EU FUNDED PROJECT

Georgian Research and Development Policy Assessment

Report

Daria Khlebovitch
Madis Saluveer

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Contents

Preface

This report has been prepared within the framework of implementing the project"Creating an Effective Model of Science Administration: Review of EU best practices and Elaboration of Recommendations with the Ministry of Education and Science of Georgia." Preparation of this report is an intermediate result of the project implementation, a basis for a discussion about elaboration of recommendations on a strategy of developing research activities in Georgia. The general objective of the project is to render assistance to the Ministry of Education and Science of Georgia and the National Science Foundation in drawing up a clear strategy and distinct policy of modernizing the system of R&D in Georgia, as well as elaborating recommendations on improvement of the legislative base in terms of making them more in line with European standards. Problems related to the project are not of accidental nature. In drawing up the terms of reference for the project, defining its objectives, tasks, defining organizations that will have an interest in the outcomes, an attempt was made to pay attention to the most vital problems associated with the development of science in Georgia. Solution of a number of problems in the sphere of managing research activities to which, as we hope, the work performed by us would be of assistance, will allow to maintain and strengthen the local scientific potential and form new ideas contributing to its further development.

The main objective of this report is the presentation of results obtained in the course of the comprehensive assessment of the situation that has arisen in the sector of R&D in Georgia. Results of the assessment will contribute to the accomplishment of the following tasks:

- Formulation of long-term and short-term objectives of participants' activities in the process of managing R&D activities.
- Defining the contents of programmes of activities aimed at solving concrete problems in the sector under study.
- Characteristic of the current situation in the sphere of R&D and reasons which have affected this situation.
- Obtaining individual opinions from representatives of various groups that form part of the research community of Georgia.

A comprehensive analytical work related to the analysis of statistical and sociological data became the starting point for the preparation of the report. The comprehensive assessment was performed from three standpoints: from the standpoints of respondents (heads of universities and research institutions) who took part in the survey; the analysis of scientific articles published by Georgian researchers over the period 2000 – 2005; and the assessment made on the basis of results of the comparative study in which Georgia was the object of study.

The assessment did not suggest drawing up recommendations that would be immediately put into practice and would instantly make their contributions to the economic development of Georgia. The preparation of R&D funding schemes from various sources is also not a subject for recommendations.

The report includes three sections. In the summary the methods of performing the assessment are briefly described; sections 2 and 3 are directly devoted to the assessment itself and its outcomes. The report is illustrated with tables and figures.

The project management team expresses their sincere gratitude to all organizations and persons that made their valuable contributions in preparing this document.

Executive summary

This report has been prepared within the framework of implementing the project ""Creating an Effective Model of Science Administration: Review of EU best practices and Elaboration of Recommendations with the Ministry of Education and Science of Georgia." Preparation of this report is the intermediate outcome of the project implementation, a basis for discussion for drawing up recommendations related to the strategy of developing research activities in Georgia.

The main objective of the report is a presentation of the results of the comprehensive assessment of the situation that has arisen in the sector of research and educational activities in Georgia, as well as results of assessing management activities in this sector. A comprehensive analytical work related to the analysis of statistical and sociological data became the starting point for the preparation of the report on the assessment. The structure of the report comprises three sections; in the summary the methods of performing the assessment are briefly described; sections 2 and 3 are directly devoted to the assessment itself and its outcomes.

The goals of the survey were the following:

- the analysis of the impact of the process of social transformations on the organization and the status of research activities;
- the description of macroeconomic trends influencing R&D activities;
- the assessment of the current situation in R&D activities;
- the study of the system of state-managed support of scientific research;
- the assessment of a number of outcomes of R&D activities performed by the organizations of the sector;
- the identification of strengths and weaknesses of the present-day system of supporting R&D activities in Georgia, as well as opportunities and threats for its further development;
- determination of priorities for establishment of an R&D management system activities;

The information was obtained from the following sources:

1. Primary information: interviewing and questioning of respondents working in the R&D sector (higher educational institutions and R&D institutes).

2. Secondary information: statistical collections, professional journals, forums, new groups, specialized Web-sites, databases.

Serious changes have taken place in the sphere of research activities and higher education in Georgia during the past 2 – 3 years. These changes affected legislation on science and education, the structure of research and educational institutions, their financing. The time interval of so drastic changes proved to be too short. At the same time, there is a lot of work to be done as regards modernizing the system of R&D activities. The Georgian scientific community has clear objectives concerning the results of reforms and for integration into the world scientific community. The state of science, its present status, and position of scientists in the society – these are vivid examples of contradiction. At the theoretical level, important role of science as a special social subsystem in maintaining national security, reproducing technological and spiritual levels in its development, is recognized. On the other hand, low level of remuneration of

intellectual labour, underestimation of its social significance, lack of opportunities for self-realization as a scientist, emergence of the situation called "status degradation" are the facts characterizing the sphere of science.

Of course, it is impossible to ensure high level of funding of all areas of scientific research. Therefore, today it is necessary to restrict the scientific sphere, together with improving its qualitative state, maintaining directions that have already achieved recognition and are most crucial for national economy. One cannot also forget the development of social sciences and the humanities that are so indispensable in the present period of reforms and changes in priorities and values.

The scientific and educational environment is characterized by trends inherent in the transition period. Serious transformational changes are noticeable that have to be carefully studied in order to prevent grave adverse consequences while developing positive trends and to base a future policy on them. The role of the new private sector as a potential investor should be appreciated. New scientific knowledge can and must be generated not only in scientific institutions but also in higher education institutions that are an important actor in science and progress. Science is in great demand by the system of higher education; it determines both the direction and the very content of higher education. The role of higher educational institutions in the process of creating the knowledge-based economy, in the process of the innovative development of the country as a whole, is enormous.

Heads of 27 research and educational institutions: 22 research and 5 higher educational ones took part in the survey. The institutions surveyed represent different fields of scientific knowledge, and this makes it possible to see both the general and particular picture of state of research and educational activities in the country.

An attempt was made to determine the major characteristics of the institutions surveyed, among them, dynamics of the number of personnel, sources of funding, results of scientific activities in the form of published works, issued patents, and awarded prizes.

Structural changes carried out by the Ministry of Education and Science of Georgia brought about a substantial reduction in the number of personnel of research institutions (during the year 2006 the number of personnel was reduced by the factor of two and more; to be more exact, the reduction was in the range from 30% to four times).

Until the year 2006, the main amount of funding was provided by the Georgian Academy of Sciences, and since 2006, by the Ministry of Education and Science of Georgia. From this source the goal-oriented support of science is carried out. Variations in amounts of funding that were noted by respondents point to the instability of funding. Relative permanence of the number of organization receiving financial support from various international programmes still persists. Most commonly, individual and collective grants were provided by the following foundations: INTAS, ISTC, NATO, CRDF, and OSGF. The following foundations were also mentioned: the Open Society Institute, USAID-Israel-CDR. 65 % of respondents said that their institutions receive grants (both international and provided by the Georgian Academy of Sciences, as well as by the Georgian National Science Foundation) that support R&D efforts.

As before, the Ministry of Education and Science remains the major source of funding, with amounts of finance being unstable. Scopes of financing by means of international grants and programmes vary greatly from one research and higher educational institution to another. But even in the case of obtaining numerous

international grants and sufficiently large amount of money provided by a given source of finance, this source cannot be considered as a panacea for financial problems and alternative to the government funding of science. Respondents pointed out that international grants and programmes can *support* individual R&D efforts, but they *cannot ensure* sustainable development and the existence of an institute as a whole. Orientation merely to grant funding is fraught with danger of formation of "*ad hoc*, project-based science" and "*ad hoc*, interim" teams of scientists. This could cause serious damage to fundamental science as a basis of the country's competitiveness.

As yet investments made by the private business of Georgia and attracted from abroad cannot be appreciated as an essential source of funding research and educational activities. Thus, access to financial means received from various sources falls in the category of problems characterized by ever-increasing urgency. The assessment of work performed in a research or higher educational institution during the period 2002 – 2005 was carried out in terms of the following indicators:

1. The total number of publications including scientific articles indexed in the ISI Web of Science database ; articles published in other foreign journals; articles published in Georgian scientific journals; monographs issued by Georgian publishing houses; monographs issued by foreign publishing houses; theses of reports indexed in the ISI Web of Science database.
2. The number of patents for inventions and discoveries.
3. The number of grants received.
4. The number of prizes awarded (both state and international ones.)

Variations in the number of published works during the period under review were insignificant. Changes in the structure of types of publications were also insignificant. The percentage of articles published in foreign journals slightly increased, as well as the percentage of theses indexed in the ISI Web of Science database (up to 35 % by the year 2005.) Indirectly this could bear witness to the intensification of scientists' activity in submitting their works to international scientific publications, as well as to some increase in the opportunities for doing this. When considering the dynamics of the total number of publications in each concrete research or higher educational institution, one can note various trends of changes. In one third of organizations surveyed the annual number of publications has increased during the above-mentioned period (2002 – 2005), in one half of them has dropped and in one third remained at the same level. In the research and educational institutions surveyed the inventive activity ratio is very low. The patent activity ratio (the ratio of the number of organizations made applications for patents to the total number of organizations) among the research institutions surveyed is only 0.3.

Activities of research and higher educational institutions surveyed in searching for and attracting grants, perhaps, can be assessed as rather intense one. Virtually all respondents declared that workers of those institutions seek for any opportunity to obtain one or another of grants. At the same time it was pointed out that the system of grant-based support is far short of being perfect.

Changes in the sphere of research activities in Georgia have also been assessed. Most of respondents (68 %) considered the emergence of opportunities for cooperating with foreign counterparts to be a positive change. More than one third of the respondents (namely, 36 %) considered the intensification of material support received from various sources as a positive change. The respondents made references (8) to the Georgian

National Science Foundation. The respondents expressed restrained optimism in their assessing the positive nature of transformations that have taken place in the sphere of research efforts. However, the degree of positive influence of the transformation is not great yet, and multilateral efforts are needed in order for research activities to acquire the key and very significant role in the state and the society.

Negative impacts of transformations found a particularly noticeable reflection in:

- outflow from science and education by highly skilled personnel;
- decline in the status of intellectual labour and lowering of its social significance;
- formation of the negative image of science by public at large.

Thus, it proved correct that social consequences of reforms tangibly told on the image and status of researchers, and their professional mobility has not stem from with their attempt to improve their professional qualification but is a means of ensuring the higher income.

For five groups of consequences the assessment was made that correlated to their positive influence on the status of R&D activities in Georgia. Respondents held that material support on the part of the government has become stronger, the possibilities for research effort carried out by researchers have increased; positive influence on the material conditions of workers was noted; demand for science on the part of the system of higher education is formed; new opportunities for self-realization as a scientist emerged.

At the same time, virtually do not vanish problems caused by inadequate competence of personnel (especially "managers of science"), lack of necessary co-ordination of reforms between the Ministry of Education and Science, on the one hand, and scientific institutions, on the other; non-transparency of scientific evaluations; incompleteness of the grant system. Practically all respondents touched upon the problem of expert evaluation of projects and grants provided by the Ministry of Education and Science. Such an expert evaluation is a new phenomenon, and appraised by many respondents as positive one; however, in this case the very problem of its implementation, lack of clear and understandable criteria for evaluating project proposals and justifying of the amount of allocated financing are subjected to sharp criticism.

To estimate the state of the system of managing research activities in Georgia, respondents were asked to write down scores in the range from 1 to 10. An average score proved to be 4.3; almost one third of the respondents estimated the state of the R&D management system by 3 points.

Respondents were also asked to list circumstances *that hamper the establishment of an efficient system of managing research activities in Georgia.* As a method of analyzing the system of the support of research activities, the SWOT-analysis was chosen.

After generalizing and grouping individual opinions of respondents, the characteristics of strengths and weaknesses displayed by the system as well as a table of opportunities and threats for this system were drawn up.

It should be noted that the respondents in their answers more often pointed out the weaknesses of the system studied. Besides, the list of weaknesses is more diverse than that of strengths. One can assign to the **strengths** of the system that should be taken into consideration it its further reforming:

1. Resolution in the approach to reorganization of research institutions,

wish for positive changes.

2. Competitive system of allocating government subsidies for science.
3. Establishment of the National Research Foundation and a grant-based funding system.

Among **weaknesses**, the following ones should be first of all eliminated:

1. Vague formulation of the objectives and stages of reforming.
2. Lack of defining most promising directions of science development.
3. Inadequate co-ordination and complication of relations between scientific institutions and the Ministry of Education and Science.
4. Low level of participation of the research community in the reorganization of scientific institutions.
5. Lack of development of library, information, communication infrastructure.
6. Obsolescent material and technical basis of, and provision of materials and equipment for science, lowering of the scientific level of experimentation.
7. Unattractiveness of work for young specialists.
8. Non-transparency of peer reviews, incompleteness of the grant system and the methods of project appraisal.

The circumstances were identified that make it possible to continue the course of reforms and facilitate their going on, as well as the circumstances that could affect these reforms adversely.

Particular attention should be given to urgent tasks existing in the sphere of research activities, namely:

- strengthening of the material and technical basis of research and educational institutions;
- intensification of the professional mobility and extension of international co-operation;
- integration of science with the educational process;
- increase in remuneration of labour, improvement of trained personnel and its characteristics.

The respondents spoke out actively as to which main provisions should be taken into account when developing a system of R&D activities in Georgia. They came to conclusion that the system should be based on principles of integration of science and higher education, priority of scientifically justified decisions over politicized ones, support on the part of the government, due regard to special national features of Georgia, reasonable commercialization. The respondents expressed also their personal opinions of approaches to establishment of a system of funding research activities. All of them noted serious imperfection of the present-day system of funding that not only prevents institutions from carrying out scientific activities of real value, but also gives rise to unhealthy, morally bad competition between research institutions. The role of the government in the system of funding research efforts still remains to be key one, and not only in the matter of ensuring flow of money, but also in the assistance in attracting resources from the private sector and non-profit organizations.

The process of establishing the system of R&D activities goes on with complications inherent in such a process, and not always this process has solely positive consequences. The present situation seems to be contradictory, but research and educational institutions do their best in order to accept it and learn to cope with it

successfully by choosing certain techniques to organize their work. Scientific community had already shaped their attitude toward reforms, and results of expert survey have demonstrated this to a sufficient degree.

Finally, as main directions of transformations that have to serve as a basis for the strategy of developing the system of R&D management in Georgia, the following ones may be recommended:

1. Expansion of professional mobility of R&D personnel engaged in the sphere of science and education.
2. New vision of the role and importance of universities in carrying out scientific investigations.
3. Strengthening of interaction between R&D institutions and firms.
4. Improvements in the system of financing R&D.
5. Determination of priority lines of research and the establishment of coordinating bodies for solving this task.
6. Expert evaluation of grants, projects, dissertations.
7. Development of scientific and technological parks.
8. Introduction of the basics of business into activities of research and educational institutions.
9. Development of radically new fundamental courses of study for the system of higher education. Intensification of introducing market elements in the education area.
10. Reproduction of scientific schools.

1. The study in brief

1.1 The essence of the problem and subject of the study

A comprehensive assessment of the current situation in the sphere of research activities in Georgia was determined as a result of the project implemented. It was supposed that in performing such an assessment it would be necessary not only to use available official statistical data, but also involve representatives of the research community so as to obtain an unbiased picture of the state of a sector surveyed along its various dimensions while maintaining open discussion and freedom of expressing opinion.

The study was of an exploratory nature, and its objective was to analyze the present situation as thoroughly as possible. Carrying out of such assessment will allow to define more profoundly problems in order to better understand their nature, and then to propose justified recommendations and formulate the strategy of sustainable development of the R&D sector.

The process of reforming the system of R&D activities in Georgia and collateral phenomena and problems became the subject of the study.

1.2. Objectives and tasks of the study

The main goal of the study was to obtain a comprehensive assessment of the state of the system of R&D activities in Georgia and characteristics which the system has today and at the current stage of implementing the reforms.

The tasks of the study were the following:

- The analysis of the impact of the process of society transformation upon the organization and the state of R&D activities;
- The description of macroeconomic trends influencing R&D activities in Georgia;
- The assessment of the present situation in the R&D activities in Georgia;
- The determination of urgent issues in the sphere of developing R&D activities in the years ahead;
- The determination of strengths and weaknesses of the existing system of supporting R&D activities in Georgia, as well as opportunities and threats for its future development;
- The determination of priorities in establishing the system of research management.

1.3. Sources of information

The used sources of information were related to the goals set and to problems to be solved. The survey entailed carrying out both qualitative and quantitative assessments.

Information has been obtained from the following sources:

1. Primary data: interviewing and questioning of experts engaged in the R&D sector. Methods of obtaining primary data and the purpose of these data are described in item 1.5.

2. Secondary data: statistical collections, professional journals, forums, news groups, specialized Web-sites, databases.

A number of issues could be studied on the basis of secondary data available, while for studying other issues it was necessary to know the opinion of respondents engaged in R&D and higher education. Secondary data were used for investing macroeconomic trends, special features of the transition period and its influence on the state of research activities. The use of secondary data made it possible to make comparisons between countries.

1.4 Methods of study

The analysis of primary and secondary data was performed in the course of the study For the analysis of data one-dimensional and multi-dimensional methods of analysis were used. Methods of comparison and generalization, the method of analytical grouping, methods of expert estimates, and content-analysis of documents were used, too.

1.5 The characteristics of respondents and the structure of the questionnaire

The array of primary data was obtained by means of the questioning and the interviewing of respondents: directors (rectors) or deputy directors (pro-rectors) of R&D and higher educational institutions.

The goals of obtaining information from respondents were the in-depth definition of problems facing the system and an attempt to find a preliminary solution to these problems. The respondents were informed about the goal of the study, its paramount role in the project implementation. The idea consisted of the following: a respondent was motivated to speak freely about his or her attitude to a problem and about the means of its solution. Generalized results of the interviews and questioning provided the basis for the analytical report.

For gathering information the closed questionnaire consisting of 19 questions was used. Interviewing was carried out by the method of face-to-face conversation, and it was open-ended.

Questions were subdivided into 5 groups, and each group was assigned an ordinal number from I to V. Brief characteristics of these groups are as follows:

Group I. General information on the organization (institution): status, number of personnel employed.

Group II. The state of financial resources of the organization (institution): amount and source of financing.

Group III. R&D activities performed in the organization (institution), the number of published scientific works and their type, issued patents, received grants, and awarded prizes.

Group IV. The present state of the R&D system in Georgia.

Group V. Conditions of and grounds for establishing an up-to-date system of R&D activities in Georgia.

Each of returned questionnaires was checked for the completeness. Adjustments for non-response were necessary only in individual cases.

The questionnaire contained questions of various types:

- open-ended questions to which a respondent could answer by him/herself, without using any prompts whatsoever;
- closed question with options of responses;
- continuous rating scale.

2. Review of the current situation in the R&D sector in Georgia

2.1. The impact of the transformation process on the research community in Georgia

The concepts "globalization" and "transformation (transition)" today are often found in the political life of various states, as well as in social sciences. Transformations in the former socialist countries had been conditioned mainly by international influence, and consequently entailed taking into account international experience, models of development, models of governance and various processes therein. Concurrent with transformation, such necessity is enhanced by intensification of the globalization process and emergence of the "global community". The transformation process has to ensure efficient economic management in post-socialist countries and a search for optimum relationship between economic and social interests, public and private sectors, diverse forms of ownership, democracy, private entrepreneurship, and market economy. Transformations have caused various contradictions, many of which gave rise to negative social phenomena and led to non-fulfilled expectation associated with changes in social relations. All these phenomena are actively present in research and education. These circumstances generated a need for a reconstruction of the old social institutions whereas the outline and components of models of new institutions were not always tangible. The academic community of Georgia found itself in an awkward and unaccustomed situation, for the first time being suddenly faced with the problem of at least partially giving up academic freedoms for the sake of activity directed towards attracting additional resources indispensable for supporting scientific and educational processes. In many respects this had to do with a search for new sources of financing, with the redistribution of expenditure on R&D efforts in favour of private sector rather than public one. Table 1 presents data characterizing the distribution of internal expenditure on R&D activities by sector of activity. It is quite obvious that in most industrialized countries private and higher education sectors account for the greatest share of expenditure.

In countries undergoing the transition period, the percentage of expenditure on R&D activities is higher in the public sector. This may reflect both the established practice when the government covers a major part of expenditure on financing scientific efforts, and a desire to maintain the "science-supporting" role of the government during the transition period.

Table 1

Distribution of internal expenditure on R&D activities by sector of activity in the year 2000, the percentage

Country	Total	Sector			
		Public	Business	Higher education	Private non-profit
Austria	100.0	6.4	63.6	29.7	0.3
Belgium	100.0	6.0	73.7	19.2	1.1
Bulgaria	100.0	72.5	20.3	5.8	1.4
Czech Republic	100.0	23.0	61.1	15.6	0.3
Denmark	100.0	7.0	69.3	23.1	0.6
Estonia	100.0	24.4	23.9	51.2	0.4
Finland	100.0	10.4	69.9	19.2	0.6
France	100.0	16.9	62.2	19.5	1.4
Greece	100.0	22.1	32.7	44.9	0.4
Iceland	100.0	24.5	57.2	16.1	2.2
Latvia	100.0	33.5	17.2	49.3	0.0
Lithuania	100.0	57.9	4.4	37.3	0.3
Netherlands	100.0	14.2	58.2	27.0	0.5
Poland	100.0	44.9	21.4	33.5	0.3
Portugal	100.0	19.8	34.4	35.6	10.2
Republic of Korea	100.0	13.4	74.9	10.4	1.3
Russia	100.0	24.5	69.9	5.4	0.2
Slovenia	100.0	23.1	59.7	15.5	1.7
Spain	100.0	15.4	54.6	29.8	0.2
Sweden	100.0	2.8	77.6	19.4	0.1
Switzerland	100.0	1.3	73.9	22.9	1.9
United Kingdom	100.0	8.9	67.0	22.6	1.5
United States of America	100.0	9.0	68.9	16.8	5.3

Sources: Россия и страны мира. 2004. Стат. сб./Росстат. М.: 2004; Россия и страны – члены Европейского Союза. 2005. Стат. сб./Росстат. М.: 2005; European Innovation Scoreboard 2006.

Expenditure on science in the structure of GDP is an indicator of no less importance. In Fig. 1 are shown the corresponding indicators for the EU countries (EU-25) for the year 2004.

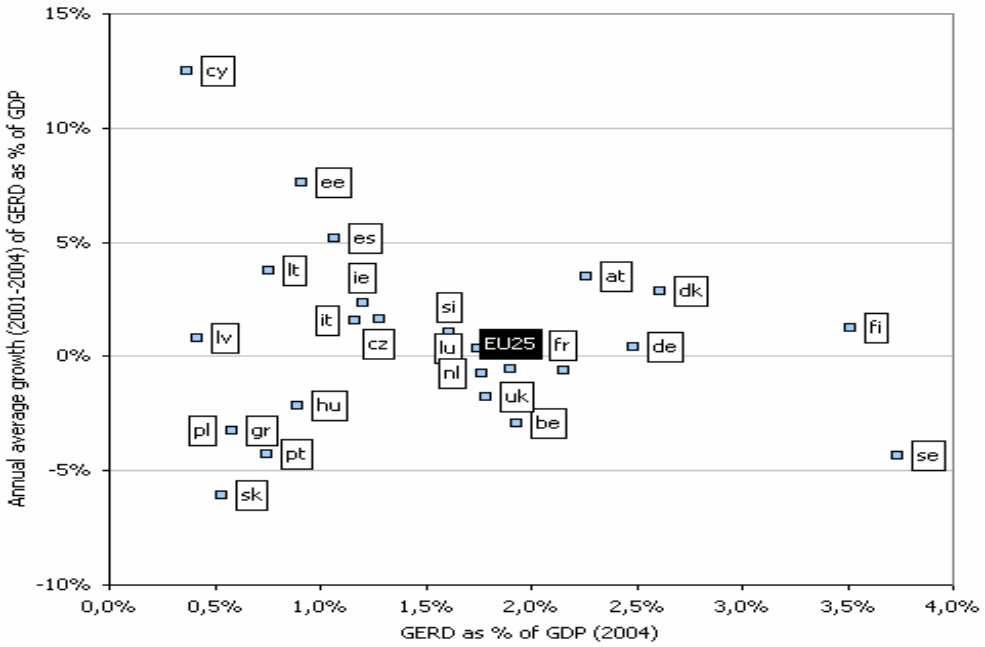


Fig. 1. Gross expenditure on R& D (GERD) as % of GDP, EU-25
Source: ERA-WATCH 2007

The share of internal expenditure on science in the GDP of a number of countries is shown in Table 2. The disparity between the share in countries with transitional economy and other countries may reach 20 times. This indicator characterizes the priority given to the development of science in one or other country.

Table 2
Internal expenditures on R&D as percentage of GDP

Country	1998	2000	2002	2004
Armenia	0.28	0.26	0.34	…
Austria	1.78	1.86	1.93	2.26
Azerbaijan	0.42	0.35	0.31	…
Belarus	0.82	0.81	0.64	…
China	0.70	1.00	1.23	1.44
Czech Republic	1.24	1.33	1.30	1.28
Denmark	2.06	…	2.52	2.62
Finland	2.88	3.40	3.46	3.48
France	2.17	2.18	2.20	2.16
Georgia	0.25	0.19	0.17	…
Germany	2.31	2.49	2.52	2.49
Hungary	0.68	0.80	1.02	0.88
Iceland	2.07	2.75	3.09	2.97
Japan	2.95	2.99	3.12	3.15
Kazakhstan	0.22	0.17	0.26	…
Kyrgyzstan	0.21	0.13	0.20	…
Latvia	0.45	0.48	…	…
Lithuania	0.57	0.60	…	…
Moldova	0.88	0.58	0.45	…
Poland	0.68	0.66	0.59	0.56

Country	1998	2000	2002	2004
Portugal	0.69	0.80	0.93	0.78
Romania	0.49	0.37	0.38	…
Republic of Korea	2.55	2.65	2.91	2.63
Russia	0.95	1.05	1.25	1.17
Slovakia	0.79	0.65	0.58	0.53
Slovenia	1.40	1.46	1.54	…
Spain	0.89	0.94	1.03	1.05
Tajikistan	0.04	0.07	0.05	…
Ukraine	1.22	1.14	1.02	…
United Kingdom	1.80	1.84	1.88	…
Unites States of America	2.60	2.72	2.67	2.68

Source: Россия и страны мира. 2004. Стат. сб./Росстат. М.: 2004; OECD Factbook 2006

The dynamics of GDP and the annual average growth rates of GDP in CIS countries over the period 1991 – 2004 are given in Tables 3 and 4.

Table 3

Indices of GDP volume in constant prices

Country	The percentage change over previous year					2005 over 2000, %
	2001	2002	2003	2004	2005	
Armenia	109.6	113.2	114.0	110.1	113.9	177
Azerbaijan	109.9	110.6	111.2	110.2	126.4	188
Belarus	104.7	105.0	107.0	111.4	109.2	143
Georgia	104.8	105.5	111.1	106.2	107.7[1]	130[2]
Kazakhstan	113.5	109.8	109.3	109.6	109.2	163
Kyrgyzstan	105.3	100.0	107.0	107.1	99.4	120
Moldova	106.1	107.8	106.6	107.3	108.4[1]	131[2]
Russia	105.1	104.7	107.3	107.2	106.4	135
Tajikistan	109.6	110.8	111.0	110.6	106.7	159
Ukraine	109.2	105.2	109.6	112.1	102.4	145
Uzbekistan	104.2	104.0	104.2	107.7	107.2[1]	122[2]
CIS, on the average	106.0	105.0	108.0	108.0	107.0	139

[1] January – September

[2] 2000 over 2000, %

Source: Социально-экономическое положение стран СНГ в 2005 г.// Общество и экономика, 2006, № 3.

During the period 1991-2004 an increase in GDP in all the countries has been noted although it has not always been steady.

Table 4

Annual average growth rate of GDP in CIS countries over the period 1991 – 2004, %

Country	1991 – 1995	1996 – 2000	2001 – 2004	1991 – 2004
Armenia	88	105	112	100
Azerbaijan	81	107	110	99
Belarus	92	106	107	101
Georgia	78	106	107	95
Kazakhstan	91	102	110	100
Kyrgyzstan	87	106	105	98
Moldova	83*	98	107	95*
Russia	91	102	106	99
Tajikistan	82*	100	111	96*
Ukraine	86	98	109	97
Uzbekistan	96	104	105	101*

* Estimate

Source: Статистический сборник «Национальные счета стран СНГ: 1995 —2003». М.: Статкомитет СНГ, 2004.

With small expenditure on science this sector, under current conditions, has no capabilities to solve the problem of transferring industry to a new technological level, to ensure a considerable growth of GDP and hence, to earn a decent return for the sector. "Small", or project-based research performs only cognitive functions but cannot efficiently perform its social and economic functions. Fundamental science cannot exist and develop on terms of self-financing because it performs mainly cognitive functions, is not directly related to practice, and does not bring direct income from commercialization of research outcomes. However, it is difficult to overestimate its role as a "basis" for applied sciences. Entrepreneurs would never be willing to become engaged in certain lines of research because of their non-profit nature (for example, social security, education, ecology, etc.)

The character of relationship between science and the state has changed considerably in the last decade, and this fact has been reflected in the dramatic reduction of budgetary financing of science. Because of the economic crisis, the resource base of science has deteriorated considerably. According to estimates made by foreign experts, the provision of scientific institutions with research equipment is 80 times worse, and with scientific literature 100 times worse than in the West. This process of deterioration is both quantitative (number of personnel employed, expenditures) and qualitative ("brain drain" of people most capable for work, as well as young scientists; social and psychological degradation of workers, ageing of the material and technical basis). One cannot but take into account also the fact that radical reduction of the number of people employed in research has also a psychological aspect. This phenomenon entails social upheavals, will lead to social tension, the alienation of people. The problem of reproduction of scientific schools and the intellectual scientific elite has become paramount. The crisis of science had also an adverse impact on its regional structure. The danger of losing science-intensive directions of research that are difficult to restore could also become real.

Under the drastic reduction of public financing of science, the "interim", ephemeral teams of scientists that receive grants only for carrying out individual scientific tasks

acquire an ever-increasing importance. The new patterns of research organization are not in most cases adequate substitutes for traditional ones, particularly in fundamental research. In the opinion of experts, such type of scientific school is closer to university-based science rather than to the established research system in the framework of the Academy of Sciences or sector-related science (today, "business sector" is a more accepted name for it).

Foreign foundations that provide financing on the basis of grants or direct investments have become one of the main channels of obtaining financial aid in the last decade for carrying out fundamental or applied research.

The statistics of a number of persons employed in research as well as their breakdown by sector can serve as an evidence of the level of R&D development. Unfortunately, this indicator is available only for the EU-countries. The structure of employment by research sector in the EU-countries is given in Table 5. For most new EU member states, the share of persons employed in the sphere of higher education is large. For countries with higher level of economic development the share of persons employed in the business sector is large, and this not infrequently corresponds with the success of these countries (Austria, Belgium, Denmark, Germany, Finland, Ireland, Sweden, and United Kingdom) in commercialization of research outputs.

Table 5

Breakdown of the number of researchers by research sector in 2003 (%)

Country	Total	Sector			
		Public	Business	Higher education	Private non-profit
Austria	100.0	4.1	66.3	28.9	0.6
Belgium	100.0	7.0	56.6	35.6	0.8
Czech Republic	100.0	30.6	41.5	27.3	0.6
Denmark	100.0	8.9	61.6	28.9	0.6
Estonia	100.0	20.7	12.6	66.3	…
Finland	100.0	11.3	56.6	31.2	0.9
France	100.0	12.9	51.1	34.1	1.8
Germany	100.0	14.7	58.1	27.2	—
Greece	100.0	13.8	26.4	59.5	0.3
Hungary	100.0	31.2	29.5	39.3	—
Ireland	100.0	6.4	63.8	29.8	—
Italy	100.0	19.0	39.3	39.7	1.9
Latvia	100.0	28.6	7.3	64.1	...
Lithuania	100.0	32.9	3.7	63.4	...
Netherlands	100.0	15.6	46.9	36.4	1.2
Poland	100.0	22.6	11.7	65.6	0.1
Portugal	100.0	20.6	15.4	50.4	13.6
Russia	100.0	32.2	60.6	7.2	0.1
Slovenia	100.0	34.1	34.8	29.5	…
Spain	100.0	16.7	29.8	53.2	0.3
Sweden	100.0	4.9	60.6	34.5	—
United Kingdom	100.0	9.1	57.9	31.1	1.9

Sources: Россия и страны – члены Европейского Союза. 2005. Стат. Сб./Росстат. М.: 2005; European Innovation Scoreboard 2006.

The number of personnel engaged in R&D activities in some countries as well as its change during the period 1995 – 2002 are shown in Table 6. This period has been noted for intense transformation processes in a number of countries, and is essentially reflected in the indicator studied (in most cases toward its considerable decrease).

Figure 2 suggests that of EU-countries in 2003 the largest share of R&D personnel in the labour force was noted in Finland (2.42 %), Belgium (1.45 %), France (1.38 %), the smallest share was in Hungary (0.59 %), Czech Republic (0.57 %) and Portugal (0.49 %).

Table 6

The number of personnel engaged in R&D activities[1]

Country	1995	1998	1999	2000	2001	2002	2002 over 1995, %
Armenia	7591	8133	6528	7309	6965	6737	88.7
Azerbaijan	16926	15299	15678	15809	15929	16019	94.6
Belarus	39300	32477	31791	32926	32119	30711	78.1
China	751700	755200	821700	922131	956500	1035197	137.7
Czech Republic	22687	22740	24106	24198	26107	26032	114.7
Estonia	…	4600	4545	3700	3700	…	80.4
Finland	33634	46517	50604	52604	53424	55044	163.7
France	318384	309161	314452	327466	333518	…	104.8
Georgia	21497	17009	15138	12726	12391	16031	74.6
Germany	459138	461539	479599	484734	480606	478617	104.2
Hungary	19585	20315	21329	23534	22492	23703	121.0
Italy	141789	145968	142506	150066	153905	…	108.5
Kazakhstan	25372	17593	15482	14756	15339	15998	63.1
Kyrgyzstan	4558	3748	3766	3493	3495	3440	75.5
Latvia	5238	4437	4301	5400	5400	...	105.0
Lithuania	…	12847	12794	11791	11900	…	92.6
Moldova	8688	7515	6543	5889	5356	5102	58.7
Netherlands	79256	85486	86773	88504	89664	…	113.1
Poland	83590	84510	82368	78925	78027	76214	91.2
Portugal	15465	19421	20806	21888	22970	24403	157.8
Romania	60939	52454	44091	33892	32639	32799	53.8
Russia	1210589	967499	989291	1007257	1008091	986854	81.5
Slovakia	16182	16461	14849	15221	14422	13631	84.2
Slovenia	9879	8290	8495	8568	8608	8615	87.2
Spain	79988	97098	102237	120619	125750	134258	167.9
Tadjikistan	3062	4018	4945	2696	3447	3294	107.6
Ukraine	293121	214926	199434	187531	181531	177983	60.7

[1)] Data for foreign countries and Russia are given in the equivalent of full employment (FTE), for CIS countries – in natural persons (men).

Sources: Россия и страны мира. 2004. Стат. Сб./Росстат. М.: 2004; European Innovation Scoreboard 2006.

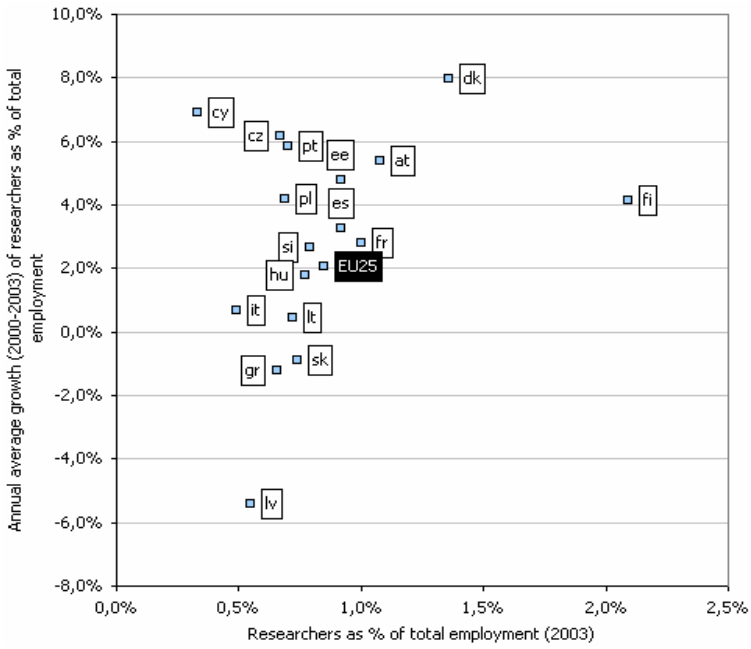


Fig. 2. The share of R&D personnel in the labour force
Source: ERA-WATCH 2007

Figure 3 clearly demonstrates the changes in the number of personnel engaged in R&D activities in a number of FSU-countries. Let us stress again that in most countries the number of personnel engaged in the R&D sector has dropped while for a number of countries (Azerbaijan, Latvia, Lithuania) the tendency for gradual regain of this number is typical.

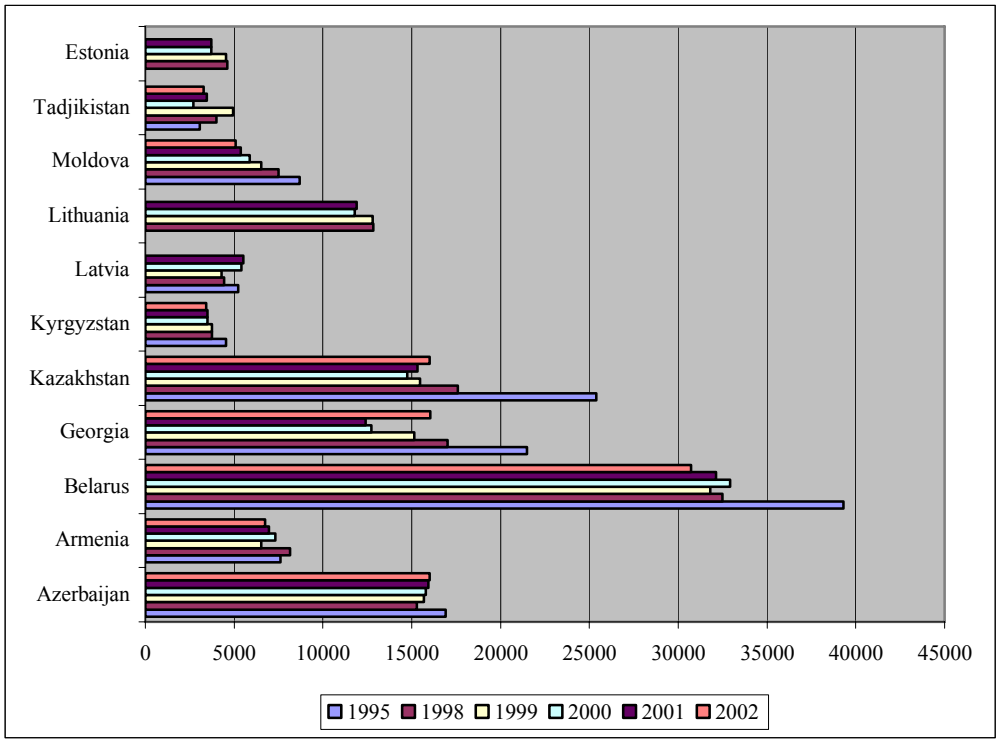


Fig. 3. Changes in the number of personnel engaged in research in a number of FSU-countries (thousands. of people)

The process of transformation of the global industrial economy into the knowledge-based economy is apparent. Year after year the percentage of workers using personal computers with the access to the Internet increases. In 2003, this indicator already reached 43 % for Belgium, 52 % for Sweden, 53 % for Denmark and Finland, and has continued increasing in the following three years. In 2003, the share of innovation-oriented enterprises in the total number of industrial enterprises came to 75 % in Ireland, 66 % in Germany, 59 % in Belgium, 55 % in the Netherlands. In EU-countries, rounds of European Innovations Scoreboard take place at regular intervals, the third of them took place in 1998 – 2002. Sweden, Finland, Switzerland, and Denmark were declared European leaders in the field of innovation in 2006. Among new EU-countries, Slovenia, Estonia and Czech Republic were declared as countries that are most successfully developing innovation-wise.

Fundamental science involved in the generation of new knowledge is not only a national asset but also an essential element of maintaining social and political stability in a country, one of the indispensable components of a national idea. Without the development of fundamental research, the process of carrying out reforms in a country cannot be successful. There is a good reason to assert that investments made into research are a national priority for many countries in the world.

The number of research publications is one of the most important indicators for evaluating the research activities in a country. Despite a considerable decrease of the

number of research personnel the number of published works steadily increases in most transition countries (cf. Table 7).

Table 7

The number of papers published by researchers from a number of countries over the period 1980 – 2005

Country	1980-1989	1990-1994	1995-1999	2000-2005
Armenia	1850	1696	1593	2479
Azerbaijan	2091	1668	970	1253
Belarus	5677	5840	6281	6471
Estonia	1220	1436	2570	4098
Georgia	1736	1413	1216	1781
Kazakhstan	2218	1814	1055	1344
Kyrgyzstan	312	276	138	273
Latvia	1462	1520	1735	2220
Lithuania	1442	1325	2053	4381
Moldova	1322	1227	1006	1156
Russia	...	55871	141719	162142
Tajikistan	608	630	208	220
Turkmenistan	144	159	64	48
Ukraine	32410	25645	22002	25808
Uzbekistan	2461	2174	1878	2208

Source: Ü. Must. Changing publication pattern and research collaboration of former Soviet Union States// Archimedes Foundation.

The continuation of carrying out research in many countries today depends on either the availability or lack of financial support on the part of various foundations. This compels researchers to seek for possibilities of publishing their works in internationally recognized journals, since the latter option might considerably increase the probability of obtaining a grant for research activities. The increase in the number of publications does not correspond to the changes in the number of quotations. The tendency toward the increase in the number of quotations has become apparent only within the last 10 years. The pattern of scientific publications changes depending on a language in which they were prepared. A transition from the use of Russian to the use of English is clearly noticeable (cf. Table 8).

Table 8

The percentage of publications in FSU countries in various languages over the period 1980 – 2005

Country	1980 – 1989			1990 – 1999			2000 – 2005		
	Russian	English	Other	Russian	English	Other	Russian	English	Other
Armenia	50.4	*49.0*	0.6	27.9	*71.6*	0.5	4.4	*95.3*	0.3
Azerbaijan	50.8	*48.7*	0.5	34.3	*65.5*	0.2	4.4	*95.4*	0.2
Belarus	63.8	*35.6*	0.6	39.9	*59.9*	0.1	5.8	*94.0*	0.2
Estonia	28.9	*69.8*	1.3	6.6	*92.8*	0.6	0.5	*99.1*	0.4
Georgia	53.6	*45.4*	1.0	29.1	*70.4*	0.5	2.5	*97.2*	0.3
Kazakhstan	62.7	*37.0*	0.3	46.4	*53.4*	0.2	4.4	*95.4*	0.2
Kyrgyzstan	72.8	*27.2*	0.0	51.2	*48.6*	0.2	11.0	*89.0*	0.0
Latvia	54.9	*44.1*	1.0	21.7	*78.0*	0.3	6.7	*92.8*	0.5
Lithuania	47.4	*51.9*	0.7	10.9	*88.8*	0.3	2.1	*96.8*	1.1

Country	1980 – 1989			1990 – 1999			2000 – 2005		
	Russian	**English**	**Other**	**Russian**	**English**	**Other**	**Russian**	**English**	**Other**
Moldova	59.9	*39.3*	0.8	35.2	*64.4*	0.4	1.5	*97.3*	1.2
Russia	69.1	*27.3*	3.6	30.7	*69.2*	0.1	8.0	*91.2*	0.1
Tajikistan	77.3	*22.0*	0.7	59.4	*40.5*	0.1	6.8	*93.2*	0.0
Turkmenistan	72.9	*27.1*	0.0	64.6	*35.0*	0.4	6.2	*93.8*	0.0
Ukraine	58.1	*33.3*	8.6	35.7	*61.8*	2.5	6.7	*92.9*	0.4

Source: Ü. Must. Changing publication pattern and research collaboration of former Soviet Union States// Archimedes Foundation.

2.2. Trends characterizing the present state in the field of R&D activities in Georgia

Serious changes have occurred in the sphere of research and higher education in Georgia during the past 2 – 3 years. These changes touched upon the legislation related to science and education, the structure of scientific research and higher educational institutions, and financing. The period mentioned was too short for so dramatic changes. At the same time there is a great deal of work on modernizing the R&D system yet to be done. The scientific community of Georgia has well-defined objectives as far as achieving good results of reforms and integrating into the world research community are concerned.

The state of science, its current status, and position of scientists in society – all this is a striking example of contradictions. At a theoretical level, the important role of science as a special social subsystem in maintaining national security, reproduction of technological and spiritual level in the development of the country is recognized; however, practically the situation in science is critical.

Among the most impressive manifestations of a crisis are the low level of remuneration of intellectual labour, underestimation of its social significance, lack of opportunities for self-realization as a scientist. The situation of the "declining status" of a scientist – researcher – lecturer has arisen.

Studies carried out by universities and research institutions are independent of one another. R&D institutes wish also in the future to retain independence from universities. They are starving for technical staff.

The Ministry of Education and Science provides financial support only for payment of salaries. Financial resources necessary for all other expenses born by a research or higher educational institution have to be obtained by means of receiving grants or renting out their building space.

Research institutions are deprived of any possibilities of training PhDs. Research workers should be able to teach in universities. Problem of commercialization of scientific results is urgent, and it should be discussed and supported at the state level.

There is no developed system of carrying out expert evaluations which has a profound effect on the system of grant delivery assessment of research results.

Under limited scope of public financing, research institutions in Georgia are both compelled and motivated to seek additional finances from various foundations and international organizations needed for the implementation of various aspects of their scientific activities. Table 9 lists major international foundations operating in Georgia.

Table 9

Main characteristics of international foundations operating in the sphere of R&D in Georgia

Programme	Year of establish-ment	Purpose of a programme	Number of projects (programmes) /budget, mln USD	Activities provided for in a programme
ISTC	1992	Contribution into fundamental research, international programmes, innovations, and commercialization of scientific results	80/26.0	Joint research
STCU	1993	Prevention of proliferation of weapons of mass destruction	50/5.0	Training and re-training. Support of people having been impaired by earthquakes. Purchase of laboratory equipment. Scientific trips, seminars, summer schools.
INTAS		Development of scientific collaboration in 12 CIS-countries and strengthening of the research potential, assistance in long-term co-operation	250/5.9	Scholarships. International seminars. Scientific trips. Joint projects.
NATO (14 sub-programmes)		Programmes of developing science and technologies	88/10.0	Seminars. Joint research. Visits of experts.
TEMPUS	1995	Support of institutions of higher education	68/7.8	Development of curricula and study courses. Management of universities. Mobility of students. Institutional development. Joint European projects. Grants for individual mobility of lecturers.
TACIS	1992	Various technical support provided in CIS countries	36.4*	Support of institutional, legal, and administrative reforms. Development of a system of social support and protection. Etc.
EC FP Programmes EC 7-th FP	1984 2007	Support of researchers	150.0	
CRDF	1997	Support of the global scientific community	8/3.4	Joint research. Partnership in industry. Support of the infrastructure in education.

Programme	Year of establish -ment	Purpose of a programme	Number of projects (programmes) /budget, mln USD	Activities provided for in a programme
GRDF	2003	Development of scientific-and-technological potential in Georgia	11/2.3	Bilateral research. Programmes of mobility. Assistance in holding international congressed and conferences. Programme of scientific and technological entrepreneurship. Programme of partnership with business. Establishment of centers of research and education.
IFS		Support of research performed by scientists from developing countries in the sphere of the use of renewable natural resources.		Provision of grants for research effort.

* Budget for the years 2004 – 2006.

Source: G. Kochoradze. Review of International Foundation Activity in Georgia. Materials of the project workshop 23.02.2007.

Figure 4 illustrates the dynamics of financing within the framework of the TEMPUS programme in Georgia geared for the needs of higher educational institutions.

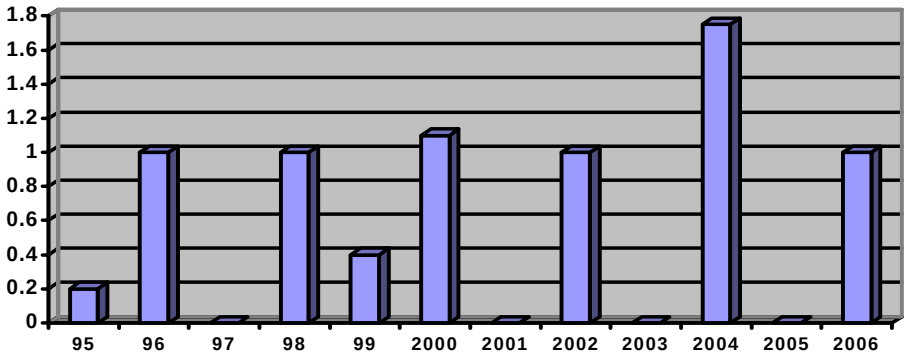


Fig. 4. Volume of financing in the framework of the TEMPUS programme in the years 1995 – 2006, million euro

Source: G. Kochoradze. Review of International Foundation Activity in Georgia. Materials of the project workshop 23.02.2007.

Figure 5 shows the structure of various projects within the framework of the TEMPUS programme.

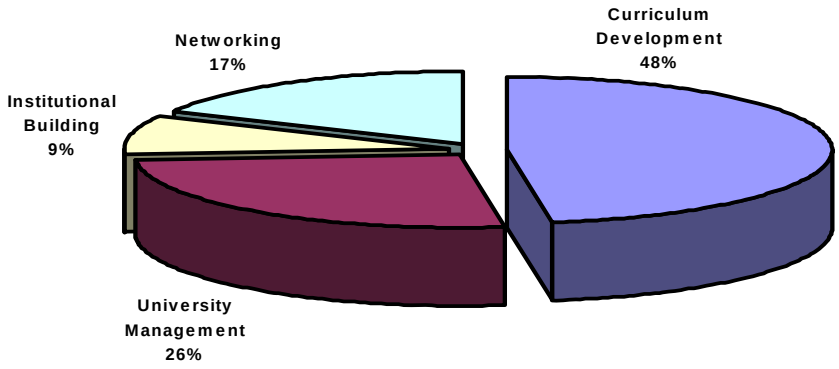


Fig. 5. The structure of various projects in the framework of the TEMPUS programme in the years 1995 – 2006

Source: G. Kochoradze. Review of International Foundation Activity in Georgia. Materials of the project workshop 23.02.2007.

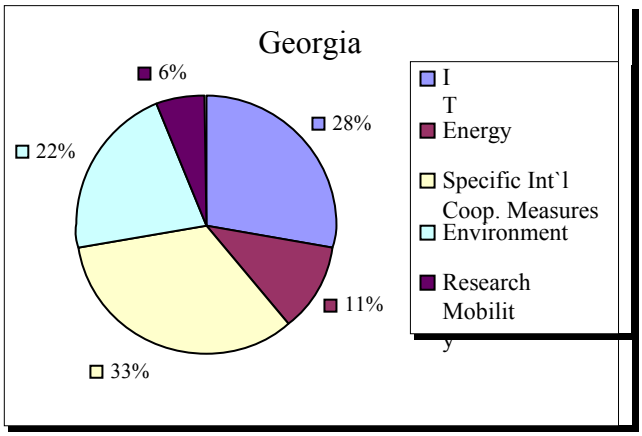
Georgian participation in the EU Framework Programmes 5 and 6

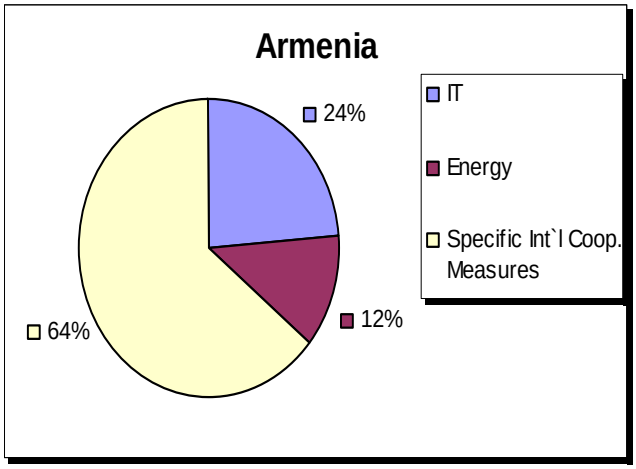
Participation in the 5th Framework Programme 1998-2002

Georgian research organisations took part in 17 projects in FP5 with total EC funding of 590,000 euro (for comparison: Armenia participated in 15 projects with total EC funding 920,000 euro).

Characteristics of Georgian and Armenian participation can be seen on the following charts

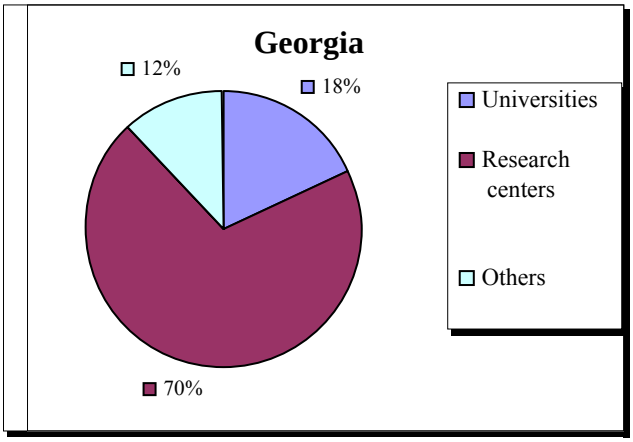
Participation by project fields

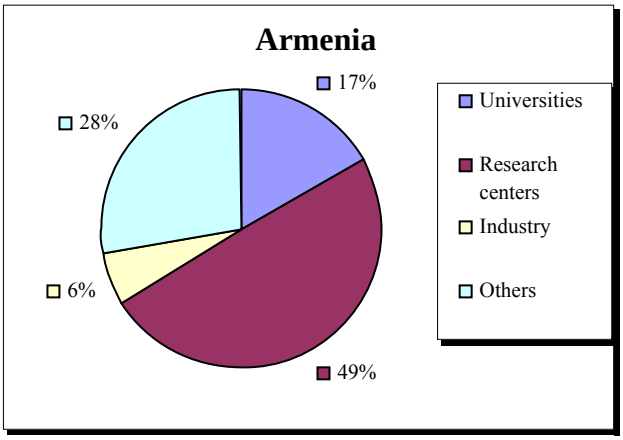




Source: EC Delegation to Georgia, July 2006

Participation by types of organisations





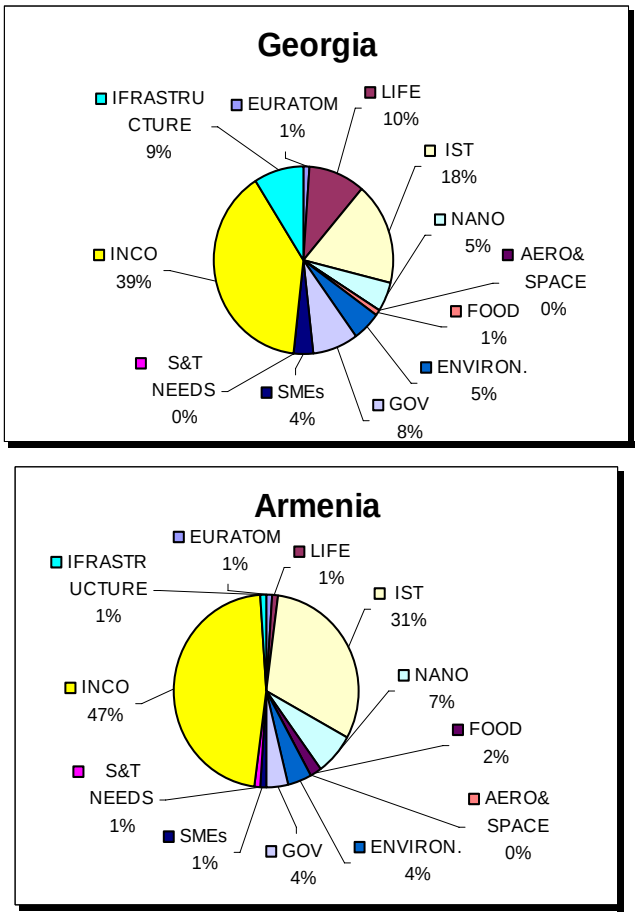
Source: EC Delegation to Georgia, July 2006

Participation in the 6th Framework Programme 2003-2006

Georgian scientific organizations participated in 93 submitted proposals, of which 17 projects were financed (the success ratio 19%, EC financing sum total exceeding 1,730,000 euro). Armenian organizations participated in 81 submitted proposals, of which 6 were selected (the success ratio 6%, EC funding sum total exceeding 1,825,000 euro). Azerbaijan participated in 54 submitted proposals, of which 6 projects were financed (the success ratio 11%, sum total of EC funding exceeds 1,090,000 euro).

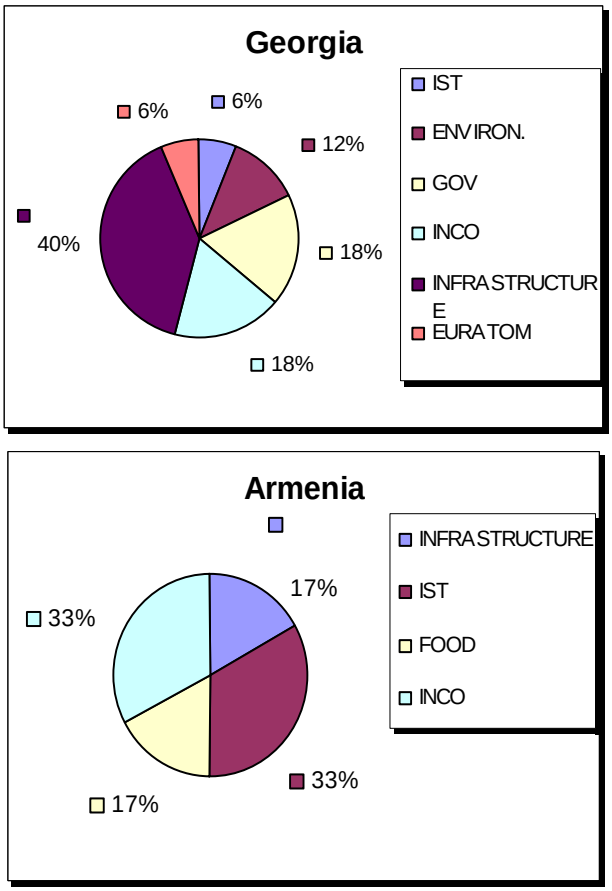
Characteristics of Georgian and Armenian participation in FP6 can be seen on the following charts.

Submitted proposals by research field



Source: EC Delegation to Georgia, July 2006

Selected projects by research field



Source: EC Delegation to Georgia, July 2006

The following conclusions can be drawn from Georgian participation in the EU framework programmes:

1. The success ratio of proposals submitted to FP6 involving Georgian partners is similar to the average EU participant (20%). But, considering only the projects addressing the core 7 thematic sub-programmes, the success ratio is down to 11%.
2. The remained Georgian projects are almost exclusively Specific Support Actions and Coordination Actions, i.e. not the cooperative research projects producing new know-ledge.
3. It also reflects the fact that most submitted proposals often had modest scientific ambitions.
4. More emphasis should be placed on the selection of high quality project partnerships in the future, as well as clearly indicating the "EU added value" component of the proposals.
5. The project budgets should better reflect the actual costs of labour in Georgia.

Of course it is impossible to provide high level of financing for all lines of research. Therefore, the question should be a certain narrowing of the research sphere together with a simultaneous improvement of its qualitative state, i.e. maintaining those lines that have gained recognition and are most relevant for the national economy. One cannot also forget about the development of social sciences and humanities that are so necessary at the present period of reforms and changes in priorities and values.

The main problem of **commercialization of research outcomes** is the lack of a domestic user, i.e. large-scale domestic market of high technologies. New private sector is not prepared to invest into expensive and long-term scientific projects. It is important for institutions not only to sell profitably the results of their work but also to integrate into the international research community as a full-fledged partner. This could offer possibilities of accumulating academic, economic and social advantages.

New scientific knowledge can and must be generated not only in R&D institutions but also in higher education institutions. Science is in great demand by the higher education system, it determines the purposes and content of higher education. The system of education, in turn, is a main supplier of cadres for basic science, it guarantees the most complete dissemination and use of the latest scientific achievements. But the research activity of many lecturers, especially in the humanities, is their private business, and that's all. The presence of scientific publications is obligatory but is not taken into consideration in determining the teaching load. Students and lecturers of higher educational institutions are isolated to a large degree from practical applied research.

At the same time, the role of higher educational institutions is of paramount importance in the process of formation of the knowledge-based economy. This is a situation when scientific knowledge obtained in research and higher educational institutions is being translated into a product in a design office, and afterwards is implemented thus creating income and new jobs. Weakening of the material basis of universities necessary for carrying out scientific studies brings along a loss of key positions of universities in scientific studies, and the centre of applied scientific developments moves more and more into large firms.

In conclusion, let's cite two opinions of speakers at the project workshop on 23 February 2007 devoted to the extension of collaboration between R&D institutions and universities.

Irma Ratiani, Director of the Shota Rustaveli Institute of Georgian Literature

As of today, there are a number of research institutes in Georgia of high scientific reputation. On the other hand, have all universities opportunities for, wish of, and capabilities to being involved in the process of integration with academic research? Integration may be successful only in the case when it is carried out on the competitive basis, when there is an integration of a strong research institute with a strong university that has already been organizationally prepared for such integration.

The new methods for extending co-operation between academic institutions and universities are recognized as necessary and very important. The Act on Higher Education asserts that the main objective of higher education is its integration with science, establishment of close co-ordination by means of educational activities, as well as scientific research in various areas of knowledge. This issue becomes especially topical in training masters and candidates of science.

Until very recently the role of academic research in education (among other things, in training masters and doctors of science) was insufficient and was reflected in the quality of scientific and qualification works. Educational technologies used in higher education were reduced to traditional lectures and seminars, and were to a substantially less degree related to research outcomes.

The conditions for scientific work and research are unsatisfactory. Until very recently the co-ordination of work between R&D and educational institutions was poor. Over the last 20 years most of academic and sectoral research institutes have functioned in isolation from each other. Most research outcomes and achievements obtained by sectoral and academic institutes were inaccessible for the subjects of the higher education system. Research carried out within the framework of preparing candidate and doctoral dissertations were of independent nature rather than correlated with the programmes and curricula of universities.

Higher education institutions and R&D institutes did not elaborate a common approach to the assessment of the quality of dissertations and to the criteria for compliance of scientific works with the status befitting a dissertation. Quite a number of dissertation works "rejected" by higher educational institutions were successfully defended either in sectoral institutes or institutes of the Academy of Sciences, and vice versa.

Thus, a situation emerged under which isolation of one subject from another came into conflict with the basic idea underlying any research organization, namely, co-operation and collaboration in all acceptable and necessary forms.

Co-operation between the K.S. Kekelidze Institute of Georgian Literature and the Ivan Javakhishvili State University of Tbilisi may be considered as an example of efficient interaction between a university and an R&D institute. The Institute of Georgian Literature promoted the course of the educational process in the State University and to the implementation of educational programmes through providing invaluable resources. However, this practice was gradually lost from the beginning of 1980s.

Unfortunately, the new scientific centres that were launched in universities after the 1980s for various reasons failed to make a substantial contribution to the creation of the basis for serious research efforts in educational institutions. This was probably conditioned by the peculiarities of scientific work so distinctive from teaching work. A successful implementation of research is difficult enough under conditions of heavy teaching load of both lecturers and students. In order to co-ordinate the educational process with research activities, heads of educational programmes in universities should enjoy strong support on the part of their colleagues from research institutes. The latter should provide an adequate scientific basis for approved educational programmes of universities for students and postgraduates. In line with this understanding, in December 2006 an agreement between the Institute of Georgian Literature and the State University of Tbilisi was reached. According to this agreement the Institute plans:

- *Collaboration with and support of the University in the field of training masters and candidates of science, the provision of an adequate scientific basis for and guidance of preparation of master's and candidate dissertations.*
- *Participation in peer review of research work.*
- *A free access to the library and archives of the Institute for all students and lecturers of the University*
- *Support of participation of students in various scientific projects, for example, in publishing encyclopaedias, readers, manuals, textbooks, etc.*

Nino Partsvania, Acting Director of the A. Razmadze Institute of Mathematics

Researchers, as a rule, should be involved in the process of teaching and thanks to their lectures and seminars, students (especially seniors) and postgraduate students would have access to the information about the latest scientific achievements. In fact, the existing teaching potential of scientific workers is not used efficiently. Today, when R&D institutes are deprived of the function of training young specialists, the participation of researchers in the educational process is underestimated and underused. In higher educational institutions teaching of each subject is supported by a limited number of specialists, and this by no means ensures the progress in teaching these subjects.

The process of co-operation between R&D institutes and universities should be supported by the government and financed from the government budget.

The Ministry of Education and Science of Georgia should elaborate a number of measures designed to support those universities that would entrust (wholly or in part) R&D institutes with training of masters

in a number of subjects. Benefits for students in this case would be the following: classes with most qualified specialists; attending scientific seminars; acquaintance with the latest scientific achievements; use of libraries of R&D institutes; and possibilities of participation in international research projects,

Only a small part of scientific workers can be efficiently engaged in training postgraduates, and most of them are employed in research institutions rather than in higher educational ones. This is a deadlock situation: those organizations that are entitled to train postgraduates suffer from the shortage of specialists capable of supervising a dissertation, whereas an organization in which there are such specialists has no right to train postgraduates. A solution would be to set up a "tandem" between R&D institutions and higher educational ones. Most well-known research institutions should be incorporated into the educational system of the country.

3. The assessment of the state, processes and the prospects for the system of R&D activities in Georgia

3.1. List of organizations surveyed and their main characteristics

3.1.1 Structure and characteristics of the organizations surveyed

Heads of 27 R&D and educational institutions (22 research institutes and 5 higher educational institutions) participated in the survey. The institutions surveyed represent different fields of scientific knowledge which allows us to get an insight into both the general and particular pictures of the state of research and educational activities in the country.

The following institutions were surveyed:

1. Shota Rustaveli State University
2. Ilya Chavchavadze State University
3. Ivan Javakhishvili State University of Tbilisi
4. Georgian Technical University
5. State Agricultural University of Georgia
6. A.I. Dzhanelidze Geological Institute
7. G.A. Tsulukidze Institute of Mining
8. Research Institute for Agricultural Radiology and Agroecology
9. Institute of Water Management
10. G.V. Tsereteli Institute of Oriental Studies
11. N. Muskhelishvili Institute of Computing Mathematics
12. Institute of Animal Husbandry and Feed Production of Georgia
13. N. Nodia Institute of Geophysics
14. Shota Rustaveli Institute of Georgian Literature
15. Institute of Plant Immunology
16. Institute of Molecular Biology and Biological Physics
17. A.N. Natishvili Institute of Morphology
18. Niko Berdzenishvili Institute of History
19. Institute of Food Industry
20. Institute of Politology
21. I.S. Beritashvili Institute of Physiology
22. Petre Melikishvili Institute of Physical and Organic Chemistry
23. A.S. Chikobava Institute of Linguistics
24. Tbilisi A.M. Razmadze Mathematical Institute

25. L. Kanchaveli Institute of Plant Protection
26. TECHINFORMI
27. Centre for Studying Productive Forces and Natural Resources of Georgia

The breakdown of institutions surveyed by the number of personnel is shown in Fig. 6. It should be noted that in the period between 2002 and 2005 the number of employees (including research workers holding academic degrees) was characterized by its stability virtually in all institutions. Only annual average fluctuations (both increase and reduction) in their number, no more than 15 – 20 %, and not in all institutions, were noted. Radical changes took place in 2006, when the number of personnel virtually in all institutions studied (except for the Shota Rustaveli State University) dropped, on the average, almost by 50 % (reduction in the number of personnel ranged from 30 to 300 %).

This can be explained as follows: in 2006 all institutions that formerly were attached to the Georgian Academy of Sciences were given the status of legal entity under private law, and they turned out to be under the jurisdiction of the Ministry of Education and Science. This is also related to the optimisation of the network of scientific institutions in the country with the result that these institutions were partly abolished and partly integrated with universities.

In 2006, the salary of scientific researchers was less than 115 lari per month (minimum amount of remuneration of labour in Georgia). New administrations of the R&D institutions asserted that they were about to raise the salaries at least up to 115 lari per month; however, the budgets of the institutions remained at the previous level. A dramatic reduction in the number of personnel became the only possibility to raise salaries.

In 2006, the share of scientific researchers with academic degree in the total number of personnel on the average was equal to 46 %, varying for different institutions from 25 to 75 %. Over the period 2001 – 2006, according to the survey there have not been serious changes in the structure of the employed depending on whether an academic degree was conferred upon a scientific worker or not. The percentage of researchers holding academic degrees remained rather stable, and in a number of institution it has even increased. For example, in 2005 in the State University of Tbilisi the percentage of researchers holding academic degrees amounted to almost 60 % while in 2002 it was only 29.2 %. The share of technical personnel in the structure of the employed in all organizations surveyed dropped slightly.

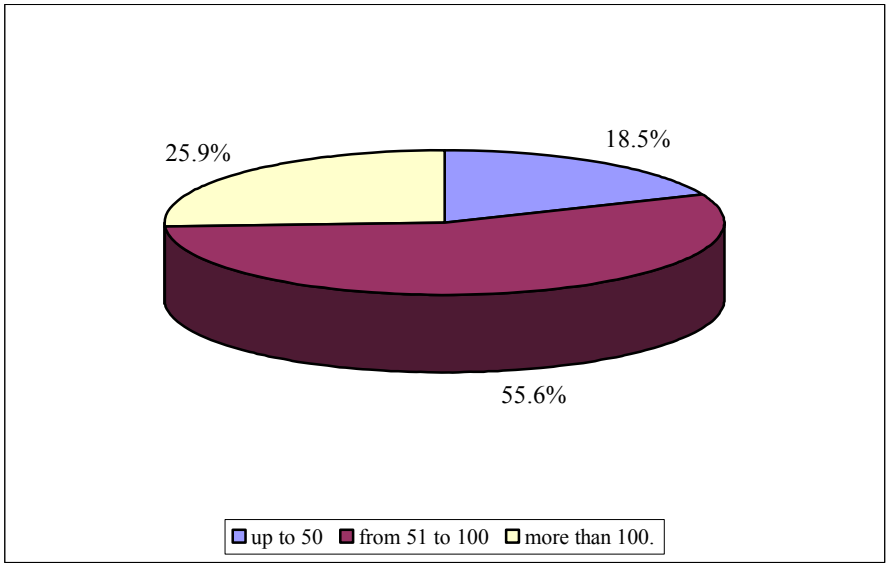


Fig. 6. The structure of the organizations surveyed according to the number of personnel

One of most important characteristics of an organization is the availability of financial resources needed for carrying out research activities. The respondents were asked to point out by means of which sources of funding and to what amount, the financial resources of their institution are generated.

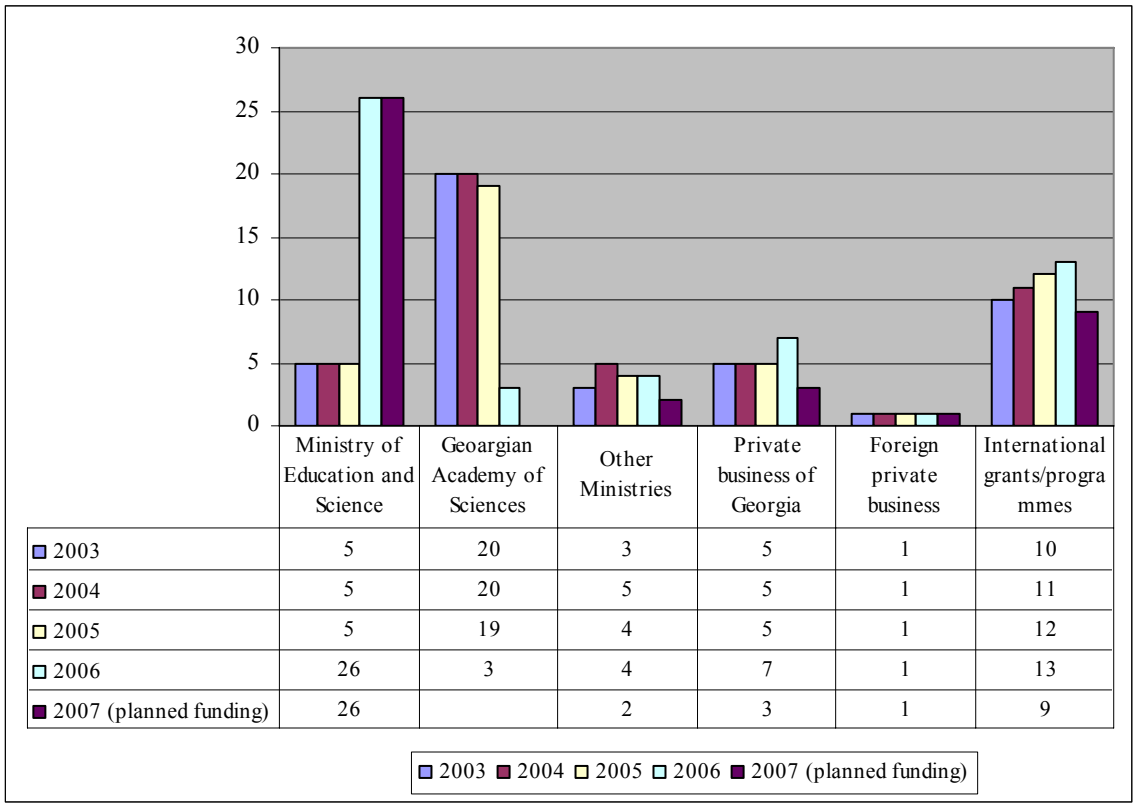
The major sources of financing and the number of organizations receiving them are shown in Figure 7. It can be seen clearly that prior to the year 2006 the major amount of finance was provided by the Georgian Academy of Sciences, and thereafter by the Ministry of Education and Science who provides the targeted support to science. Variations in the amount of finance pointed out by the respondents testify to the instability of financing.

The number of organizations receiving financial support from different international programmes is relatively stable. Most commonly, individual and collective grants were provided by the following foundations: INTAS, ISTC, NATO, CRDF, GRDF, OSGF. Such foundations as "Open Society" Institute and USAID-Israel-CDR were also mentioned.

Although only 13 respondents pointed out grants as the source of financing research activities in 2006, already 65 % of them answered that grants (both international as well as by the Georgian Academy of Sciences, and the Georgian National Science Foundation) are available for support of the R&D activities. Te following organizations pointed out the largest amounts of financing having been obtained from international grants and programmes during the years 2003 – 2007:

1. Ilya Chavchavadze Institute of Oriental Studies
2. State Agricultural University of Georgia
3. A.I. Dzhanelidze Geological Institute
4. G.A. Tsulukidze Institute of Mining
5. Institute of Water Management
6. G. Tsereteli Institute of Oriental Studies

7. N. Muskhelishvili Institute of Computing Mathematics
8. N. Nodia Institute of Geophysics
9. L. Kanchaveli Institute of Plant Protection
10. Institute of Plant Immunology
11. A.N. Natishvili Institute of Morphology
12. I.S. Beritashvili Institute of Physiology
13. A.M. Razmadze Mathematical Institute
14. Ivan Javakhishvili State University of Tbilisi
15. TECHINFORMI



	Ministry of Education and Science	Geoargian Academy of Sciences	Other Ministries	Private business of Georgia	Foreign private business	International grants/programmes
2003	5	20	3	5	1	10
2004	5	20	5	5	1	11
2005	5	19	4	5	1	12
2006	26	3	4	7	1	13
2007 (planned funding)	26		2	3	1	9

Fig. 7. The number of organizations receiving R&D financing from various sources

Participation of private business of Georgia is also noticeable in R&D financing though it is very inactive yet. Less than one third of the respondents pointed out that private business of Georgia served as a source of forming financial resources of an organization. In accordance with estimate made for the period from 2003 to 2007 (forecast), the sum total of investments made by private business ranged between 10,000 and 420,000 lari for different institutions and was unequal over the years during this period.

Support to research in the form of participation of private business and international programmes may be of very selective nature, and underlines the significance of regular receipts from the government budget.

Thus it may be concluded that the rudiments of a new model of funding that can and must be further elaborated have already been formed.

It is said that the sources of finance would determine to a large extent the behavior of R&D organizations in the field of innovation. In those organizations where budgetary sources of finance prevail, more attention is paid to pure basic research although goal-oriented and applied research is also carried out. The predominance of extra-budgetary sources of finance in R&D organizations makes itself evident in more clearly defined commercialization of their activities, i.e. the emphasis is shifted toward the final stages of the innovation process — experimental development, its transfer to and mastering in production, introduction of new products into the market. The activities of those R&D organizations where budgetary and extra-budgetary sources of finance are more or less balanced are most intensive with respect to carrying out research of both basic (pure and goal-oriented) and of applied nature.

3.1.2 Analysis of the most important indicators characterizing the activities of the organizations surveyed over the period 2002 – 2006

The assessment of the activities performed by R&D organizations can be carried out on the basis of a number of indicators. Respondents were asked to assess the activities of a research or higher educational institution over the period 2002-2006 by the following indicators:

1. The total number of publications, including scientific articles indexed in the ISI Web of Science database; articles published in other foreign journals; articles published by foreign publishing houses; theses of reports indexed in the ISI Web of Science database.
2. The number of patents for inventions and utility models.
3. The number of grants received.
4. The number of prizes awarded (state or international).

Publications are indicative of the research activity performed by an R&D or higher educational institution. The dynamics of the total number of publications (according to estimates made by the respondents) in the institutions surveyed is illustrated in Figure 8, and the dynamics of the number of publications of various types in Table 10.

Figure 8 shows that the variations in the number of publications over the above-mentioned period were small. It should also be noted that the publications by scientific workers of the Ivan Javakhishvili State University of Tbilisi account for a considerable percentage of the total number of Georgian publications. Their share ranged from 52 % in 2002 to 35 % in 2005. The changes in the structure of publication types were also insignificant (Table 10, Fig. 9). The percentage of articles published in foreign journals, as well as the percentage of theses indexed in the ISI Web of Science database increased a bit. Indirectly it may witness to the intensification of scientists' activities in submitting their works to international scholarly editions, as well as to some increase in the opportunities for doing this. It is believed that publications in high-level international journals serve as an important indicator of the effectiveness of scientific activities.

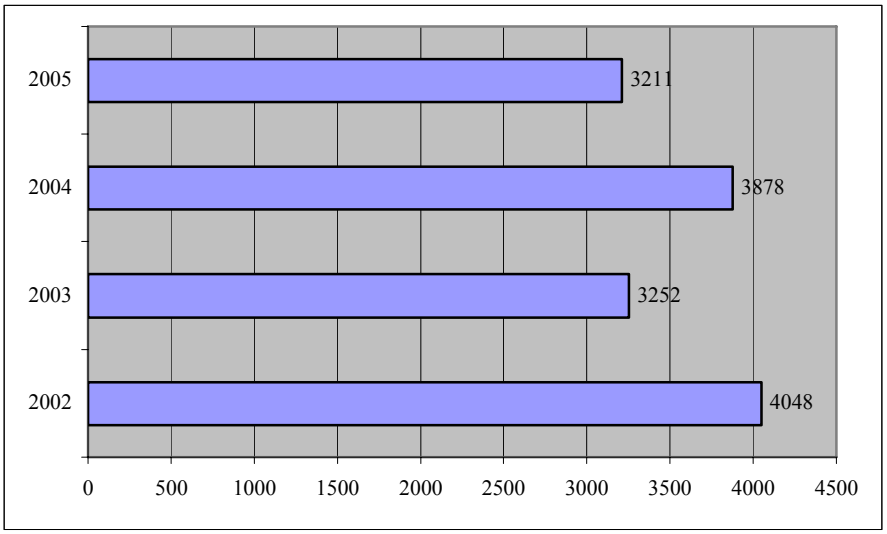


Fig. 8. The dynamics of the total number of publications; number of published works

When analyzing the dynamics of the total number of publications in each R&D or higher educational institution, one can see different lines of change. In 1/3 of organizations surveyed the annual number of publications has increased by 50 % over 2002-2006, in 1/2 of them — has dropped, in 1/3 has remained at the same level on the average.

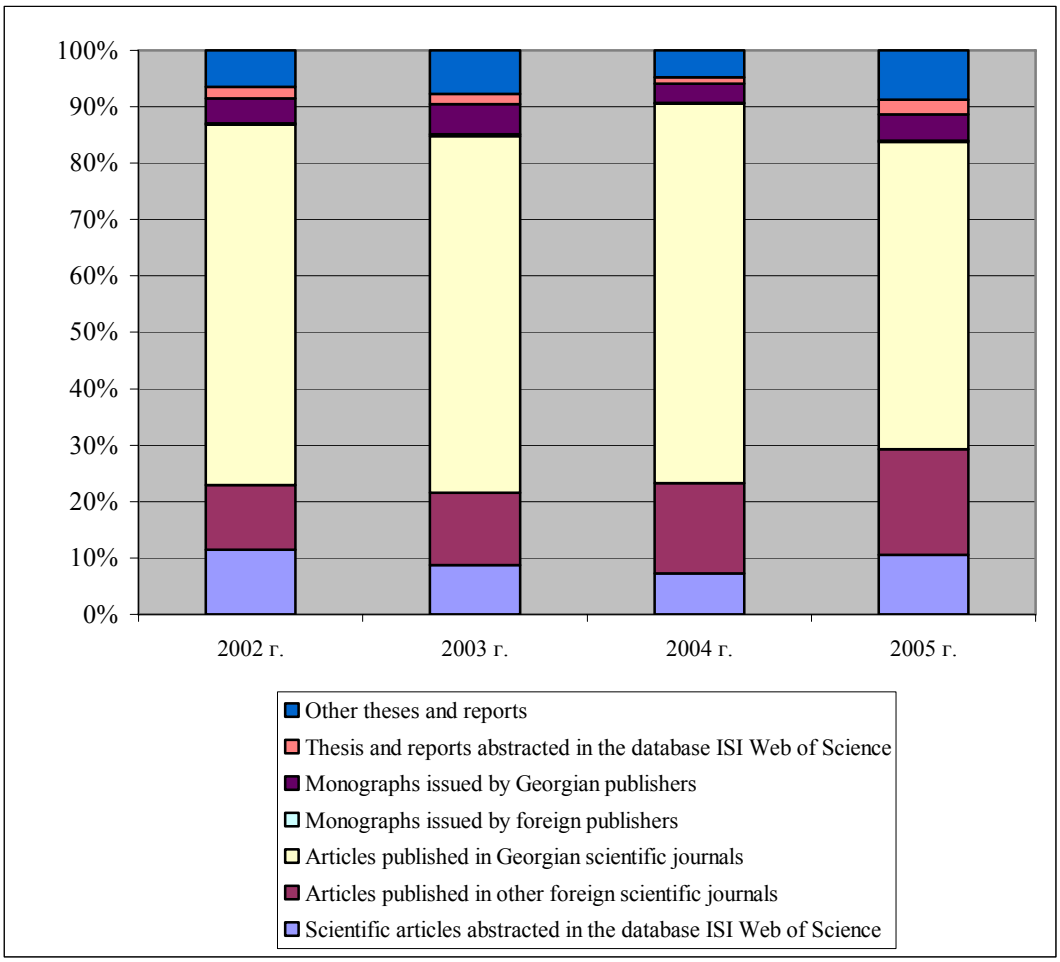
The contribution made by each of the 27 research and higher educational institutions into the total number of scientific works is different which can be attributed to objective causes (belonging to a concrete research area, scope of R&D in progress, the rate of obtaining the results of experiments, the access to (especially international) scientific publications, etc.).

When presenting the research outcomes, the necessity for external market orientation has nowadays considerably increased. The participation in international publications and the representation of Georgian science in foreign journals promotes the scientific achievements in the global market, shapes a certain image of the country and its researchers.

Table 10

The dynamics of the number of publications of various types, the number of published works

No.	Type of publication	2002	2003	2004	2005
1	Scientific articles indexed in the ISI Web of Science database	463	281	284	338
2	Articles published in other foreign journals	466	418	621	602
3	Articles published in Georgian scientific journals	2587	2045	2609	1750
4	Monographs issued by foreign publishers	8	11	2	8
5	Monographs issued by Georgian publishers	180	173	134	149
6	Theses of reports indexed in the ISI Web of Science database	80	58	43	85
7	Other theses of reports	264	249	185	279
Total number of publications		4048	3235	3878	3211



* Monographs issued by foreign publishers are not represented in this chart because of their relatively small number.

Fig.9. The structure of types of publications

How has the percentage of indexed scientific articles and theses as well as articles published in foreign scientific journals changed? In 2002-2005, the percentage of publications in foreign and indexed journals initially decreased rather substantially, from 38.0 % to 27.7 % but then began to increase gradually. All in all this is positive but we have to bear in mind that it applies only for the group of the 27 institutions surveyed. Further monitoring of this process for all R&D and higher educational institutions and the assistance in maintaining the positive trend will be necessary.

Among other important indicators characterizing the R&D institutions activities are the number of grants received, mobility of scientists, purchase of laboratory equipment, etc., as well as the number of patents for discoveries and utility models.

Patenting of results of research and technological activities plays an important role in the process of creating innovation and disseminating new technologies. Over the past two decades an increase of the patent activity ratio[1] has been observed in all industrialized countries, and the last decade is characterized as the period of "patent boom." At present, patenting activity, especially changes in the dynamics of the patent activity ratio has not been adequately studied because of its complex and multifactor nature, and ambiguity of this phenomenon. Nevertheless, patenting of scientific and research and technological results obtained in the public sector is considered a means of protecting products of intellectual labour, and it is generally agreed to consider the subsequent trade in patents and licenses as a sign of commercialization of the work of state-managed scientific systems. The increase in the patent activity ratio and the rise in capitalization of scientific results should be defined as indicators of implementing the strategy of R&D and innovations. In the Georgian R&D and educational institutions surveyed the patenting activity ratio is very low. Among the research institutions surveyed the patent activity ratio is 0.3. The dynamics of the number of patents is illustrated in Figure 10.

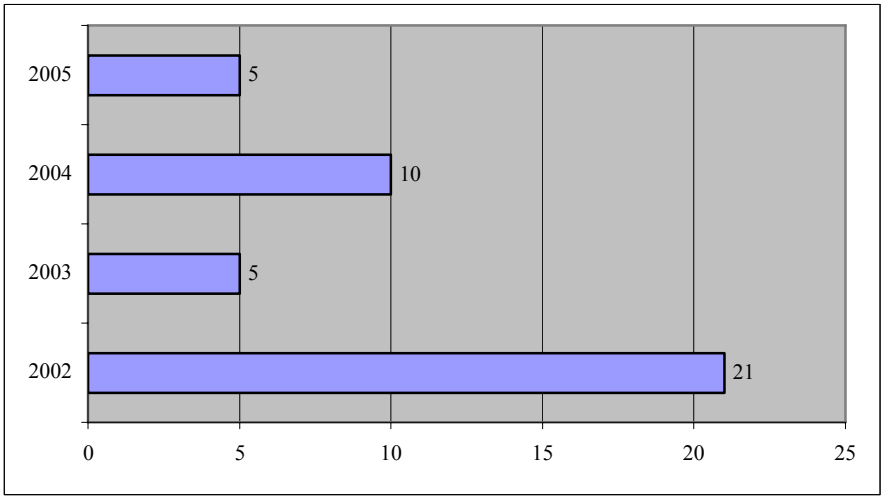


Fig. 10. The dynamics of the number of patents in the organizations surveyed

[1] The ratio of the number of organizations that made applications for patents to the total number of organizations belonging to a given sector. The same refers to the term "the invention activity ratio" (see below.)

The activity of the institutions surveyed in obtaining research grants can be evaluated as intense enough. Virtually all respondents declared that researchers of their institutions try to find opportunities for receiving grants, since they are well aware that this is the only possible way of carrying out research, or performing an experiment. At the same time it was pointed out that the system of providing grants is far from perfect. The dynamics of the number of grants obtained by organizations surveyed is shown in Figure 11.

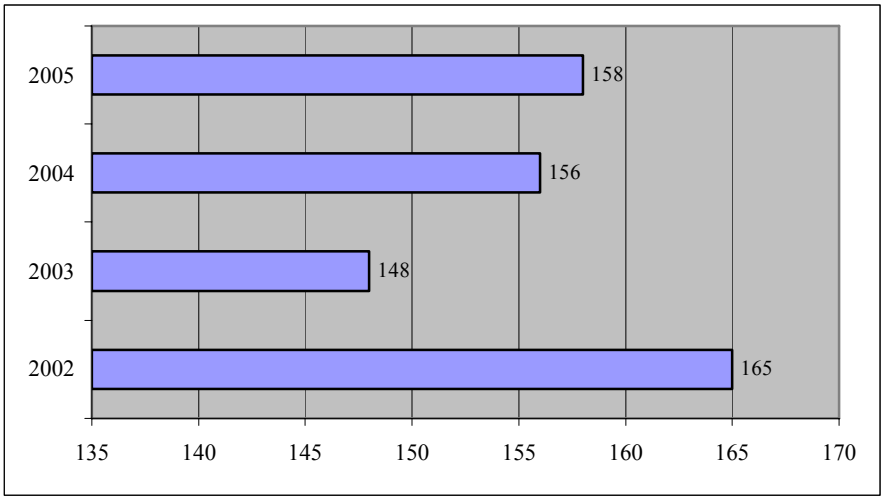


Fig. 11. The dynamics of the number of grants received by the organizations surveyed.

The distribution of grants by the institutions surveyed is, of course, unequal. It should be noted that 43 % (in 2002) and 26 % (in 2005) of the grants received by the institutions surveyed were obtained by the Ivan Javakhishvili State University of Tbilisi. The largest number of grants received in the period 2002 – 2005 were by:

1. N. Nodia Institute of Geophysics (grants provided by the Academy of Sciences totalled two thirds of all grants received)
2. Shota Rustaveli Institute of Georgian Literature
3. Institute of Molecular Biology and Biological Physics (mainly grants provided by the Academy of Sciences)
4. A.N. Natishvili Institute of Morphology (grants from the Academy of Sciences was pointed out)
5. A.S..Chikobava Institute of Linguistics
6. A.M. Razmadze Mathematical Institute of Tbilisi

One third of the respondents did not indicate that their institutes had received any grants at all.

In an attempt to ascertain what was the share of financing by means of international grants and programmes, the following results were obtained. In the small group of 27 organizations surveyed, the financing by international grants comes up to the level of 40 – 50 % of the total amount of financing. However, this is rather an exception than the rule. Several more respondents, giving figures about the state of financial resources of their organizations, pointed out that financing based on international grants amounted to

as much as 15 – 20 % of the budget of a research institute. However, as a rule, the share of financial resources received from international grants and programmes does not exceed 6 % in the budget of an organization, ranging between 1.5 and 8.0 % in the majority of institutions surveyed.

3.2 Results of assessing the current state of the R&D policy system in Georgia

3.2.1. Changes in the sphere of R&D activities

The current scientific-and-technological potential of Georgia in 2005 comprised of about 100 scientific research and design organizations, with the number of personnel employed slightly exceeding 9000 (in 2005, the number of researchers was 9186) which means a sharp decrease in the total number of research personnel over the last 5 years. However, the percentage of researchers holding an academic degree among the research personnel has increased during the said period from 46.4 % in 2003 to 64.1 % in 2005.

In the course of the assessment, first and foremost, an attempt was made to find out *which changes the respondents in the sphere of R&D activities considered to be positive ones*. The respondents could choose among eight versions, and they could indicate as many variants as they thought to be necessary. They could also express their own opinions on the positive changes having occurred within recent years in the sphere of R&D activities in Georgia. The results obtained are given in Table 11.

Table 11

Distribution of answers to the question: "Have any changes in the sphere of R&D activities in Georgia, which you consider to be positive ones, occurred within recent years?"

Version of a reply	**The share of respondents choosing this version, %**	**Comments made by respondents**
The emergence of opportunities for collaborating with foreign colleagues	68	Due to the introduction of the Internet in the country
Establishing contacts with the global scientific community	52	This opportunity is little used. Contacts are still weak. Further strengthening of contacts would require an adequate financing, in particular, for payment of *pro rata* financial contributions to international organizations.
Elimination of the information isolation from foreign countries	48	Not all R&D institutions are able to enjoy such an opportunity because of lack of means, including technical ones, as well as finances for purchasing required sources of information, both on paper and on electronic data carriers.
Organization of joint research	44	In the opinion of a number of experts, this is a challenging task.

Version of a reply	The share of respondents choosing this version, %	Comments made by respondents
Intensification of the material support received from various sources	36	GSNF, INTAS, CRDF, MNTC, the Georgian National Science Foundation, INCO-COPERNICUS, NATO, ISTC; a system of grants is being formed but not rapidly and efficiently enough.
Development of research activities in higher educational institutions	24	Joint activities of the Institute of Plant Immunology and the Batumi State University are being developed. Development of a system of combining jobs is in progress.
Development of new lines of research	24	This is a challenging task, intensification is needed; new lines of research would be possible only if financing is increased.
Other	8	Experts pointed out the establishment of the Georgian National Science Foundation, the process of decentralization of science management.
No positive changes have occurred	8	

* Respondents could choose as many versions of answers as they considered necessary, and make comments on each of the versions chosen by them.

Thus, the majority of respondents (68 %) considered the emergence of opportunities for collaboration with their foreign counterparts to be a positive change.

One can assume that this is due to the development of a grant system and the participation in international programmes, as well as due to the simplification of the procedure of publishing in foreign research journals. The world practice is indicative of the increase in the percentage of publications prepared by international teams, and the very emergence of such a process should be supported and encouraged.

More than one third of the respondents (namely, 36 %) considered the intensification of the material support from various sources as a positive change. The rudiments of the material support of small-scale research of purely practical nature on the part of private entrepreneurship are emerging (the respondent from the Institute of Organic and Inorganic Chemistry pointed it out) but various factors are holding back this process. In particular, when solving ecological problems, an entrepreneur would prefer to "settle an affair" rather than introduce an already existing solution.

Some respondents believe that the contacts with the global research community had not been severed, there was no such thing as the informational isolation from foreign countries, and the system of joint research existed also in the 1990s. Collaboration was arranged, and joint research efforts were carried out practically all the time (including the Soviet era). The problem lies not so much in the existence or non-existence of co-operation as in the number of scientific contacts, their efficiency and mutual benefit,

possibilities of obtaining access to databases, the number of joint projects and collective publications. It is just this that permits to build up the "international visibility and prestige of Georgian science".

The answers to the questionnaire contained pretty many references (8) to the Georgian National Science Foundation. This organization is considered today as one means that is of assistance in obtaining financial aid for research, and as the rudiment of a national system of grants. The emergence of GNSF can be characterized as an element of the successful development, and it should be encouraged as the very first step toward the creation of a system of various financial instruments intended for supporting research and innovations.

> One of respondents writes: «It would be possible to eliminate the so-called "isolation" and to extend contacts in the case when an organization has at least a minimum of funds necessary for purchasing conventional and electronic data carriers, databases, obtaining money for study tours of researchers and experts abroad. Finally, it is necessary to purchase advanced technical facilities which permit to maintain contacts with the global research community at the modern level».

Thus it may be concluded that the respondents were unbiased in their assessment of the positive nature of changes occurring in the domain of R&D in Georgia. However, the degree of positive influence of transformations is not large yet, and many-sided efforts are needed in order for the domain of R&D activities to acquire the leading and especially important role in the country and in society.

3.2.2 The impact of changes on the state of R&D activities

One of the fundamentally important issues are the consequences of carrying out transformations. Examination of this issue makes it possible to understand in which manner and to what degree the reform steps have had their impact on the different elements of the research activities. The respondents were asked the question, *"What has been the impact of transformations carried out in the country over the last two or three past year on the state of the R&D activities?"* The respondents could not only choose a version of the answer (11 variants) that would correspond to their personal opinion, but they could also define more exactly the degree of negative or positive manifestations of these consequences. The results of responses to this question are shown in Table 12.

At first sight it may seem that opinions are characterized by a great diversity. In assessing the adverse consequences of transformations, most of the respondents were inclined to conclude that the consequences manifested themselves *to an average extent*. In evaluating the favourable consequences of transformations, the respondents were of the opinion that these consequences manifested themselves only *to a small degree*.

For a more comprehensive analysis, the responses related to the consequences of transformation were combined into groups according to whether a negative or positive influence was mentioned by the respondents. Such generalized opinion groups are presented in Table 13.

The respondents inclined to the *negative* assessment in the case of three groups of consequences.

In their opinion, the adverse consequences of the transformation period were most evidently reflected in the following:

- outflow of highly qualified workers from the sectors of science and education;
- declining of the status of intellectual labour and of the evaluation of its social importance;
- formation of low public opinion of the image of science.

Table 12

Opinion of the respondents related to the influence of transformations carried out in the country over the last 2 – 3 years on the state of R&D activities; share of respondents that pointed out the manifestation of consequences of transformations

No.	Consequences of transformations (favourable/adverse)	Negative manifestation of consequences			Positive manifestation of consequences		
		Strong	Medium	Weak	Strong	Medium	Weak
1.	Weakening/Strengthening of the material support on the part of the government	15	10	10	—	20	20
2.	Weakening/Strengthening of the moral support on the part of the government	20	5	15	15	10	30
3.	Restriction imposed on/ Increase in the possibilities for research activities carried out by researchers	10	10	5	—	25	50
4.	Adverse/Favourable effect on the material conditions of researchers	10	5	10	—	25	50
5.	Adverse/Favourable effect on the social position of researchers	15	20	10	—	5	45
6.	Outflow/Inflow of highly qualified personnel from/to sectors of science and education	15	45	10	—	5	20
7.	Decline of/The rise in the status of intellectual labour and lower/higher assessment of its social importance	25	35	10	10	5	10
8.	Formation of low/high public opinion of the image of science	15	30	20	5	5	20
9.	Lack of need/Need for science on the part of the system of higher education	10	15	10	10	15	30
10.	Lack of possibilities/Emergence of new opportunities for self-realization as a scientist	5	20	5	—	30	30
11	Emigration of professionals/ Their return from abroad	—	35	10	—	5	35

Thus it was confirmed that the social consequences of reforms have been substantially reflected on the image and status of researchers, and their social mobility is not associated with an attempt to improve their professional skills but is a way of ensuring higher income.

For five groups of consequences, the assessment indicated their positive impact on the state of R&D activities in Georgia.

The respondents from the institutions surveyed were of the opinion that:

- material support on the part of the government had increased;
- the possibilities for research activities of researchers had increased;
- the effect on the material conditions of researchers had been favorable;
- demand for science on the part of higher education is being formed;
- new opportunities for self-realization as a scientist had emerged.

It may be suggested that virtually all the favorable consequences were caused by the *increase in the material support* on the part of the government. It is just the continued intensification of this support that the respondent count also in the future. The decline in income has always been considered not only an economic but also a moral and psychological problem.

It is interesting to note that the respondents who represented higher educational institutions in 100 % of their answers pointed out that the transformations have had a positive impact on the formation of demand for science by the system of higher education.

The consequences of change in three groups were considered to be both positive and negative to the same extent. These are: strengthening/weakening of moral support on the part of the state; negative/positive impact on the social status of researchers; emigration of professionals/their return from abroad.

It should be noted that the opinions of the respondents on these issues point out the ambiguity of the consequences of transformations; the complexity of performing such an assessment, and the diversity of individual opinions which is indicative of their honesty and independence.

Table 13

Generalized opinion as to the influence of transformations carried out in the country during the last 2-3 years on the state of R&D activities; the share (%) of respondents who pointed to the manifestation of consequences of transformations

No	Consequences of transformations (favourable/adverse)	Manifestation of consequences		
		Negative	Positive	Prevailing
1.	Weakening/Strengthening of the material support on the part of the government	35	60	Positive
2.	Weakening/Strengthening of the moral support on the part of the government	40	40	To the same extent
3.	Restriction imposed on/ Increase in the possibilities for research activities carried out by researchers	25	75	Positive
4.	Adverse/Favourable effect on the material conditions of researchers	25	75	Positive
5.	Adverse/Favourable effect on the social position of researchers	45	50	Virtually to the same extent
6.	Outflow/Inflow of highly qualified personnel	70	25	Negative

No	Consequences of transformations (favourable/adverse)	Manifestation of consequences		
		Negative	Positive	Prevailing
	from/to sectors of science and education			
7.	Decline of/The rise in the status of intellectual labour and lower/higher assessment of its social importance	70	25	Negative
8.	Formation of low/high public opinion of the image of science	65	30	Negative
9.	Lack of need/Need for science on the part of the system of higher education	35	55	Positive
10.	Lack of possibilities/Emergence of the new possibilities for self-realization as a scientist	30	60	Positive
11	Emigration of professionals/ Their return from abroad	45	40	Virtually to the same extent

In a generalized form, the relationship between positive and negative impacts of transformations may be expressed by special coefficients. They reflect a gap between the answers about the positive and negative impacts, and the higher their value, the higher is the majority of answers containing the assessment of positive impacts of transformations on the status of research activities. Groups of impacts and their typical coefficients are shown in Figure 12.

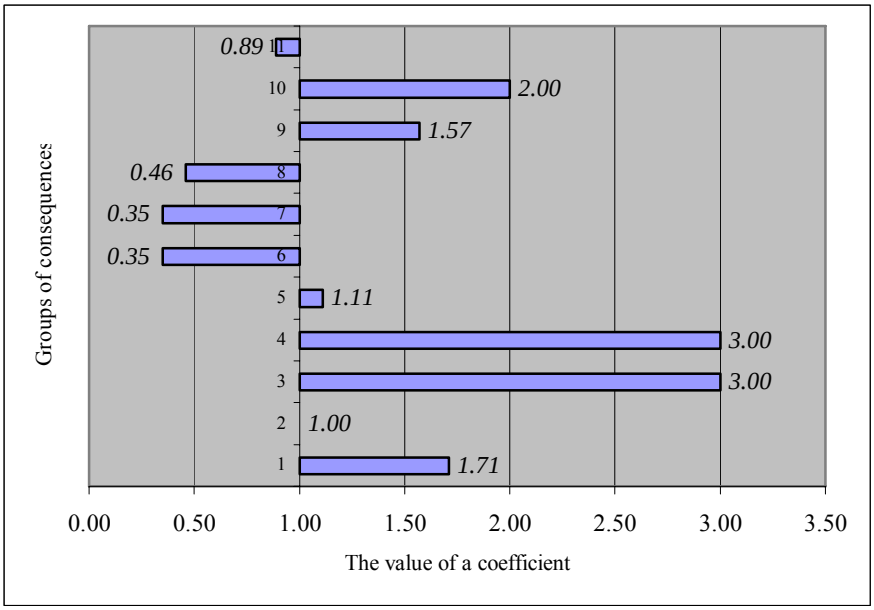


Fig. 12. Coefficients used for various groups of consequences caused by transformations

An important feature of the assessment under review is that an objective picture of the impact of transformations on the status of R&D activities was obtained. Very few of these transformations turned out to be negative, there were and are examples of successful undertakings and programmes. This testifies to the fact that the process of adaptation is going on. In the future it will be necessary to reduce the negative

manifestations of impacts and to significantly intensify positive impact of transformations being carried out.

3.2.3 The state of the R&D management system in Georgia

In order *to evaluate the present state of the R&D management system* in Georgia, the respondents were asked to assign a grade in the range of 1 to 10 scores. Score 1 meant that the state of the system was appraised by a respondent as "could be no worse", score 10 meant "excellent". The range of these appraisals was wide enough but none of the respondents assigned a grade higher than 8. Two respondents refused to make an appraisal and in doing so they expressed the opinion that "the system has not been formed yet, and it is too early to speak of any appraisal." The average score was 4.3 while almost one third of the respondents appraised the status of the R&D management system at 3 points (Fig. 13).

The respondents were also asked to enumerate the *circumstances that hamper the creation of an efficient R&D management system in Georgia.* The answers let us to formulate the following list of (Table 14).

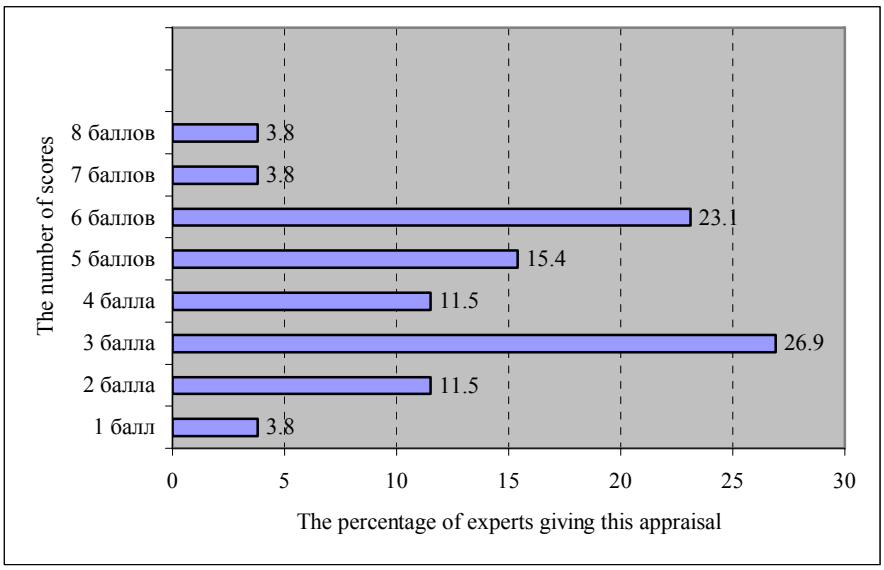


Fig. 13. Appraisals made by the respondents (and scores) about the state of R&D management system in Georgia

Table 14

Circumstances that hamper the creation of an efficient R&D management system in Georgia

Circumstances caused by the present state of the R&D and higher education system in Georgia	Circumstances caused by other conditions
1. Poorly developed R&D and service infrastructure. 2. Excessive centralization of research management. 3. Lack of a concept for developing research activities.	1. Inaccurate forecasts of socio-economic development. 2. Erroneous fiscal and innovation policy. 3. Neglect or non-active involvement of the scientific potential of the country into the process of making an independent state.

Circumstances caused by the present state of the R&D and higher education system in Georgia	Circumstances caused by other conditions
4. Extremely weak and biased system of selecting publicly funded projects. 5. Non-readiness of higher educational institutions for integration with R&D institutes in an effort to implement joint programmes. 6. Non-participation of scientists in developing reform plans. 7. Lack of wide discussion in scientific circles about the ways and methods of creating an efficient R&D management system. 8. Lack of a system of commercialising research outcomes.	4. The progress of reform processes, delays in the formation of a management system. 5. Inadequate experience in working within the new system. 6. Mentality of old cadres, stereotypes. 7. Imitation of foreign management systems without considering the traditions of R&D activities in Georgia.

One respondent wrote: «*A list of such circumstances is very long, and many of them do not lie on the surface but will become apparent in the progress of reforms. For example, it is evident for everybody that any construction requires funding and in this case, as a rule, material resources are put in the forefront while much less attention is given to the environment in which this process has to be carried out. Restricting our consideration to the "environment", we can point out certain circumstances: social or "external" circumstances – politicization of the research community; ,unfounded confidence in one's own competence in issues which are far beyond the scope of one's professional activity; and "internal" circumstances existing in R&D organizations – excessive centralization of management in institutes (the director settles all the matters), and, as a result, low level of personal initiative against the background of nihilism that has developed a great deal within recent years.*»

3.2.4. Strengths and weaknesses of the present-day system of supporting R&D activities in Georgia; opportunities and threats to its existence

The most important moment of improving the operations of any system is the analysis of its current status and special features of its functioning, as well as the identification of the total combination of conditions influencing the system at the moment. As a method for the analysis of the system of R&D activities in Georgia the SWOT-analysis was chosen. Traditionally, the SWOT method assumes four lines of analysis:

1. Strengths – analysis of advantages that a system has
2. Weaknesses – analysis of disadvantages that a system has
3. Opportunities – external factors that can improve the functioning of a system and promote obtaining additional advantages by the system.
4. Threats – external factors that can weaken a system and make its functioning more complicated.

The SWOT-analysis provides a basis for the improvement of system components and its proper functioning. The SWOT-analysis allows to determine a list of problems and to form strategic lines of developing the system. In doing so, the cumulative effect of various factors both within the system and in its environment should be taken into consideration.

The SWOT-analysis will allow:

1. To choose a line of development for the system and its components.
2. To take advantage of the strengths of the system.
3. To eliminate or to take into account the weaknesses of the system.
4. To use (or not to miss) the opportunities provided by the system's environment.
5. To avoid external threats and dangers.

In the course of the survey the respondents were asked two questions:

- *What, in your opinion, are the strengths and weaknesses of the existing system of R&D activities in Georgia?*
- *What, in your opinion, are opportunities and threats for the existence and development of the system of R&D activities in Georgia?*

In answering these questions the respondents had to fill in the empty matrix fields by themselves. In this manner, individual views on both the object of the study (the R&D system) and its individual components were obtained. After generalizations and groupings of individual opinions expressed, the characteristics of the strengths and weaknesses of the system (Table 15) as well as of the opportunities and threats for the system (Table 16) were prepared.

It should be mentioned that the answers by respondents concerned more the weaknesses of the system. Besides, the list of weaknesses is more diverse than the list of strengths. One can assign the following to the strengths of the system that should be taken into account in the process of its further reforming:

- The resoluteness in tackling the reorganization of research institutes, wish for positive changes.
- The competitive system of allocating public grants for research.
- Establishment of the Georgian National Science Foundation.

Table 15

Determination of the strengths and weaknesses of the R&D system in Georgia

Parameter to be estimated	**Strengths**	**Weaknesses**
Organization of the system's performance	1. Resolute approach to the reorganization of research institutes, positive wish for changes. 2. Wish to reconstruct Georgian science according to modern standards. 3. Convergence of education and science.	1. Low competence of personnel. 2. Vague formulation of the purpose and stages of the reforming. 3. Slow process of reforms. 4. Priority directions of science development have not been defined. 5. Inadequate coordination and complex relationships between research institutions and the Ministry of Education and Science. 6. Lack of criteria for defining optimal managerial decision making, hasty reorganization efforts. 7. Low level of participation of research community in the reorganization of research institutions.

Parameter to be estimated	Strengths	Weaknesses
		8. Dependence of the existence of R&D institutions on winning in a competition of grant-supported projects.
Contents of the system	1. The existence of several world-recognized scientific schools. 2. System of doctoral studies. 3. Contacts with foreign research centres. 4. Self-reliance of scientific collectives in determining the urgency of research topics.	1. Seriously lagging behind European research centres. 2. Poorly developed library, information, communication infrastructure. 3. Unattractiveness of work for young specialists. 4. Little interest in research on the part of higher educational institutions.
Material resources		1. The obsolescent material and technical basis and the system of material and technical supplies, low level of the scientific experiments.
Finance	1. Maintenance of base-line funding for research institutions during the transition period. 2. The competitive system of distributing state subsidies for research.	1.Low salaries, lack of material incentives for work. 2.Small budget of the Georgian National Science Foundation.
Innovations	1. Establishment of the Georgian National Science Foundation and the grant-based system of financing.	1. Research activities performed by enterprises are not taken into consideration 2. Non-transparency of expert evaluations, incompleteness of the grant system and methods of project evaluation.

Table 16

Determination of the opportunities and threats for the R&D system in Georgia

Parameter to be estimated	Opportunities	Threats
Economic factors	1. Involving representatives of business into the development of the system. 2. Establishment of a multi-channel funding system. 3. The system of international grants and goal-oriented funding. 4. The process of aggregating R&D institutions.	1. Inadequate base-line funding on the part of the government. 2. Complete change-over to the grant-based system of funding. 3. Low activity of sponsors.
Factors related to governmental regulation	1. Enhancement of the coordinating role of the Ministry of Education and Science and the Academy of Sciences. 2. Certain interest in science displayed by the Government of Georgia.	

Parameter to be estimated	Opportunities	Threats
Political and legal factors	1. Constitutionally protected right for freedom of creative labour. 2. Improvement of the legislative base that regulates research activities.	1. Political stagnation. 2. Prolonged nature of the transition period. 3. Poor legislative base. 4. Corruption.
Scientific and technical factors	1. Scientific potential represented by highly qualified personnel. 2. Development of the system of training research managers. 3. Maximum identification of the available and prospective scientific potential.	1. Reduction of the scientific-and-information activities to zero. 2. Abolishment of "non-commercial" sciences (the humanities) 3. Planned alienation of research institutions from their experimental bases.
Socio-demographic factors		1. Refusal to work in science on the part of youth.
Socio-cultural factors		1. Decline in the prestige of science. 2. Interruption of the process of continuity in science. 3. Poor understanding of the role of science in making a sound, civilized society.

Of weaknesses, first and foremost, the following ones must be eliminated:

- Vague formulation of the goal and stages of the reforms.
- Uncertainty in defining priority directions of science development.
- Inadequate co-ordination and complex relationships between research institutes and the Ministry of Education and Science.
- Low level of participation of the research community in the reorganization of research institutions.
- Obsolescent material and technical basis of, and provision of materials and equipment for science, low level of the scientific level of experiments.
- The unattractiveness of work for young specialists.
- Low salaries, lack of material incentives to work.
- Non-transparency of expert evaluations, incompleteness of the grant system and the methods used for project evaluation.

What circumstances could make possible to continue the course of reforms and alleviate this process, and what circumstances can have an adverse effect on it? The major opportunities available for further development of the R&D system are the following:

1. Establishment of a multi-channel funding system.
2. Enhancement of the coordinating role of the Ministry of Education and Science and the Academy of Sciences.
3. Increase in the scientific potential represented by highly qualified workers.
4. Development of the system of training research managers.

The list of threats obtained on the basis of assessments made by respondents is very serious. Obviously, it does not seem possible to eliminate the impact of all threats. However, the SWOT-analysis enables to determine a list of threats whose effect would be *desirable and possible* to reduce first. The following threats can be assigned to this category:

1. Low activity of sponsors.
2. Reducing scientific-and-information activities to zero.
3. Planned alienation of research institutes from their experimental bases.
4. Decline in the prestige of science.
5. Poor understanding of the role of science in making a sound, civilized society.

The results of the SWOT-analysis make it possible to answer the following questions:

1. What strengths allow (or may allow) the use of the opportunities offered by the external environment?

- The wish to reconstruct Georgian science in line with the present-day standards.
- The availability of several world-recognized scientific schools.
- Maintenance of base funding for research institutions during the transition period.
- Convergence of education and science.

2. What weaknesses may hamper the use of one or the other opportunity?

- Priority directions of science development have not been defined.
- Complex relationships between research institutions and the Ministry of Education and Science.
- Hasty reorganization of science.
- Non-transparency of expert evaluations, incompleteness of the grant system and the methods used for project evaluation.

3. What strengths may help in the elimination of existing threats?

- The maintenance of base funding for research institutions during the transition period.

4. What threats, in combination with weaknesses of the system, may present most grave hazards?

- The dependence of the existence of R&D institutes on winning in a competition of grant-supported projects.
- Inadequate competence of R&D managers and refusal to work in science on the part of youth.
- Lack of definiteness concerning the prioritized directions of research development and poor understanding of the role of science in making a sound, civilized society.
- Low salaries, lack of material incentives to work in science, interruption of the process of continuity in science, as well as refusal to work in science on the part of youth.

How to exploit the opportunities?	*How to reduce threats?*
To pay more attention to economic factors in the development of the R&D management system in Georgia. Not to make hasty decisions. To intensify governmental regulation for supporting research activities. To continue improving the legislative base regulating research activities. To work out a concept for developing a system of training research managers and to attract youth to the profession. Not to give up employing researchers of older age with a high research potential.	To pay more attention to political and legal factors which may lead in perspective to the lessening of threats not only for the system of R&D management but also for the stability of the state as a whole. To reconsider the system of the state funding of research in favour of the increase in public expenditure for research. To create a system of grant-based funding. To create a high status of researcher and a high prestige of scientific activities, with the active participation of the government and representatives of private business in this process.
What interferes with the use of opportunities?	*What are the greatest hazards?*
The process of shaping approaches to the reform of R&D activities. Serious structural changes.	The grave and comprehensive nature of threats, together with a great number of weaknesses that are currently inherent to the R&D management system and cannot be eliminated quickly.

Fig. 14. Comparison of the strengths and weaknesses, and opportunities and threats for the R&D management system

3.2.5. List of urgent tasks in the sphere of developing R&D activities for the next 2-3 years

To the question *"What are the most urgent tasks in the sphere of developing R&D activities that have to be solved first and foremost in your institution/organization in the next2-3 years?"* the respondents could answer by writing down their own opinion. This question produced a great resonance and all the 27 respondents gave to a greater or lesser extent detailed answers to it. The analysis of respondents' opinions revealed that the range of problems requiring urgent solution is wide. Very different groups of problems - financial, organizational, informational, problems related to human resources and formation of human capital of an organization were indicated. After a generalization, the following urgent tasks in the sphere of research activities were formulated. Table 17 and Figure 15 list these items in descending rank of significance for each task.

Let us bring here several statements made by respondents.

The representative of the P.G. Melikishvili Institute of Physical and Organic Chemistry:

«It would be necessary to update totally all the research instruments and equipment but this is easier said than done. The same refers to the condition of institute's buildings and facilities, although if funds were available it would be possible to attain their satisfactory condition in 1 – 2 years, and a fully acceptable situation in 2 – 3 years. The system of supply is to be recovered, needless to say, with due regard for today's realities.

It is imperative to radically restructure the R&D management (previously run entirely by a "triumvirate" – director, deputy director, academic secretary), and in this line the first steps have already

been made: the R&Dl department was established; it is necessary to attract young specialists (or people who are able to become them) operating in the field of legislation in Georgia (environmental legislation, licensing legislation, etc.) in order to perform a realistic assessment of projects' feasibility, supply and cost, commercialization, and business-analysis.

Researchers must develop habits of flexible work in both small teams (within one laboratory or in the framework of collaboration between laboratories), and in aggregated (several laboratories, several R&D institutes, etc.) teams organized for solving concrete problems.»

Table 17

Urgent tasks for developing R&D activities in scientific institutions for the next 2-3 years

No.	Group of tasks	Individual tasks of a group formulated by respondents	The share (%) of respondents indicating this group of tasks	Rank of the task
1.	Strengthening the institution's material and technical base	Strengthening of the material and technical base of expeditions, experimental laboratories and plants; upgrading of research instruments and equipment; computerization of research institutes; acquisition of reagents; repair and maintenance	57.6	I
2.	Revival and intensification of researcher professional mobility and co-operation	Exchange of specialists, financing of study tours abroad, carrying out expeditions, organization of trainings, seminars, summer schools, joint research	53.8	II
3.	Integration of research with education	Collaboration with higher educational institutions, establishment of science and technological parks	26.9	III
4.	Elimination of a problem of the information support for the activities performed in R&D and educational institutions	The availability of scientific sources both for obtaining information and for preparing publications, allocation of funds for receiving foreign publications	23.1	IV
5.	Increase in remuneration of labour	Increase in salaries in R&D and educational institutions at least 2 – 3 times	23.1	IV
6.	Increase in the funding of research institutions		23.1	IV
7.	Improvement of personnel training, improving the quality of R&D management personnel	Formation of new working habits in personnel; formation of working habits in members of small groups, including international ones; development of programmes for improving human resources in leading R&D institutions; attracting young researchers	19.2	V

No.	Group of tasks	Individual tasks of a group formulated by respondents	The share (%) of respondents indicating this group of tasks	Rank of the task
8.	Creation of a national system of grants and foundations	Establishment of a research foundation for the humanities	19.2	V
9.	Reorganization of R&D management	Training of personnel in the field of research management	15.4	VI
10.	Development of new research lines topical for the national economy, establishment of goal-oriented programs		15.4	VI
11.	Commercialization of research output		15.4	VI
12.	Development of consulting Activities on the basis of universities		3.8	VII

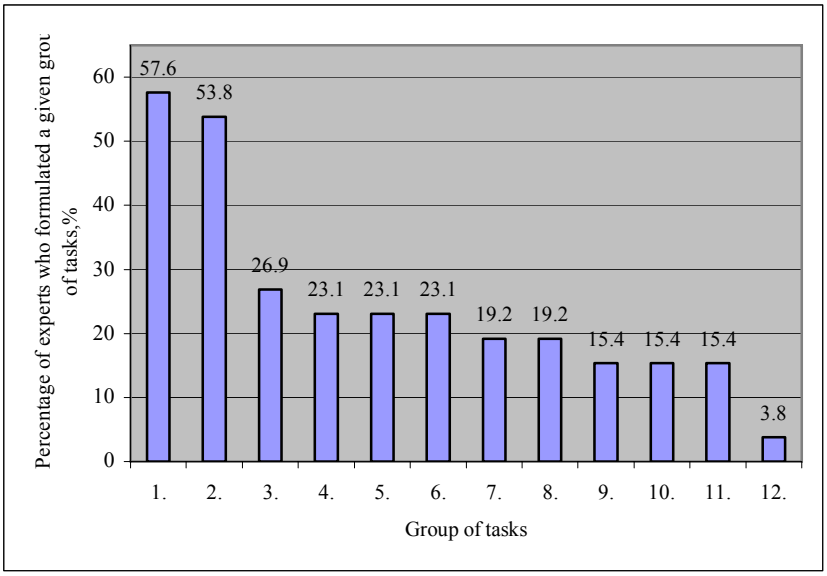


Fig. 15. The list of groups of tasks to be solved in the next 2 – 3 years

The representative of the Institute of Animal Husbandry and Feed Production of Georgia proposes the following with respect to the9th group of tasks:

«1. In the context of the revival of the mountainous regions of the country, correct selection of branches of animal husbandry, improvement of techniques of work and introduction of these methods into farms.

2. Development and introduction of technology of procurement, storage and processing of fodder crops, as well as development and introduction of optimum nutritive regime for animals and poultry.

3. Development and introduction of economically and environmentally justified systems of agro-technical practices with the aim of forage growing on arable lands located in major livestock production zones of the country.

4. Development and introduction of agro-technical practices aimed at both radical and simplified improvement of pastures, increase in their productivity under conditions of a mountainous land».

For the representative of the A.S. Chikobava Institute of Linguistics, the following problems are most urgent ones:

«1. Inquiry into questions related to the refinement of speech and definition of standards of the Georgian literary language.

2. Comparative study of Kartvelian languages and study of dialects.

3. Monographic study of languages used in the Highland Caucasus and the analysis of their affinity with Kartvelian languages.

4. Problems of lexicology of the Georgian language and preparation of all kinds of lexicons.

5. Inquiry into topical issues in the sphere of research activities and definition of groups of tasks (from I to XII) will allow to identify prospects for development of Georgian science and measures for improved management aimed at their implementation.»

To more particular and short-term tasks was devoted a question in answer to which the respondents were asked *to outline the most urgent ("sore") problems in the sphere of R&D activities in their institutions which have to be solved first and foremost.*

All the respondents noted that the main goals which should be accomplished by R&D and higher educational institutions are the intensification of research activities and dissemination of their results and achievements to the global scientific community. In order for these institutions at least to come closer to the attainment of this goal, the following urgent questions must be promptly addresses and solved:

1. Improvement of the material and technical basis of R&D and higher educational institutions, purchase of computers, office equipment, equipment for laboratory experiments and observations (65.4 % of respondents).
2. Increased funding and support of research, including expeditions, scientific trips, publications in the foreign press (53.8 % of respondents).
3. Increased salaries for personnel in R&D and higher educational institutions (30.8 % of respondents).
4. Attract and retain young scientists, restoration of the system of preparing doctoral dissertations in research institutes, development of the system of preparing doctoral dissertations in higher educational institutions (26.9 % of respondents).
5. Renewal of library stocks, as well as establishment of electronic libraries (23.1 % of respondents).
6. The necessity for urgent repair of buildings and facilities: heating, power supply, communication systems (11.5 % of respondents).

Among other most urgent issues requiring prompt solutions, experts pointed out the following ones:

- the determination of priority directions of research activities and funding of most prospective programs;
- moral stimulation of researchers creative efforts;
- the development of R&D management skills;
- provision of favourable conditions for introducing new methods and technologies;
- organization of courses of foreign languages;

- organization of contractual work with various agencies and companies;
- fundamental change in the system of receiving grants and prizes; the transparency and impartiality of this system;

The list of problems is diverse. Clearly, respondents often outlined urgent problems related to the specific character of activities carried out in a definite R&D institution.

> On the basis of experts' views, using their opinions on the most urgent tasks in the sphere of development of research activities, the priority measures envisaged in the programmes of reforming research and higher education institutionsl can be defined.

3.3. Conditions and grounds for establishing a modern R&D system in Georgia

3.3.1 Institutional structures and social forces that are to participate in developing the system

Scientists maintain themselves as a socially active group even though today their status is not so high as would be necessary. Optimistic expectations that scientists associate with a change in social relations and comprehensive reforms also persist. All the respondents without exception expressed their opinions with great interest on conditions for and grounds of establishing an up-to-date system of R&D activities in Georgia. Some of the respondents were more radical in their proposals while opinions expresses by others were a bit softer.

> The system of R&D management in the country is now at the stage of its establishment. The efficiency and workability of this model will very much depend upon who participates in developing the system, interest of which groups would be taken into account.

It should be kept in mind that an organization has to maintain (or even develop) its ability to achieve its goals and to overcome the objective difficulties associated with entry into the system of market relations. Deconstructive outcomes caused by reforms have to be overcome by means of new models and mechanisms. The conditions under which R&D activities are carried out especially in transforming societies, change rapidly. This calls for institutional differentiation.

In respondents' opinion, *the following organizations and individuals must participate in the development of the R&D management system in Georgia*:

1. The Ministry of Education and Science
2. Ministries and agencies dealing with research in various sectors of the economy
3. The Academy of Sciences and the Academy of Agricultural Sciences
4. The Ministry of Economic Development
5. The State Chancellery
6. The Georgian National Science Foundation
7. Representatives of higher educational and research institutions, chairpersons of academic boards

8. Councils of young scientists
9. Boards of directors of R&D institutes
10. The Public Council – a group of authoritative scientists that enjoy high confidence and have been elected by the Georgian research community together with officials of the Ministry of Education and Science
11. Associations of prominent businesspersons (for rendering assistance in the intensification of the process of commercializing research outputs).

Problems related to the development of the R&D management system have to be solved by representatives of three groups: government ministries and agencies; public research organizations; organizations incorporating prominent businesspersons. One third of respondents attached extremely great importance to participation *of the Public Council* in the process under discussion. Other public organizations are considered today as the only possible champions of researchers' rights. Opinions were also expressed that a public institution of independent expert evaluation should be established which could provide independent opinion about various decisions.

A "tandem" comprising of representatives of government structures together with actively working scientists will play an important role in decision-making when developing the R&D management system.

3.3.2 Main provisions that are to be taken into account when developing the system

Unfortunately, a number of respondents pointed out some vagueness, fuzziness in defining the directions and ultimate goals of public reforms, including reforms in the domain of research and education. Nevertheless, all the respondents actively expressed their opinion as to what *basic provisions must be considered in developing the system of R&D activities* in Georgia. These provisions are the following:

1. Integration of Georgian research into the global research community.
2. Rejection of politicized decisions when the question concerns basic and applied science.
3. Patronage of research by the state.
4. The presence of the concept of developing Georgian fundamental, applied, and university-based science.
5. Taking into account the national values and special features of the country's development, available potential, development of those research institutions that can support and strengthen Georgian economy. Definition of research priorities, including new ones.
6. Integration of research performed in higher educational institutions and R&D institutes.
7. Stimulation of developing priority areas of research.
8. Enhancement of the role of applied science and investing its representatives with the role of government experts in individual sectors (for example, in food industry.)
9. Commercialization of research outcomes, with due regard for the interests and demands of the providers and beneficiaries of the outcomes.
10. Creation of a system of attracting and retaining young researchers.

11. Flexibility of the R&D management system, with the use of the principle of linkage and feedback between its participants. Appraisal of the efficiency of the management system has to be carried out on a regular basis.

12. At the executive level (R&D institutions) it is necessary to draw a clear distinction between administrative and research functions.

One of the respondents expressed the following opinion:

«The process of establishing the R&D management system at the present-day level calls for the division of research institutes existing in Georgia into two categories:

1. Institutes that can be brought up to the university level and will be, correspondingly, established as university research structural units.

2. Institutes whose subject of research is of extremely specific nature which would exclude carrying out such research effort at the university level and, correspondingly, establishment of such institutions as university research structure units.»

The proposals submitted by the respondents may be ranked at a later stage depending on their importance for each stage of reforms. Each of proposals can subsequently be more detailed. Important aspects of the matter influencing the creation of an up-to-date R&D management system in Georgia, are the complex nature of problems, exactness of set goals, active role of the state, creation of social partnership, search for a balance between commercialization of research outcomes and development of basic science. The role of higher educational institutions in the new system will change considerably, although as yet very few people consider a university as an entrepreneurial organization. In this list of basic provisions that the respondents put forward the innovative mode of thought is present.

3.3.3 Approaches to the establishment of the R&D management system

The assessment had to facilitate the determination of grounds for creating the system of R&D activities in Georgia. Two most important components of this system are management and funding.

The answers to the question: "I*n your opinion, how must the system of managing R&D activities in Georgia to be organized?*" revealed the following personal views.

The majority of respondents irrespective of what status the organization represented by them has suggested establishing a Coordination Council, a special body under the Ministry of Education and Science, that would consist of experienced, authoritative, highly skilled researchers with organizational skills.

In the respondents' opinion, all academicians, heads of research institutes have to become actively involved into the management process and should become active participants of the decision-making procedure.

Opinions of the majority of respondents supported also the proposal that Expert (Consultative) councils should be established, and that the peer reviews should become part of the system of managing research activities.

There were solitary opinions expressed that co-ordination of research efforts has to be carried out through the Academy of Sciences, as well as opinions that it is necessary to establish the National Research Council under the President of Georgian Republic though no indication of its power and functions was mentioned.

The respondents also suggested that special subdivisions should be established in the Ministry of Education and Science based on the project management principles.

Here are some concrete statements made by the representatives of R&D institutions.

«In order to develop an R&D management system, a comprehensive analysis of existing R&D management systems that effectively operate in other, comparable with Georgia, countries, should be performed with due regard for established research traditions and local conditions (in Georgia).»

«The system of R&D management in Georgia should combine two approaches: managing fundamental research – here the autonomy of appropriate R&D institutes should prevail, whereas in managing applied developments economy (the market) is a major management instrument»

«General management of R&D activities in Georgia should be carried out by the Ministry of Education and Science. In the management and decision-making processes an important role should be assigned to the sectoral expert (consultative) councils. In this case it would be necessary to strictly specify both the sphere of decision-making and functions in the process of creating the system; these issues are rather complex and would require careful consideration. It is desirable to do away with a traditional practice of subjective selection of members of such councils, but this is easier said than done, even more so as the factor of "new vision" will not always guarantee the desired result. The degree of freedom with which the "participants" of research activities (institutions and their management) are endowed presently seems to be adequate for the given transition period; however, as the system will evolve a number of functions will need to be limited while other functions and powers, on the contrary, should be broadened.»

3.3.4 Approaches to the establishment of the R&D funding system

The question: *"How, in your opinion, the system of funding R&D activities should be organized?"* resulted in following opinions.

First of all, it should be noted that the respondents, quite independently of one another, expressed very similar opinions. The respondents believe that:

- the Ministry of Education and Science, together with the Expert Council, should define a list of institutions with priority funding;
- private investors should be drawn into funding short-term programmes;
- models of funding projects related to basic and applied/exploratory research should be different;
- the Ministry of Education and Science and the Georgian National Science Foundation should carry out coordination activity in regard to higher educational institutions and research institutes of the Academy of Sciences.

An opinion was also voiced that applied research should only be grant-financed. All the respondents emphasized a grave imperfection of the current competitive system of financing research institutes. In this connection it was pointed out that in the system of financing research activities such element as peer-review and audit should be present. The government should be of assistance in attracting funds from the private sector and non-profit organizations. The Ministry of Economic Development should support introduction of innovative developments and promote commercialization of a number of research areas.

Here are a few statements made by the respondents:

«Public funding should be maintained for some time, otherwise not only grave social consequences but also a virtual collapse of the remnants of the material and technical basis would be inevitable. At a later time, the Ministry of Education and Science should define those units (institutes, laboratories, working groups) that, for a variety of reasons, will not be able to manage without public funding and whose maintenance is essential for the state. Along with the funding of targeted projects (grants) on the basis of periodic competition, it is desirable to provide short-term funding of projects of advanced or other nature for which the time factor plays a crucial role because of the dynamics of circumstances.»

«Financing of research activities by government should be on the basis of a two-level system. In particular, the tasks and goals in the R&D sphere should be divided into two groups:

1. Current goals and task. They would encompass those research activities that an institution would not be able to implement in a relatively short span of time. Correspondingly, having regard to either accomplishment and achievement of, or failure to accomplish and achieve these goals, the government would be able within a budget year, to efficiently tackle the question as to whether to increase or reduce the amount of funding for an institute.

2. Long-term goals and tasks. They would encompass research activities that determine the very existence of a given institute as an independent subject. These goals and tasks are associated with the implementation of long-term, multi-annual or permanent interests of the state. Correspondingly, under such conditions the state can determine the indicators of long-term funding of a given institute."

"The funding system should be managed by the government, in accordance with the established priorities but it would be necessary to take into account the opinion of the research community. It is necessary to ensure the participation in this process of individuals well aware of the R&D process. The management process must be transparent and based on the principles of open fair competition."

"The funding system should ensure: (1) level of general financing; (2) targeted grant-based financing of individual branches of science having not only pragmatic but also social, cultural importance; (3) free, grant-based funding of science when anyone who wishes may take part in the open competition»"

It can be assumed that the proposed funding system would encourage new traits in researchers: initiative, elements of entrepreneurial activity, and so on; in other words, those productive values that characterize current economic behaviour, including behaviour of workers of intellectual labour.

As for the *circumstances that hamper the creation of an efficient system of financing R&D activities in Georgia,* the respondents pointed out the following:

1. Poor development of the economy of Georgia.
2. Inadequate allocation of expenditure for research in the budget.
3. Lack of up-to-date knowledge concerning the organization of funding.
4. Slow decision-making virtually at all levels.
5. Subjective approach used in the process of decision-making.
6. The uncertainty of criteria for evaluating projects submitted to a grant contest.
7. Rupture of links between research and production.
8. Lack of impartial experts, lack of instruments of financial expertise and peer-review of project proposals.
9. Key role of personal relationship in decision-making.

3.3.5 Assessment of research areas for the development of science and economy in Georgia

When reforming the R&D system, it is important that an effort must be made to determine the perspectives of various areas of scientific knowledge, with due regard for the general context of the status of science. This is a matter of strategic importance, decisions on which have traditionally been made at the level of the Ministry of Education and Science and the Government. Nevertheless, if the new system is striving to establish and maintain linkages and feedback, then at the level of making strategic decisions it would be vital to know the opinion of the research community on *the perspectives of research areas.* The respondents were asked to name those areas of scientific knowledge which they could characterize as very promising, less promising, and scarcely promising. It is necessary to point out an important nuance: the respondents associated the perspectives of one or the other research area not only with the specific nature of scientific activities of institutions representing them but also with the economic situation in Georgia and the foreign policy of the state as a whole. Everyone tried also to protect the interests of their institutions.

In the opinion of the participants of the survey, the following research areas are most promising in Georgia (Figure 16):

- biotechnology (33.3 % of the respondents pointed out that this area is *very promising*);
- food industry (29.6 %);
- mathematics and information science (29.6 %);
- processing of agricultural raw materials (25.9 %);
- medicine (14.8 %)
- history, literature, and linguistics of Georgia (14.8 %)
- ecology (11.1 %)
- political science and sociology (7.4 %)

Among the most promising areas were also mentioned: physics, geophysics, power engineering (including solar one), humanities.

It should be especially noted that the views of both respondents from higher educational institutions and R&D institutes about the perspectives of one or another research area turned out to be completely concurrent.

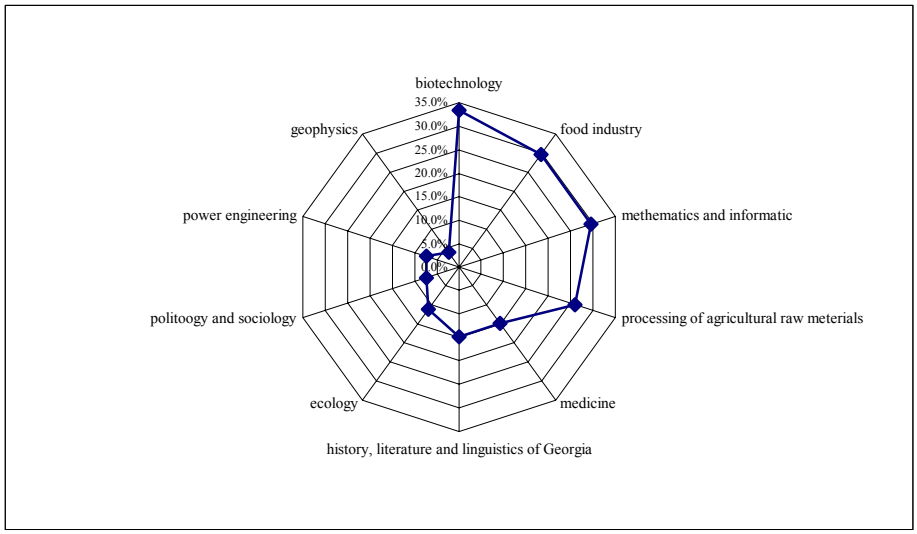


Fig. 16. Degree of priority of individual research areas, the share of respondents having indicated it

The number of answers to the question about less promising and scarcely promising branches was considerably smaller. However, among the less promising branches were indicated space research, geological prospecting for useful minerals, astronomy, geography; while among the scarcely promising areas were those branches of scientific knowledge that are associated with large financial investments.

On the basis of the opinions expressed by the respondents it may be concluded that among promising areas of scientific knowledge are those for which the probability of commercialization of research outcomes would be high, and the percentage of finding innovative solutions (biotechnology, informatics, medicine) would be high. The importance of creating innovations is very great for R&D institutions, both in terms of obtaining additional finances as well as increasing the competitive capacity of a particular area and/or of the national economy.

3.3.6. Main problems arising in the process of commercialization of research outcomes

On the other hand, support to such areas is associated with great expenses as the chain of creating innovations would be long enough. Management of the process has to be implemented in each of its links. The greatest risks would arise in case when any link in the chain of creating innovations turns out to be weak, and inadequately managed. In the course of the survey an attempt was made to find out which links, in respondents' opinion, are currently the weakest in Georgia. The respondents could point out all those links in the innovation chain which in their opinion are the weakest ones to date.

The answers are generalized in Figure 17. Apparently, at present the weakest links in the chain of innovations are: financial support (85.2 % of respondents), commercialization (70.4 %), business analysis (66.7 %), and economic analysis of new ideas (55.6 %).

Links of creating innovations	Percentage of respondents pointing out the weakness of this link	Degree of weakness of a link
Generation of new ideas	22,2	VII
Economic analysis of new ideas	55,6	IV
Screening of most topical ideas	29,6	V
Feasibility study of an idea	29,6	V
Development of an idea, Evaluation of production capacities	22,2	VII
Business analysis: potential markets, risks	66,7	III
Testing	25,9	VI
Commercialization	70,4	II
Financial support of innovations	85,2	I

* The degree of the weakness of a link is characterized by the intensity of cell shading.

Fig. 17 Respondents' opinions on the weakness of various links in the chain of creating innovations in Georgia

The successful transition to an innovative model of development of science and economy will depend in many respects on the efficiency of the functioning of the R&D, and, first and foremost, on rates and quality of transferring R&D outcomes into production. In today's world this is becoming more and more complicated and R&D of inter-sectoral or interdisciplinary nature has become most urgent and promising one. New ideas and discoveries emerge in increasing frequency at the intersection of different branches of knowledge.

Nowadays, the activities of R&D organizations cannot be limited only by the sphere of research as such; the innovative trend of these activities must become increasingly distinct. Ideally, an organization has to implement the following stages of the research and innovation process:

- Pure basic research
- Goal-oriented research
- Applied research
- Experimental developments
- Transfer of the results obtained to production

- Placing in production
- Promotion of products in the market (marketing of outcomes and technologies)

An innovative component geared toward the commercial success should be present in the activities of the overwhelming majority of R&D organizations.

A representative of the P.G. Melikishvili Institute of Physical and Organic Chemistry made the following additional comments:

«As a rule, generation of new ideas is carried out not on the basis of real needs of society but on the basis of potentialities of a "generator", although I cannot rule out possibility that this could be typical not only for Georgia. The economic analysis of new ideas as a link may be considered lacking. The feasibility analysis of an idea is carried out at an extremely low level, if taking place at all. Business planning is in its infancy not only with respect to innovative projects, but also in the full sense of this word. Most of the few examples of successful commercialization (I shall confine myself only to the chemical industry) were based on developments made in the institute, but those efforts were made within the framework of individual entrepreneurship; the reason is that an R&D organization has no possibilities for investments. »

3.4. Main conclusions from the results of the assessment

The main objective of performing the assessment was to study the processes, problems, and development prospects related to the R&D system in Georgia. The question is, first and foremost, about the impact of macroeconomic reforms on research activities.

The progress of processes, existence of problems and prospects in research and development activities - all these factors are closely associated with modernization processes going on in the social sphere, and this is accompanied by major internal reconstruction of the entire system of R&D activities.

Representatives (directors, deputy directors, rectors or vice rectors) of R&D institutes and universities from different research areas took part in the assessment.

Data were assembled about the main characteristics of the organizations surveyed, in particular, the dynamics of the number of personnel, sources of funding, outcomes of scientific activities in the form of published works, issued patents and awarded prizes.

Structural changes carried out by the Ministry of Education and Science resulted in a considerable reduction of the number of research personnel in the R&D institutions (during the year 2006 the number of personnel was reduced two times and more).

Shortage of finances, obsolescent material and technical basis, and lack of young researcher at the R&D institutes are the permanent (and, in this sense, habitual) "leaders" in the list of problems mentioned by respondents.

The Ministry of Education and Science still is the main source of funding but the volume of funding is unstable. **The volume of funding by means of international grants and programmes differ greatly from one R&D institute to another**. But even in the case of receiving numerous grants and sufficiently large amounts of money provided by a particular funding source, project-based financing cannot be considered as a panacea for all financial problems and a substitute for governmental financing of

research. The respondents pointed out that **international grants and programmes can *support* individual R&D activities but they *cannot guarantee* a sustainable development and the very existence of an R&D institute as a whole.**

Investments by private business of Georgia and from abroad cannot yet be considered as a substantial source of financing R&D activities. Thus, access to funding from various sources is an increasingly urgent problem.

The results of the assessment showed that the percentage of publications in foreign journals, as well as publications indexed in the ISI Web of Science database had slightly increased (by the year 2005 this indicator reached almost 35 % of all publications).

As for the patenting activity, it still exists in the organizations surveyed but its ratio is very low.

When considering the positive effects of the R&D reform the respondents pointed out that more opportunities for cooperation with foreign counterparts have emerged; the system has become more open for data flows from outside.

The respondent appraised the state of the R&D management system in Georgia, on the average, at 4.3 points on a 10-point scale.

As for the overall consequences caused by the early period of reforms, both positive and negative ones can be identified. It should be noted that the latter, in respondents' opinion, show themselves to an average extent while the latter appear to a slight extent. To the **most adverse consequences** of reforms were assigned the decline in the status of intellectual labour and its social significance, as well as the outflow from science and education of qualified personnel. **Of the positive factors**, the emergence of opportunities for self-realization as a scientist and a favourable influence on the material conditions of researchers were mentioned.

At the same time, problems due to the incompetence of personnel (especially "research managers"), lack of necessary co-ordination of reforms between the Ministry of Education and Science and R&D institutes, non-transparency of peer-reviews, and the incompleteness of the grant system, **practically do not disappear**.

Virtually all respondents (to a lesser or greater extent) referred to the **problem of peer review of projects and grants** provided by the Ministry of Education and Science. Such a peer review is a new phenomenon, and many respondents consider it as a positive one, but in doing so, the respondents severely criticize the procedure of its implementation, lack of clear and understandable criteria for the evaluation of project proposals and for the justification of the amount of allotted project funding.

Particular attention should be paid to the urgent tasks that exist in the sphere of developing research activities, including:

- strengthening of the material and technical basis of R&D and higher educational institutions;
- intensification of professional mobility and extension of international co-operation;
- integration of research and higher education;
- increase in the remuneration for work;
- human resource improvement.

The respondents actively expressed their opinions as to which main provisions must be taken into account when developing the R&D system in Georgia. They concluded that **the system should be bases upon the principles** of integration, priority

of scientifically justified decisions over politicized ones, patronage on the part of the state, due regard for national features of Georgia, and reasonable commercialization of research outcomes.

The respondents also expressed their personal opinions concerning the creation of the system of funding research activities. All of them pointed out serious imperfection of the present-day funding system which would not only prevent institutions from carrying out research of real value but would also generate unhealthy competition between the research institutions.

The role of the state in the system of R&D funding remains the key one, not only in providing the main flow of money but also in attracting the resources from private sector and non-profit organizations.

The results of the study are of great importance for a deep insight into the reforms carried out nowadays and for their impact on individual sectors of the national economy (in particular, on research and higher education). Problems causing serious adverse consequences have been identified; however, at the same time it was found that new opportunities for further development of R&D activities as well as for the elimination and overcoming of existing difficulties have also emerged. It was determined what are the typical strengths and weaknesses of the R&D management system at the given moment in Georgia, and what opportunities exist for its further elaboration. The results obtained will be used as the basis for recommendations on the elaboration of the R&D strategy aimed at the development of the system of research management in Georgia.

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Project management team

Project management team leader	Madis Saluveer, Archimedes Foundation, Estonia
Senior long term expert	Lasse Koivunen; Retectum OY, Finland
Ministry of Education and Science of Georgia, liaison person	Archil Samadashvili
Georgian National Science Foundation, liaison person	Theodore Dolidze
Georgian National Science Foundation, local project office	Khatia Ananiashvili
Georgian National Science Foundation, local project office	Nikoloz Bakradze
Project consultant	Daria Khlebovitch