenance of scientific activity started with revealing and maintenance of new tendencies in the field of the organization and implementation of scientific activity results.

The science is exposed to legal influence as one of social activity kinds, with principles inherent in it, the organization and the administration system.

Issues concerning legislative maintenance of a science, scientifically-technical and innovative activity are exclusively important for all countries and in particular for the post-socialist countries, including Republic of Moldova, in connection with country transition to market relations, globalization processes; transition of the country to an innovative way of development, use of scientific achievements in real sector to economy, scientifically-innovative activity.

From the date of declaration of independence in Republic of Moldova, base legislative acts has been adopted, in which general issues concerning scientific activity was regulated, as well as the organization and principles of its regulation, a basis of state scientifically-technical and innovative policy.

The legal base of the science includes a wide range of legislative documents and by-laws, including Parliament and Government decisions, departmental by-laws, etc.

The legislation regulating development of the science, techniques and an innovation in Republic of Moldova from the moment of declaration of independence has passed some stages of formation and development.

The first responsible and serious act in the field of science realignment is adoption in 1998 by Parliament of the Decision concerning the

Reform conception of scientific researches and elaboration sphere. In the conception it is noticed, that development of Republic of Moldova as sovereign state is possible only on the base of modern scientific and innovative approach.

Thanks to it, the sphere of scientific researches and elaborations is one of the national priorities. Conception revealed the strategic target of necessary reforms in science sphere which consists in formation of new relations between researchers and the state, the relations corresponding to conditions of market economy. The conception represents system of principles of criteria and the mechanisms necessary for perfection of science sphere management for the purpose of its adaptation to market economy.

Among principles of reforming of sphere of scientific researches and elaborations can be marked some, such as:

1. The statement of the role of scientific researches and elaborations as moving forces of socially - economic progress.

2. Evolutionary character of changes.

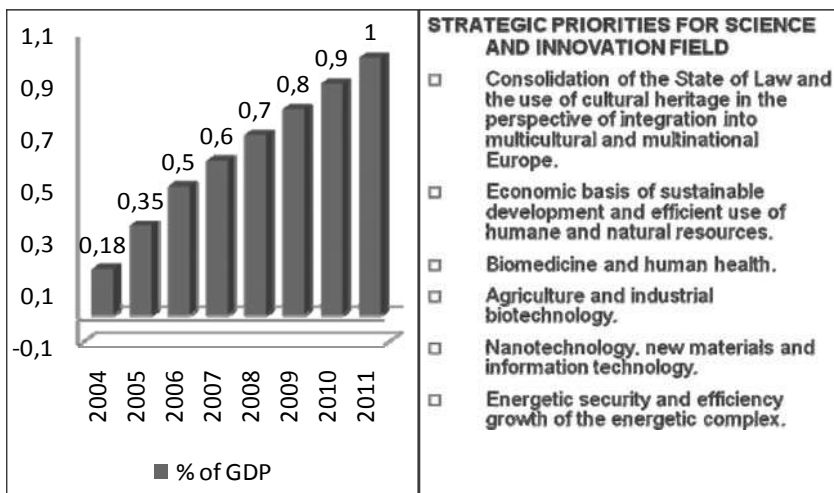
3. Activity division in sphere of scientific researches and elaborations on: conceptual, performing and expert.

4. Maintenance of priority financing of sphere concerning scientific researches and elaborations and social protection of scientists.

In the concept was definite purposes of the reform among which we will note: definition of priority directions; reorganization of institutional science systems; formation of mechanisms concerning scientifically-technical expert examination; preservation and development of scientifically-technical potential; working out of legal, financially-economic and organizational mechanisms for effective functioning of scientific sphere, scientific researches and elaborations, etc.

Among mechanisms of carrying out of reform in the sphere of the science the concept distinguishes: reform of institutional systems with necessity of creation of the science state control institution; definitions of priority directions; working out of government programs as the basic tool of carrying out of a policy of the state; scientific expert examination.

In the Concept was reflected the reform of financing system. The reform provides gradual increase from above 1% of GDP of a share of budgetary funds on scientific researches and elaborations. Principles and ways of allocation of budgetary funds to the executors of scientific researchers have been designated.



**Partnership Agreement between Government and Academy of Sciences**

In the Concept issues concerning perfection of a payment to workers in sphere of scientific researches and elaborations are revealed. Also in the concept was reflected normative and legal aspects concerning reformation of the science, Academy of Sciences of Moldova, integration of sphere of scientific researches and elaborations with higher education system, science reform at interdepartmental level, human resources and personnel selection, a science supply with information, financially-technical maintenance of a science, reform in the field of the international cooperation, etc.

On the basis of the Concept on July, 29th, 1999 Parliament adopted the basic Law concerning the state policy in the field of scientific researches and elaborations.

This act defines the state policy purposes in scientific and scientifically-technical activity, establishes main principles and directions of state regulation and management of the science. In the law main principles of a state policy in the field of scientific researches and elaborations are defined, subjects concerning state policy are defined, issues concerning formation and carrying out of state policy in the field of scientific researches and elaborations are revealed, as well as the powers of Parliament, the Government, the Central body of public administration in the field of scientific researches and Supreme Council for Sci-

ence and Technological Development, the structure of Council is presented and its functions are designated.

In the law was foreseen the creation of Expert-advisory Council of scientific researches and elaborations, as well as powers of other branch bodies are revealed, questions of priority directions, government programs and expertise are presented.

The law defines a policy in the field of financing of scientific researches and elaborations, reveals financing sources, a supply with information of scientific activity, personnel selection in sphere of scientific researches and elaborations.

On July, 27th, 2000 the Parliament of Republic has adopted the Law concerning the Academy of Sciences of Moldova in which the Status of Academy, Functions and the rights of Academy of Sciences, Directions of activity, the Rights of Academy of Sciences, Issues concerning membership, Structure and the Management of Academy of Sciences, Issues concerning property of Academy of Sciences, financing system of Academy of Sciences have been revealed.

The law which defines bases of a state policy in the field of scientifically-technical information and the order of its formation has been adopted by Parliament on October, 3rd, 2002. The purpose of the law and sphere of its action was defined. Subjects concerning the relations in the field of scientifically-technological information were noted, the State policy in the field of scientifically-technological information, issues concerning monitoring of activity in sphere of scientifically-technological information, the rights and duties of subjects in relations in the field of scientifically-technological information, space of the scientifically-technological information, establishment and function of establishment of the scientifically-technological information, the market of scientifically-technological information production, the international relations and cooperation in the field of scientifically-technological information have been reflected in this law.

The science and technological development are the major factors of economic development which are connected with innovative activity. Innovative processes unite science, technological development, techniques, economy, management and business. For Republic of Moldova creation and adoption of its standard-legal certificates concerning innovative activity was extremely important. On July, 10th, 2003 Parliament of Republic of Moldova adopted the Law concerning the State policy in the field of an innovation and the technology transfer.

Over a period of 2003 year by the Government of Republic of Moldova has been approved a variety of statutory acts and decisions in the field of the science and technology development. Among them we will note: the list of Government programs in the field of the science and technology transfer, the Republic of Moldova Governmental regulations concerning the methods of creation and realization of governmental programs in the field of the science and techniques, strategic priorities of Republic of Moldova in the field of the science and techniques for 2003-2010 years, the Concept concerning professional training in the field of the science, the Governmental order concerning establishment of the higher grant for doctoral candidates in Republic of Moldova, etc.

In the 2004 year the Parliament of Republic of Moldova has approved the Republic of Moldova Code concerning science and innovations.

The bases of the State policy in the field of the science and innovations, the modalities of State Policy realization, functions and powers of the public authorities in the field of the science and innovations, Academy of Sciences abilities and its role in the field of the science organization, issues concerning accreditation of the organizations in the field of the science and innovations, issues of certification the scientific and scientifically-pedagogical top skills personnel, protection of intellectual property and informational supply of the science and innovations, issues concerning material-technical and financial maintenance of the science and innovations, etc. are revealed in this Code.

Important standard-legal text in the field of the science and innovations is the Governmental order No.27 from January, 22<sup>nd</sup>, 2009 concerning the adoption of the Agreement about Partnership between the Government and the Academy of Sciences of Moldova for 2009-2012 years.

In this decision issues concerning the main aims of the science and innovations, strategic directions of activity in the field of the science and innovations, the rights and duties concerning carrying out of the state policy realization in sphere of the science and innovations, issues of financial maintenance of the science and innovations sphere, etc., are designated.

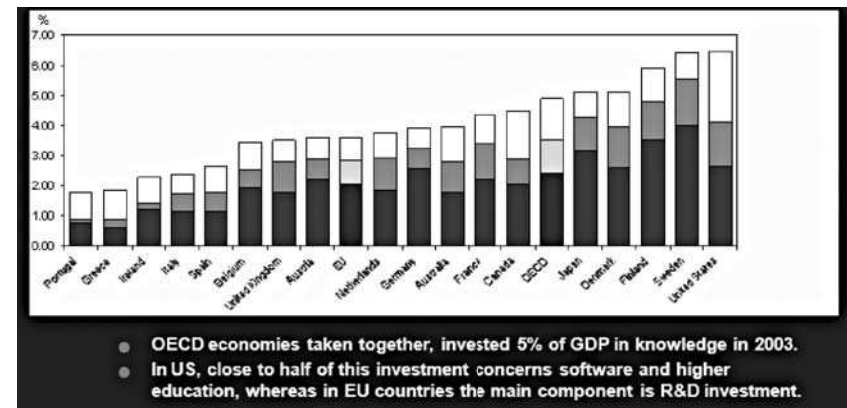
**Interactions**

In these conditions, significantly increases the role of the science, education and innovations - as one more evidence, that they are fundamental categories for a sustainable development of a modern society with its numerous global problems.

Level of the science development is acting as an indicator of the society development. It basically defines the level of the economic and cultural development of the modern states.

Determinative role in the development of scientifically-innovative system belongs to the scientific and technical policy. The foresight of the state scientific and technical policy in present is an integral part of successful development of the national economy, the important component of the general policy of the state.

One of the purposes of the scientific and technical policies of the most developed countries is the increase of science and techniques contribution in national economy development, maintenance of progressive transformations in sphere of production of goods, increase of competitiveness of national products on world markets, strengthening of the state security, sustainable development maintenance, improvement of ecological conditions, etc.



*Investment in Knowledge (OECD Source)*

Transition to the market economy, as well as dynamic changes of social and economic conditions - requires constant perfection and elaboration of new legislative norms in sphere of science, techniques and innovative activity which would correspond to existing realities according to legislation of the European countries. The legislation in scientifically-innovative sphere has the target – creation of the such conditions for scientifically-technological activity which will provided a forward sustainable development of the science, techniques and innovations

together with higher education system, and will provide the growth of a competitive domestic production, an effective utilization of scientific and technical results, as well as will solve the problems concerning social, economic, political and cultural development of the country.

The role of scientifically-innovative method concerning formation of modern society development is especially important. This method is an effective remedy for crisis phenomena overcoming, re-structuring of manufacture, priority support of competitive production, formation of the high technologies markets, creation of commercialization mechanisms, etc.

In these conditions the development of scientifically-innovative activity should become a real priority for Republic Moldova. First of all it is necessary to create effective and open scientifically-innovative environment of Republic Moldova, having possibility to co-operate with surrounding scientifically-technological, educational, industrial, political, etc. internal and external environments.

Transition to a scientifically-innovative development method should be accompanied by preparation of experts in scientific and technical sphere capable to lead up scientifically-technological ideas and products to a commodity output, able to realize it on internal and external markets.

For Republic Moldova, it is extremely important to involve in scientifically-innovative activity the industry and business, without which existence of the science as steady system is impossible, because the state

Indicator	1990	2004	2008
Property of ASM	1 376,4 mil. Rub	225,2 mil. lei	352 mil. lei (\$ 35 mil.)
Science financing	\$ 41 964 050 USA	62 mln. lei (\$ 5 040 650 USA)	390 mln. Lei (\$ 37 536 092 USA)
Science financing (% of PIB per capita)	\$ 10,5 USA	17,15 lei (\$ 1,4 USA)	85,7 lei (\$ 8,5 USA)
Research institutions financed from State budget	125	101	38
PhD in Science	3495	2230	3419

*Situation in the Field of Science in Moldova (1990, 2004, 2008)*

is not capable and should not finance completely (without assistance) scientifically-technological and innovative activity. On the other hand business is interested itself in close commonwealth with scientifically-innovative sphere because that leads to the increase of competitiveness of their new products as well as production efficiency increase.

The special role belongs to personnel training. According to this, higher educational institutions should prepare specialists, capable to work in the conditions of the market economy, expansion of the nomenclature of specialties according to inquiries of the industry, business and the society. Also, it is necessary to find out and develop the essentially new forms of interaction with the industry, business, government and the society. It leads to the necessity of professorial-teaching personnel retraining in higher educational institutions. Thus preparation of the new specialists and retraining professorial-teaching personnel should be continuously connected with scientific research process.

It is necessary to develop scientific and technical business. For this purpose in scientific research institutes and higher educational institutions is necessary to create a corresponding infrastructure for scientifically-innovative activity support:

1. creation of structures for technology transfer;
2. formation by these structures of the ready products, technologies, new projects database;
3. maintenance of high level of products - by means of the organization of independent expert appraisals concerning certification and quality problems;
4. incubation of small firms with granting of office and industrial premises;
5. organization of scientific and technical examination of projects and ready high technology products and technologies;
6. creation of advertising production, etc.

It is necessary to transform at least a part of universities of Republic Moldova in educational-scientific-innovative complexes. These should be focused on modern development of real sector of a national economy or region, providing strategic competitiveness on the market of educational, scientific, scientific and technical and innovative services.

Creation of new organizational-legal forms of higher education is entered in organizational reorganization of world system of the higher school and is extremely important and actual for Republic Moldova.

Republic Moldova transition to a society based on knowledge in the conditions of globalization and the European integration (when knowledge becomes the basic method of development of economy) demands organizational-administrative change of universities.

Changes of internal and external social and economic conditions will make universities active and direct participants on the global markets, essentially influencing economic growth of the corresponding states.

Thus the basic resource of universities activity in the conditions of the global market it is freedom of initiative enterprise activity.

Main principles of creation of educational-scientifically-innovative complexes are:

- Unity of educational, scientific and innovative processes at university and its communication with economy and social sphere;
- Presence of the effective system of innovations management, including transfer, sale and commercialization of educational, scientific and innovative production;
- Integration on a voluntary basis with other organizations in the domain of education and science as well as with the industrial complex for the decision of strategic problems of development of the innovative environment and economy;
- Involving in innovative process of the majority of teachers, employees, persons with doctor degree and students, etc.

### **The interaction of the science subsystem with the state, higher education, the industry and civil society**

The status of the modern world is extremely near-critical level. Ecological, power, demographic, economic-financial, technological and other crises demand with inevitability creation of essentially new science – capable to specify the exits from crisis situations. In these conditions the interaction between various subsystems as production of goods, public relations, culture, the state, education, science, morals, the law, etc. should change according to the purposes of the societies based on transition to the new qualitative conditions.

The society, the state, economy and the science are difficult, multi-component and hierarchical systems.

The society is an essence system of reasonable and purposeful individuals who organize different kinds of vital activities, being directed to achieve certain spiritual, ecological and material ideals. The state is a

society subsystem which co-ordinates functioning of subsystems of the society. The state at the same time should operate other subsystems on the base of synergetic laws. In particular, it should exercise administration of a science, education, the industry and other society subsystems by means of straight lines and feedback. The direct communication transfers operating signals to operated elements and provides homeostasis of operated system or carries out transitions from one condition of system to other condition. The feedback transfers the information to the management subsystems concerning the results of its performance according to commands. Processing this information the management subsystems should correct the subsequent commands in conformity with laws of synergetic about small resonant influence (which carry out negative feedback).

Interacting with the science subsystem the State should realize that in present and especially in future, only Science can understand the extremely difficult phenomena and define optimum exit ways from the crisis phenomena, oriented to achieve the objectives with minimum possible losses.

Modern problems are so difficult, interconnected among themselves in nonlinear way, that only the science is capable to realize correctly and adequately a problem, to generate correctly statement of a problem and to find correct and effective methods of its solution.

The process of state interaction as a system with a scientific subsystem has some particular features.

In the conditions of immaturity and the beginning of formation of a civil society in Republic of Moldova major factors of the States interaction are the politicians, the state bureaucracy of various levels, officials, a small part of businessmen, etc.

As about science system, here the basic characters are: scientists capable to create scientific knowledge, scientific aristocracy and bureaucracy (nomenclature corporation).

In the process of interaction between the State and the science, as well as innovative system and business, the state should adapt in particular to the most effective organizational issues realized in developed countries, as well as to the industrial and commercial ways of conducting scientific innovative business. The state should define accurately strategic priorities of the development; develop reference points of average and long-term technological and economic development, based on last achievements of science and technology.

There is not less important in the process of synergetic interaction of the State with other subsystems the interaction mechanisms formation.

In Republic of Moldova before independence was a rigid vertical scheme of interaction between the science and the society: scientifically research institutes – higher educational institutions – knowledge disseminating organization – separate scientists - public institutes.

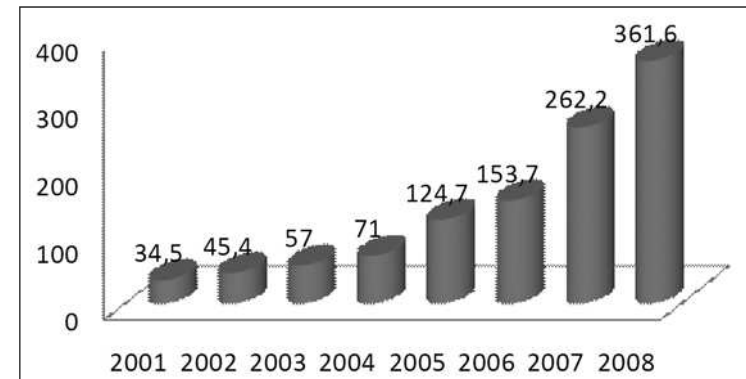
Interaction between the science and the society was extremely ideologized especially in the domain of humanities and also it was rigidly supervised by party bodies.

There was a clear split into manufacturers of knowledge and its users. Thus in mass consciousness it was cultivated the model of a totalitarian and authoritative society where the science as social institute made absolute knowledge and verities. The last after corresponding checks and the ideological control were duplicated and distributed to the consumer – the society.

At democratization of a social life the situation has essentially changed though and at the given stage there are moments of monopolization of knowledge. The possibilities to represent the alternative points of view appeared, the interaction vertical has started to collapse, have appeared new not engaged clusters of knowledge manufactures in old and new created universities, the network of non-governmental scientific institutions has developed, etc. Also changes of mutual relations between a science and the state, the science and the society, the science and the policy taking into account processes of globalization and self-organizing of essentially new clusters of knowledge, have appeared.

Manufacture of scientific knowledge depends from political, economic and social factors. Also the important role is played by civil society by means of feedback. There is a structural redistribution of manufacture of knowledge, partial diffusion of scientific stuff in other scientific institutions, partial realization of the saved up intellectual and scientific potential, combined by science officers from various kinds of scientifically-research activity, scientifically-consulting, scientifically-pedagogical and other kinds of activity.

It is possible to ascertain with confidence, that their interaction at the present stage occurs paradigmatic synergetic changes; there is a transition from vertical model to horizontal characterized by absolutely new qualitative condition peculiar to the developed of democratic civil society.



Science and innovation financing in 2001-2008

The important issue in the process of the science and State interaction is the measure of fundamental and applied science support and also innovative activity support as well as the issues concerning commercialization of sciences results. The science main task is reception of new knowledge which at the initial stages it is impossible to commercialize. Commercialization of scientific product occurs in innovative process.

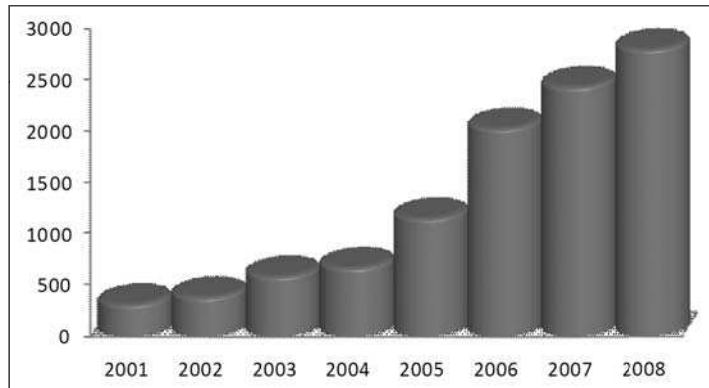
Before the commercialization of scientific product there is a whole chain: idea of the scientist or of the group of scientists, idea approbation by scientific community, basic researches, studying of possibility of applied appendices, applied researches, product or technology creation.

The big role should belong to the State in the creation and functioning of national innovative system in the conditions of transition to the market economy.

It is especially important for the States with transitive economy for which is characteristic economic recession and depression, where in the big degree the industry has been destroyed and there is no solvent demand for innovations and new technologies. Therefore at the initial stage of formation of innovative economy essential state support for technological reequipment of the country and creation of necessary conditions for its development, including legal field creation is necessary.

The state should promote creation of an effective innovative infrastructure; extend network of techno parks and multiplication of the

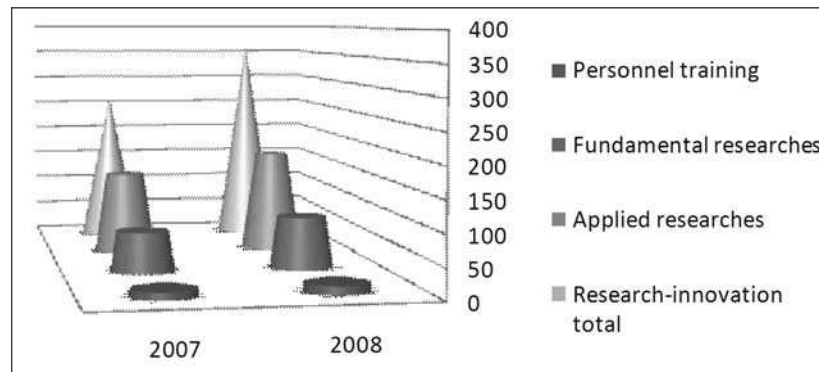




*Average salary per month, lei*

sources of financing of innovative activity, creation of conditions for commercialization of scientifically - technical workings out, creation of the competitive environment which will stimulate innovative activity. Development of the administration fiscal mechanism, development of the policy of the general and target grants, tariffs, tax privileges, import duties, support of national manufacturers is necessary. Fiscal actions should be filled by administrative monitoring of efficiency in management of strategic branches of economy.

On national level to the state should belong a coordinating role. At the international plan the state should protect national interests in the field of the science and innovations.

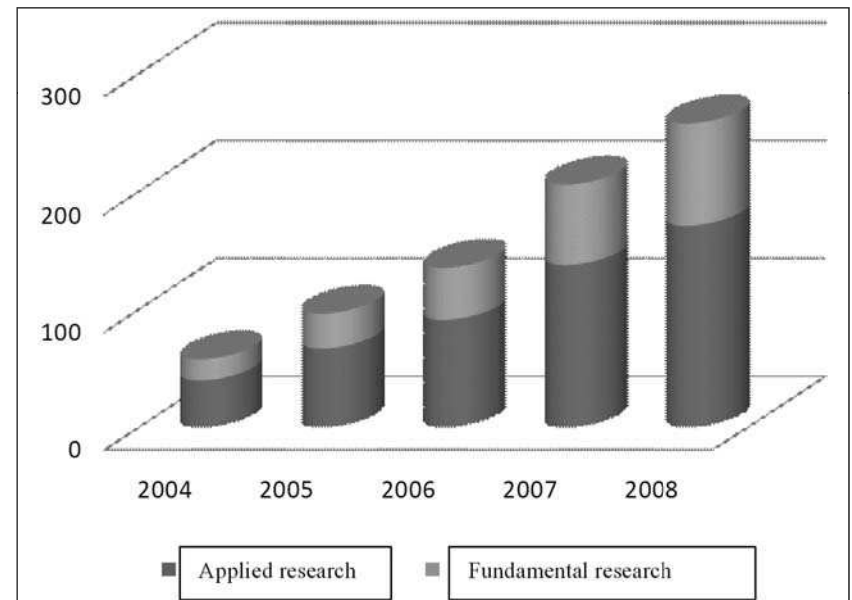


*Human resources in the scientific and innovation domain.*

Role of the state in process of market economy development should vary cyclically: to increase and to decrease. Especially its role should increase in conditions of instability and crises.

The science being concerning independent complete system cooperates with various subsystems of a society in particular with manufacture and the industry. This interaction should be carried out by mutual interchange of information and staff, as well as by interchange of material, technical, financial and other resources.

One of the basic functions of the science is the increase of well-being and comprehensive development of all members of the society. Materialization of scientific idea in the development pass some stages such as: the scientific preparation including basic researches and applied scientifically - research works as well as the engineering workings out; creation by the enterprises of new means and subjects of the work, of the new corresponding technologies; enterprise modernization; the organization of realization of the progressive new products; marketing actions; realization of new products; etc.



*Budget allocations volume for the applied and fundamental science domains (mil. lei)*

During the science and manufacture interaction, an important issue appeared – concerning the cycle reduction from the scientific research to introduction in manufacture.

Industry and the economy can be efficient on the basis of manufacture, distribution and use of knowledge and the information. It leads to creation of science intensive and technologically directed eco-politics. Main issue during the creation of new technologies is the interrelation and interaction between all participants of this process. In certain situations it is more important – than investment volumes in all spectrum of research and personnel preparation. Thus the problem of new technologies and new industry products transfer becomes fundamental. The technologies transfer from science to the industry is possible through effective cooperation between the science, manufacture, the government and the consumer.

### **The State**

A science as well as many other vital components of the society in the conditions of transition to market economy is liable to the system crisis. During this period has essentially changed a role of the state and its influence on science development. The demand concerning scientifically - technical achievements in the industries and economy as a whole has sharply fallen, influence of scientifically - technical progress on its development has decreased.

Therefore sharp necessity of science development strategy revision appeared, which should combine active state regulation, and self-control market mechanisms.

### **The Society**

A special role in science and society interaction belongs to the Man, where last becomes real force, capable to reduce entropy increase, to eliminate uncertainty systems, to promote an establishment of social order.

Nobel laureate I. Prigojin affirmed that in development of social system a special role belongs to system of values by which the person is guided. That's way the Man/person becomes the important component of difficult self organized social system.

The guarantee of successful science development is permanent democratic dialogue between the state and the science, in which values and norms of scientific community become values and norms of the

state. In the XX-th century and in particular in its second half the relation between the society and the science has changed. Earlier the science was considered as a cultural value. In second half relation varies. The society considered the science already as a mean of military, political, economic and social problem solving. The last has led in particular to occurrence of antiscientific moods in the society.

In the society the statements such as “in the conditions of crisis and backwardness of national economy the science is absolutely not necessary” have appeared. This big error of a part of the society also can lead to catastrophic results and intellectual degradation of the country.

Interactions between the science and new technologies are extremely interesting. The last are generated by the science and essentially influence a science. Thanks to it in a science have occurred structural shifts.

The science computerization, occurrence of compound dashboard complexes, has led to the organization of complex research programs. Application of information technologies allow to investigate complex systems including science system.

### **The integration of a science in manufacture**

At the present stage integration of the science in manufacture has a number of features. Abundantly clear, that the state is limited in constant escalating materials and financial assets for development. This process is objective and inevitable. Nevertheless growth of gross domestic product and of the economy as a whole is extremely caused by scientifically - technical progress.

Therefore, further with inevitability fundamental detections which will make possible to change the material sphere will be done, that should lead to considerable growth of financial and material means in science. Occurrence in science sphere of corporate structures; of intensive forms and methods; duration reduction of cycle «science - manufacture»; association of corporate resources; mutual scientific researches – it will be a new stage in development of the modern science.

Various forms of co-operative structures can be distinguish: international, national, regional, etc. At the international level creation of joint scientific centers and active participation in the international scientific programs is necessary, as well as the developing of bilateral scientific relations etc.

Creation of national co-operative scientific structures is most effective within the limits of national research programs creation. All basic sectors of the country scientifically - technical potential should participate in working out and realization of national programs: academic, branch, educational, industrial and private.

Programs of regional development should provide at high level viability and vital activity within the limits of the competence. Among other the purposes of regional programs are: the development of scientific and higher education potential, development of small, average and whenever possible of the big science intensive sectors of the industry in region, creation in region of a modern infrastructure.

Cooperation programs at level of the organizations are carried out by science institutional organizations with the industry.

Occurrence and development of new forms of the organization and cooperation in science sphere essentially will change structure of national scientifically - technical potential and scientifically - technical policy.

In mutual relation between the science and the State last stands in relation to a science as the legislator, as the basic source of financing, as the mass consumer of new scientific production, as the large subject of scientifically - innovative activity, as the coordinator of national scientifically - technical potential development.

As a result of such interaction in science system occur institutional and functional changes. The role of sectorial structure of a science changes, borderlines between fundamental and humanitarian sciences disappear, the disciplinary structure of a science also changes, integration between fundamental and applied sciences appeared, especially in the process of difficult self organizing systems studying. All it should lead to qualitatively new role of a science in development of a modern society.

Science and education will be the major factors of the development in postindustrial society. In this sense, it is necessary attentively and creatively to study education and science systems and their interaction in the developed countries, for the purpose of achieve new trajectory of development, characteristic for a society based on knowledge.

By estimations of some researchers in the middle of XXI century only 5-7 % of the population will be occupied in manufacture sphere. In this case education becomes the grant of a social survival and becomes the central factor of social development. What's why transition to a new paradigm of education based on an open and self-organising principles is necessary.

Education and sciences systems are under the influence of essential fluctuations of the environment: economic, political, social, technological, etc.

Therefore becomes necessary elaboration of theoretical bases of interaction between the education, science, the industry and the society as well as the management bases elaboration according to new conditions. Elaboration of the new strategy of the country development with synergetic effect, elaboration of correlated strategy of education, science, industry etc. development, is necessary.

The solution of science and higher education actual problems due professional level, allows to leave on a steady trajectory of socially - economic development, to find optimum ways of crisis exit. In the modern higher school occurs so-called universitification which should become the important qualitative phenomena and correspond to transition from industrial to postindustrial stage of the society development.

Considering complication of the modern world, of economic and cultural relations, the higher school should pass to qualitatively new level of the development where educational process would be in organic communication with a science. It is possible to be reached in two ways: 1. Integration of higher education with academic, university and branch sciences; 2. Creation of the research Universities.

Though the tendency of higher education commercialization, and transformation of higher educational institutions into the commercial enterprises where the relation between the teacher and the student gets market character, and there is a reduction of a share of courses of fundamental sciences in advantage to applied knowledge, nevertheless future of higher education is in science and education integration. First of all creation of several elite high schools is necessary, where the fundamental knowledge would be developed, where would be combined in optimum way fundamental and applied knowledge, where complex interdisciplinary researches would be carried out. Development of scientific researches in universities should be a condition of fundamentalization of education and improvement of experts' quality preparation.

Necessity of science and education integration is a strategic object of the state. A key element of the first way of science and higher education integration is the creation of scientifically - educational centers based on cooperation between the universities and the academic institutes in the field of training and basic researches.

Thus it is necessary to pass from simple forms of co-operation (opening of base chairs at the academic institutes) to deeper cooperation forms. This cooperation can be various: from cooperation of one academic institute and one high school, to involving in this process of many factors (from the higher school and from the academic institutes). Integration should promote substantial improvement of preparation, re-training and increase of professional qualification of experts, a foresight joint fundamental and applied researches, improvement of preparation quality of experts, development of cooperation with the technological and industrial organizations and the enterprises for the purpose of manufacture of new kinds of the high technology goods and techniques, joint preparation of masterats, doctorants and habilitated doctors, elaboration of the original new courses of lectures adapted for modern level requirements concerning science and education, creation of interdisciplinary scientifically - educational programs and projects, elaboration of common databases, sharing of telecommunications networks, integration of scientific and skilled- experimental base of the academic science and the higher school, etc.

The second way of science and education integration is the creation of elite research universities. In difference from other types of higher educational institutions in research universities the basic efforts are directed on carrying out of scientific researches and preparation of the future researchers. For them the integration of education, science, and practical activities is characteristic.

The research university consists from the research centers. The centre is the interdisciplinary organization which main task is carrying out of scientific researchers at the expense of University, or according to the state bodies order, or the state and private industrial companies.

The structure of research university includes scientific department, agency of technologies transfer, business - incubators, innovatively - technological centers. The research university is symbiosis of a higher educational institution and scientifically - research institute.

### **The priority domains of science development in Republic of Moldova**

The main factor of scientifically-technical development in the countries with transition economy (which have limited resources), is the choice of priority directions of the science and techniques development. The priority directions are the thematic domains of research and de-

velopment, which assure the main contribution in scientific-technical development and in achievement of social and economic targets of the country development.

The priority domains should be in concordance with the main goal of the country – arrangement of strong, steady and democratic economical political system capable to achieve civilized trajectory of the development and pass to postindustrial form of society.

The priority domains should facilitate transition to new energy-efficient and science intensive technologies, creation of new market of goods and services, new scientific knowledge and informational technologies reception.

For the small countries such as Republic of Moldova the choice of priority domains of development is hard and difficult task. Such countries can not embrace wide spectrum of scientifically-research activities. That's way for such countries are strictly necessary oppressive selection of priorities, in concordance with economical, political, scientifically-technical and social needs of the country.

IAE no matter how wide is the spectrum of priorities, one of the main roles in this process should be offered to fundamental science. The fundamental science is the base of national culture. In addition to the fact that the fundamental science forms the morality and the world outlook of human being, only fundamental science could solve the difficult problems concerning modern society life.

The determination of priority directions of the development is done at governmental level, where the basic vectors of science development are defined. The scientifically technical priorities should harmoniously fit national governmental priorities.

One of the basic problems during priorities determination is the determination of their number.

A wide spectrum of priorities make them just a slogan. Main development priorities choose is also determined by financial supply as well as by technical and scientific potential of the society. They are the basic reference point for scientifically-technical policy. We can remark several directions concerning the politics of determination, control, monitoring and expertise of priority directions.

According to the decision of the Parliament no.115 from 29.07.1998 concerning the Concept reformation of scientific researches and developments, the priority directions of research an developments have been assign in the following domains:

1.Human resources (natural and humanitarian sciences, the culture, education, public health).

2.Forward technologies in agricultural sector and food provision security.

3.Energetic.

4.Creation of new economic system.

5.New materials and goods, forward technologies.

6.Natural resources and medium protection.

7.Informational security.

According to the decision of the Parliament no.284 in 1999 year the list of priority domains concerning scientific research and elaborations

has been approved. The main domains of activity have been revealed:

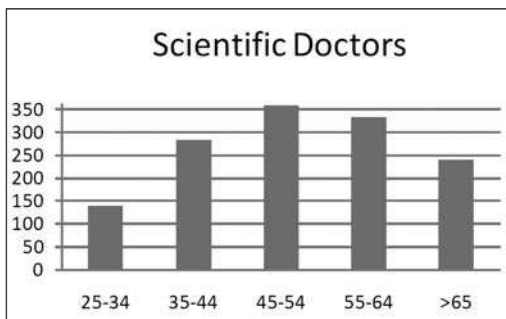
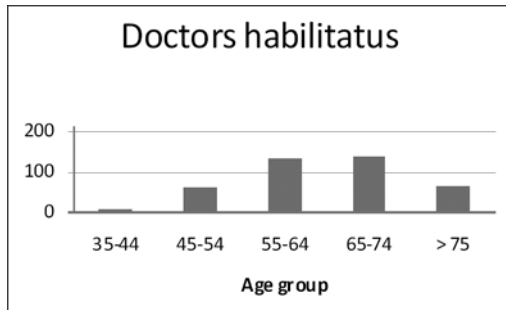
1.Fundamental science.

2.Applied science.

3.High skill scientific and scientific teaching personnel preparation.

4. Scientific process maintenance and the priority domains in applied sciences and technological development:

- Efficiency increasing of energetic sector;
- Human being and protection of genetic fund;
- Forward technologies and biotechnologies, new goods and materials from local raw materials.
- Environment protection and durable development.
- New economic systems creation.
- Scientifically technical programs in the domain of agriculture and produce processing industry.



*Human resources in the scientific and innovation domain. Repartition by the age*

• New technologies in the domain of construction and construction materials.

• The society informatisation.

• Humanitarian sciences.

According to the decision of the Parliament no.1205 in 1999 year the list of priority domains in scientific research and elaborations activity was defined:

1.Fundamental research in the domain of natural, social and humanitarian science.

2.Research in the domain of medicine, agriculture, and environment protection.

3.Acquisition of new materials and elaboration of new advanced technologies for the modern industry.

After 3 years the Parliament of Republic of Moldova has adopted other decision no.1401 from 24.10.2002 concerning the new list of priority domains in scientific research and elaborations activity for the period of time 2003-2010 years. This list contains 10 basic domains of development:

1.Fundamental research in the domain of mathematics as well as in natural, humanitarian, technical, social and economic sciences.

2.Science concerning human being life and health.

3.Agriculture science and food security.

4.Social economic revival and development based on innovations and technology transfer.

5.Energetic systems, alternative sources of energy, energy processing and effective use.

6.New materials and technologies.

7.Informational technologies, electronics and communications.

8.Ecosystems functioning, biological diversity rational use of natural resources.

9.Historical and cultural heritage of Republic of Moldova.

And at last but not at least, by the decision of the Parliament of Republic of Moldova was adopted the Strategy concerning the directions of activity in the domains of science and innovations on 2006-2010 years.

1.Edification of the constitutional state and evaluation of the cultural and historical values of Moldavian heritage in context of European integration.

2.Adoption of new human, natural and informational resources

concerning the durable development.

3. Biomedicine, pharmaceuticals, health.

4. Biotechnologies in agriculture, food security, fertile soils.

5. Nanotechnologies, industry engineering, new products and materials.

6. Energetic complex efficiency increase, energetic security, also by the means of renewable resources.

Although the list of the priority domains of development varies by the denomination and the period of implementation, the analysis shows that the main and basic priority domains of development remain constant. The researches in the domains of fundamental sciences, agriculture, economics, engineering, informatics, social sciences etc., figure practically in all the decisions of the Parliament from the 1998 year.

#### **The priority directions:**

- The methodology concerning priority directions definition, in the domains of science and techniques development applied by the ministries, Academy of Science, agencies, departments etc., as well as their synergetic unification.

- The mechanism of priority directions realization.

- Evaluation by the means of inquiry (main specialists, scientist, scientifically-technical staff, etc.) of status and perspectives of priority directions development.

- Evaluation of practice use concerning the final results, the time of the results achievement.

- Issues concerning the evaluation of the priority directions level of realization, according to the international standards. Their relevance in the process of new products creation, durable development and life existence quality increase.

- The realization of the main priorities by the means of big science intensive projects.

- The investments in priority domains.

- The issues concerning the financing of the priority domains. The mechanisms of the priority domains support (competition organization, state purchase orders, state guaranties concerning risks).

- The goals and their criteria formation. The preliminary selection of the priority domains. The structuring of the works and elaboration of budget applications. The state support forms definition. Control concerning the work and results. Projects, programs, priority domains updating.

- Financial economic expertise of the priority domains programs.

#### **How the research was done?**

The analysis concerning the situation of Republic of Moldova scientifically-technological sector (during its independence period) has been done.

It was shown, that the transition from administrative-command and central planed social-economic system to market economy – lead to structural degradation of scientifically-technological system. Recently, the Republic of Moldova scientific domain is in the system crisis. The main principles of science system crisis have been revealed. The necessity of science reform as a way of system crisis overcome has been shown. Different possible variants and scripts concerning science reform according to the Code of the Republic of Moldova on science and innovations have been proposed. Several scripts of Moldavian science development (based on the principles of transition from industrial based economy to the economy based on science) have been proposed.

The comparative analysis concerning scientifically-technological policy and science organization in Republic of Moldova (as a small country example) and Russia (as a big country example) has been done. The features concerning science development in bought countries after the USSR disintegration have been revealed (when the scientifically-technological complex was represented as integral structure).

The USA scientist's dissemination data by the aggregative science domains has been analyzed. The structural comparative analysis with the similar science structures from Russia, Moldova and EU countries has been done.

The development of scientific-innovative potential in USA as well as the relations of different US administrations with the science has been studied. The oscillatory synergetic character of innovative processes (in accordance with political fluctuations) has been revealed. The synergetic effects which appeared in the process when small innovative companies were absorbed by big corporations/companies as well as the problems which appeared during this process realization have been studied.

The organizational issues/problems of some companies based on hierarchical pyramids administration models, as well as the issues/problems which appeared during the transition of this companies to self-directed structures (functioning and being administrate preponder-

antly in horizontal mode), have been revealed.

Some issues concerning science research organization in EU and European Research Area (ERA) formation stages have been studied. The main parameters of EAR formation have been revealed, issues concerning Centers of Excellence formation have been studied, as well as EU Structural Funds formation achievements and others development stages.

Innovative activity development of different scientific sectors, as well as of the main European markets and allied European technological platforms, has been studied.

Technological platforms are oriented on concrete branches development in European economy. The main target of the leading European markets is population satisfaction with the most needed services and goods, such as: electronic services in the domain of public health; innovative construction market; protective clothing; biomaterials; recycling; renewable energy sources.

The intellectual and scientifically-research potential, as well as their basic components have been studied. The dynamics of human resources, the number of employees engaged in research and elaborations processes, convergence of researchers by the domains of science have been studied.

The structure concerning the number of doctoral candidates and postdoctoral candidates has been studied. The dynamics concerning the number of persons with academic degrees have been studied.

The recent level of scientifically-technological sector has been evaluated (according to synergetic paradigm and taking into account the prolonged process of science intuitional reform influenced by political, economical, historical, external and many other aspects). The science was evaluated as a social institute of society, capable due its autonomy to self-organize. From the other point of view the science is integral part of social, cultural and economic system for which the processes of organization are characteristic. The main features of the science related to external environment, such as the State and the Society, have been revealed. The main feature in this process is the transmission of the knowledge – for the development of the state and of the society. The relations between the State and the science should be examined on system-defined and synergetic level, when the science is examined as open nonlinear system, which interacts with external environment. In turn, the science reacts to external influence and utilizes

attributable mechanisms of self regulation. From the basic elements of science structure we can specify: the structure and the logic of scientific knowledge as a result of scientists activity; scientific community which consist from scientific collectives; scientific organizations; material-technical science base. These evaluated levels are close connected and interconnected and can exist only supplied by the resources, such as: assignments; communications; scientific equipment; information, as well as other resources. When the last resource flows exceeds their critical values – the result is the stabilization of the science structure and its stable development. Also, when the values of resource parameters are below critical values, under certain conditions it can be science destruction as systems.

As about synergetic science reforming in Republic Moldova, the optimal variant is the evolution-reformatory scenario which optimum combines the government administration as well as self-organizing and self-administration of science system.

The synergetic approach based on system criteria, concerning the processes of scientific institutions evaluation and accreditation in Republic Moldova has been studied. It was shown that the evaluation and accreditation system – is unique synergetic system, with particular properties, which are determining it's self-organizing and self-development processes. Recent evaluation and accreditation system is the important tool concerning scientific policy implementation and is created for estimation of scientific activity quality level. Among its basic functions it is necessary to note: process organization concerning the evaluation and accreditation of scientific institutions; experts database formation concerning specialized accreditation commissions; system engineering of criteria, indicators and reports concerning evaluation of scientific activity, etc.

Set of elements concerning system of accreditation evaluation have been revealed. Internal and external relations have been analyzed. It was shown that synergetic effects arise in the system of evaluation and accreditation according to joint co-coordinated actions of all its elements.

Technological levels in the system of university education have been revealed. Their interactions on a vertical and horizontal level have been studied.

On concrete examples interaction of various levels (inside university system as well as scientific and technical external levels of the

academic and branch sciences) has been revealed. It was shown that interaction of university scientific system with external environment at a correct configuration lead to synergetic effects.

Concrete practical recommendations concerning various levels interaction mechanisms perfection (in the course of self-organizing of various scientifically-educational clusters) have been developed. These integrative processes lead to structural changes in science-formation system and rising clusters represent structures of network type which major indicator is horizontal relations. These structures influence science system as well as higher education and public relations system, which simultaneously influence science-formation system by the means of the feedback.

As a conclusion it is important to notice that the science as synergetic system is always in continuous alteration. The entire world is searching for the new forms, methods and paradigms of science administration which will correspond to the new global challenges. These forms should be in strict correspondence with the synergetic laws, which helps to make science the main locomotive in the process of modern society development.

***The article was prepared with the additional contribution of  
GAUGAS P., GAINDRIC C., ANDRONIC L., LISII T., Prisacari V.,  
GUDIMA K., BAZNAT M., CALINIUC I., SIDORCO A., CAIREAC L.,  
JEREGHI T., GONTA Gh., ZUBKOV E.***