

A SCIENCE PROFILE OF UKRAINE

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Introduction

Ukraine is one of the largest countries in Europe. In terms of its geographical size, it yields only to Russia, whilst it in terms of population (48 million) - to Russia as well as to Germany, Great Britain, France and Italy. Ethnic Ukrainians make up more than three fourth of population, official language – Ukrainian. Its independence Ukraine gained in 1991 following the collapse of the Soviet Union.

Ukraine proclaimed its policy of integration with the developed democratic Europe, stating officially its membership in the EU as an ultimate goal. Establishment of knowledge-based economy will be critical for this purpose. There are certain conditions in Ukraine enabling it to conquer the goal, which supposedly can be used regardless the fact that over the last years the situation with country's S&T area was increasingly deteriorating. The situation did not recover significantly even with economic growth that occurred in early 2000. At the same time, representatives of scientific community became optimistic about positive changes that would facilitate opening capacities for Ukrainian science and rising indicators of its socio-economic efficiency.

Section 1 Socio-economic Conditions of Science Development in Ukraine

1.1 History Overview

The national scientific system of Ukraine was formed for the most part back in the Soviet Union times. The scientific and engineering complex can be considered as its core encompassing numerous research institutes, higher educational establishments, design bureaus, scientific and engineering departments of enterprises, association of inventors and innovators and so forth.

Over the Soviet Union period, Ukrainian scientific and engineering organisations played an important part in the division of labour throughout the Soviet Union. Basic macro-ratios of this complex to a great extent used to match those of industrial potential and contribution of Ukraine in the GDP of the Soviet Union. At

the same time, some parameters (e.g., level of availability economy by specialists with academic degrees) had critical dissimilarities with the mean values around the USSR.

However, as noted Russian expert in the area of research of science A. Terekhov stated with good reason: "only two the most developed republics (parts of the Soviet Union), Russia and Ukraine, are capable of conducting research along all scientific front and prepare specialists in all scientific areas". On the whole according to different estimations, Ukraine encompassed nearly 13-15% of scientific and engineering potential of the Soviet Union, but the research centres of republic had one important feature: Ukraine accommodated nearly 20% of experimental equipment of the USSR. In some areas of science and technology progress Ukrainian research organisations were in the lead. This is particularly true for electric welding, new materials, transport aviation, development of the specialized software, etc. It was not by accident that the Academy of Sciences of Ukrainian SSR was selected as the leading organisation responsible for the new materials development within the scope of the Complex Programme of Scientific and Engineering Development of Mutual Economic Assistance Council member states in 1985.

The majority of Ukrainian research organisations, including the leading institutes of the Academy of Sciences, had clear technological orientation. For example, considering the data on patents obtained abroad, among organisations in the former socialist camp countries that had the majority of US patents, E.O. Paton Institute of the Electric Welding held the distinguished seventh place (54 patents in 1969-1994).

However, it is necessary to note that Ukrainian specialists, like the majority of specialists in the Soviet Union, did not maintain active cooperation with colleagues from the most developed foreign countries for the well-known reasons, which resulted in overestimations of results of their own research and development. For instance, the poll of leading scientists about the R&D performance in Ukraine in early 90-s, revealed that the majority of them (more than 90%) believed that those exceeded or matched the world level. Regrettably, evidences did not endorse those estimations. Let alone the average technology level of developments, it can be noted that only one of ten Ukrainian scientists (with the degree of doctor or candidate of science) has works published abroad; only three Ukrainian scientists were in the list of one hundred Soviet authors most frequently quoted in the internationally acknowledged magazines. Such seclusion of Ukrainian scientific community can be also accounted for that the majority of research and development was aimed at creating powerful military potential. According to the data of former member of the Supreme Council academician P. Kysly, even in the Academy of Sciences nearly all R&D were ordered by the Military. Concerning the so called industry institutes that the lion's share of funding and material resources was allocated to, a picture was yet more remarkable there: developments of whole industries were classified in different ways and were subject to restricted

access.

On the other hand, it is not always easy to distinguish contribution of Ukrainian specialists in a certain development in pure form. Absolute majority of industry institutes and design bureaus were subordinated to Soviet ministries or were the branches of All-Union institutes. In these circumstances not always the results of their work can be sifted out of the general outcomes of headquarter organisations. Even foreign experts not well disposed toward the Soviet Union emphasized high-level integration of its science and technology system.

Reasoning as regards "safety and survival" of the most important objects in case of probable military actions also facilitated the "dispersion" of research establishments throughout the territory of the USSR. A considerable part of design bureaus and scientific establishments were thus deliberately located in Moscow region which was protected by the Soviet system of anti-missile defence. This resulted in, say, that great Ukrainian shipbuilding capacities at the beginning of 1990-s were left without adequate supply of science and technology potential.

Independence proclaimed in August, 1991 sparked hope in Ukrainian elite that liberated from supervision of the Soviet control bodies the rates of socio-economic and scientific and engineering growth of a new independent state will soar. Alas, it never happened. Actual results of the first decade of independence turned out very distant from those anticipated. The reasons of this are numerous, but we shall endeavour to consider the most important ones in the following sections.

1.2 Socio-economic Conditions of Science Development in Recent Years.

The years of establishing market economy in Ukraine demonstrated that the state does not have sufficient material resources to preserve science in such condition that it was in over the years of Soviet regime. Calamitous reduction of funding for scientific research occurred during the period of market transformations, including cutting down funds for research equipment. There are no long-term orders placed for fundamental research; scientists were left without proper remuneration, science was deprived of prestige and status of scientists eroded. These changes resulted in gradual reduction in the number of research establishments and collapse of state research institutes. Big research groups breaking up into small ones became a reality. Small research teams fully or partly funded by overseas sponsors mushroomed; scientists became primarily oriented on the interests of foreign customers, their activities were brought down exceptionally to the search for grants and other opportunities to participate in western research projects. Many scientists of middle age left their academic establishments and industry institutes and swapped their activities for more profitable ones, many of them immigrated. This caused deepening an age gap between different groups of scientists, which was accompanied by the considerable shortage of 30-40 years old specialists - the most active part in terms of creative capacities.

Ukraine is gradually acquiring a system which is basically oriented to the import of scientific and engineering outcomes instead of making its own science and technology products. Negative changes that happened in the country's economy in the last several years facilitate the process.

Ukrainian economy suffered deep crisis in 1990-s. According to the World Bank data, Ukraine was the only one post-Soviet state whose economy 1990-1999 was not growing in a single of year of the decade. Official GDP for this period decreased by more than 60%, whole industries (for example, electronics) virtually vanished. The value of domestic demand for numerous products, and especially high-tech ones, fell down dramatically. Only Yugoslavia that was in severe international blockade had even worse indexes of economic dynamics.

Duration R&D cycles generally exceed that of production cycles, and in the conditions of relatively high inflation in mid 90-s efficiency of investments in research tend to be considerably lower than the efficiency of speculative transactions with bonds or trade investments. In such circumstances the enterprises obviously were not inclined to undertake innovative activity (and banks to fund it), or even to procure new science and technology developments elsewhere. It would be inappropriate to argue that the state made no efforts to stimulate R&D and innovative activity. various national programmes in the areas of power engineering industry, coal mining were developed and adopted, wherein the value of scientific, engineering and innovative factors were supposed to have top priority. However, links between economic policy and science and technology policy remained rather weak. Funds were assigned to conduct R&D over the period of independence of the state (apparently, except for the first year,) were selected according to so-called „residual principle”.

Structural changes in Ukrainian economy also had negative impact upon the dynamics of science and technology growth and innovative development. In Ukraine during 90-s the GDP share of high-tech industries contracted whereas the share of mining industry and fuel and metallurgy complexes expanded. Calculated correlation coefficients between the general rates of changes in amounts of industrial outcome and changes of the share of different industries in general production outcome in 1990-1999 of analysis of structural changes, which is used in OECD countries, prove that production declined at the expense of mechanical engineering (relevant correlation coefficient was 0.91) and other industries standing high in value chain (0.88). At the same time the positions of black metallurgy (- 0.77), power engineering (- 0.95) oil and gas (- 0.96) and food processing (- 0.88) industries were relatively reinforced. It is known that leading industries do not belong to the group of science-intense industries. Their dominance in the economy of the state does not assure in the nearest future considerable growth of demand of industrial enterprises on S&T production.

It is necessary also to note that the very negative structural changes stemmed from low level of innovative activity of the majority of Ukrainian enterprises. Values of

the indicators of basic innovative activities (amount of the inculcated standards of a new technique, level and amount of inventions etc.) went down 5-15 times over 90-s. The most substantial decline is observed in technologically developed industries. Base industries of economy suffered the least. Yet the pattern of science and technology activities changes gradually therein: key efforts are directed not towards the development and introduction of domestic technologies and products, but towards adaptation of the imported analogues. This does not only cause establishment of hypertrophied technological dependence of the country, but also in many cases leads to negative changes in domestic science and technology potential which degrades gradually.

The economy of the country is becoming increasingly oriented towards producing goods for industries standing lower in value chain. Even the still working enterprises of machine-building sector (for example, shipbuilding), as a rule, occupy the lowest segments in the world markets, i.e. the simplest kinds of products are produced. Competition in such market segments is particularly tense, and the Ukrainian companies are persistently jeopardized to lose their existing positions overtaken by the businesses from developing countries.

In 2000-2002 in the economy of Ukraine, the considerable growth was seen: it succeeded in attaining level of 60% of GDP from the level of 1989. but that process was not accompanied by fundamental structural changes. Prevailing of extractive industries and industries related to the primary processing of products persisted to be its intrinsic feature. Domestic market does not create demand high enough for the products of domestic make, especially in machine building, pharmaceutical industry and high-tech services, let alone electronics. Modular assembly of cars or computers of imported components to satisfy domestic needs should not deceive: according to the current international classifications, such activities are attributed to the low-tech production that does not require high qualifications and R&D involved.

For Ukrainian science, the changes in overall economic situation brought about certain stabilization in terms of both the number of researchers, and the amounts of R&D funding. Yet, it does not allow speaking about overcoming crisis in Ukrainian science. The scientific system remains unreformed, whilst dynamics of its numerous characteristic features - negative.

Section 2 Analysis of statistical indexes of research system of Ukraine and international comparisons.

To provide better understanding of the situation and opportunities for development of the scientific system of Ukraine, we shall consider the range of the most ponderable factors that determine its position and principal ways of its transformation. The following factors can be considered as the most important:

- structure of scientific complex (forms, regional distribution, department

subordination, science sectors);

- personnel (level of training and retraining of personnel with higher education and research fellows: number, structure, areas of application);
- funding provision (sources of funding, amounts and share in GDP, structure of R&D investments by sources of funding and distribution among science sectors);
- level of material and technical endowment of S&T area (material and technical endowment of research and researchers);
- effectiveness of research activities (number and comparable level of scientific developments; amount, efficiency and level of implementation of scientific developments etc.).

Current status of the scientific system can be described rather comprehensively by the appropriate set of statistical indexes and analysis of dynamics thereof. Certainly, in order to obtain comprehensive estimations this is to be complemented by the thorough analysis of interlinks between particular phenomena and indicators describing them within the context of general socio-economic changes that occur in Ukrainian community.

It is possible to distinguish indicators that describe the dynamics of resources and those describing effectiveness. Such distinguishing is conditional to some extent, thus, for example, the condition of personnel factors define both potential of the scientific system and its effectiveness in terms of training of high-skill specialists.

It is necessary to note that Ukraine had not yet taken on the international standards in the area of R&D statistics. Such sectors as factory R&D, industry R&D, academic R&D and higher educational establishments R&D are persistently applied by official statistics. It looks as anachronism, especially bearing in mind that in macroeconomic statistics formal transition was made from industries of economy to economic activities.

Presently in Ukraine there is the "hybrid system" of indicators, which combine both traditional ("Soviet era approaches"), and new, or "international" approaches. In that connection, it should be noted that in some cases such combination is not unusual, since it depicts actual situation in Ukrainian science. Yet, securing "traditional" approaches is predominantly intended to disguise the actual state of affairs in the scientific-technological sphere of Ukraine.

Another problem is that state statistics accounts financial indicators only in then-current dollars. It makes an impression that R&D expenditures are incessantly growing, yet it does not enable to analyse the real state of affairs in R&D funding. To conduct international comparisons, the parity of purchasing power of national currency is not applied. Due to this circumstance, R&D expenditures data (as well

as other financial indicators) underwent the political manipulations.

Substantial problems concern the appraisal of actual condition of personnel factor of scientific potential. An issue of vital importance here is the fictitious employment in the environment of continual R&D underfunding and application of different from the West the hierarchy of scientific ranks and procedures of granting thereof.

However, in our view even more urgent are the problems with the appraisal of Ukrainian science effectiveness. Changes in official statistics, implemented in 2000, complicate the unprejudiced interpretation of the state of affairs.

2.2 Essential Indicators of the state of Ukraine's scientific system

2.2.1. Scientific organisations of Ukraine

There is ramified network of research organisations of different types in Ukraine, which in the aggregate are intended to ensure the adequate level of science and technology of the whole state and every single industry of national economy. Basic types of the organisations are as follows:

- **Design organisations.**
- **Development organisations.**
- **Higher educational establishments.**
- **Research and development and design departments at industrial enterprises.**

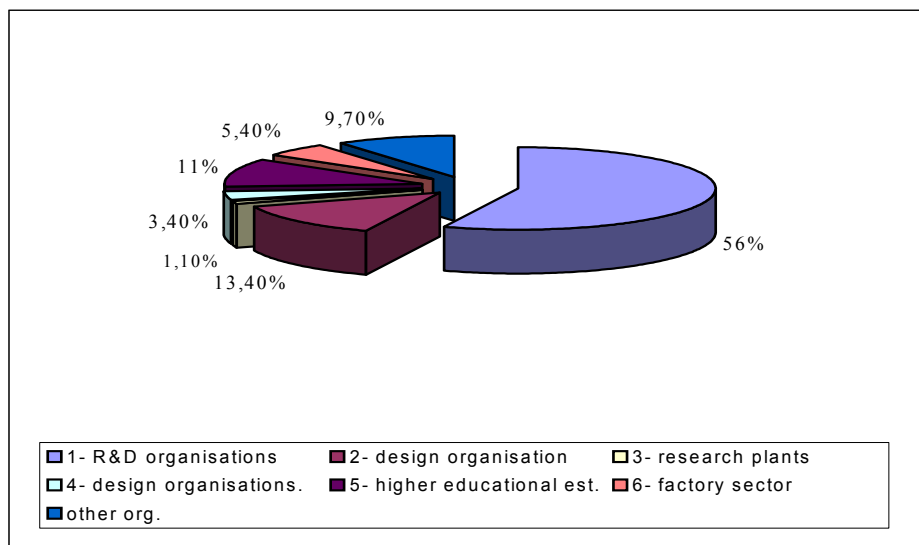
Since 1991, the organisational component of scientific potential of Ukraine is undergoing changes that became especially noticeable in last year.

Firstly, the overall number of research organisations in Ukraine was gradually increasing until 1999 (1506), and then decreased to some extent, and in 2002 there were 1479 of them. In comparison with 1991, (1344 organisations and institutes), 135 new scientific institutions were established. It can be accounted for by the fact that performance of some old structures in the new environment is not good enough, therefore new and more market-oriented spin-offs were organised.

Secondly, structural changes in specialization of Ukrainian research organisations are underway. For example, there were only 50 design and development organisations in 2001. whilst in 1991 there were 88 of those. Research organisations Ukraine in 2000 included 80 research and development and design departments at industrial enterprises. After 2001 their amount decreased by 8 %, whilst in comparison with 1991 (104 organisations) their number decreased by 19.5 %.

On January, 1 2002 there was such relation between the science sectors in Ukraine (according the sectors distribution traditional for post-Soviet science) (see diagram 1).

Diagram 1 Distribution of organisations involved in R&D, 2001



It should be noted that during 1991-2001 a general upward trend of the number of organisations included into industry sector — from 804 organisations (60% of total number of organisations) in 1991 to 921 (62.2 %) in 2001.

In terms of the number of organisations the academic sector of Ukrainian science (315 organisations) takes second place. For the last year this sector's share grew by more than 0.8%. This trend is unwavering enough - in 2000 year share of the academic sector grew by 1%. Academic sector encompasses the National Academy of Sciences of Ukraine (NAS) and academies of sciences of a particular industry — the Academy of Agrarian Sciences of Ukraine (AAS), Academy of Medical Sciences of Ukraine (AMS), the Academy of Pedagogical Sciences of Ukraine, (APN), the Academy of Legal Sciences of Ukraine, the Academy of Arts of Ukraine (AMOu), all of which are public research organisations.

2.2.2 Regional aspect

Research organisations are unevenly dispersed throughout Ukrainian regions. They are concentrated mostly in economically developed regions. According to the data for 2001. more than the fourth of all Ukrainian science and technology organisations (378 units) are located in a capital region (Kiev and its oblast). In Kharkiv region there are 227 organisations (15.3 %), in Donetsk region —91 organisation (6.2 %), Dnipropetrovsk — 103 organisations (7 %). On the whole, these four regions accommodated more than half (almost 55.4 %) of all research organisations of Ukraine in 2001.

Concerning the regional aspect of personnel potential of science, Kiev region dominates here. The capital contain above 36% of scientists of country and provides to Kiev the considerable tearing off from Kharkiv (17.2%) and Donetsk

(7.6%).

2.2.3 Dynamics of personnel potential of scientific area.

Considerable erosion of personnel potential of Ukrainian science occurred in 90-s. Overall employment in R&D reduced almost by 60%, and taking into account intense growth of fictitious employment and impossibility to conduct R&D because of lack of money for equipment and materials, actual cutback of labour spending in science, the figure was even bigger. Note that expectations of vigorous expansion of graduate studies programmes thus involving youth into scientific area were not justified. Increase of the number of defended dissertations is clearly inconsistent with the growth of the number of graduate students. In addition, many young scientists after defending dissertations choose careers outside research or immigrate.

There is a trend in Ukraine towards reduction of general employment in science and technology. Data in diagram 1 show the dynamics of employment in 1991-2002. In particular, it is possible to see that major reduction of employment fall at the first half of 90-s, however trends in the R&D employment remain negative even in conditions of the economic growth over 1999 – 2002.

Data on the dynamics for the same period of the number of specialists carrying out R&D in Ukraine are even more indicative. The cutback of such category of specialists slows down more visibly, yet the processes of relative stabilization conceal some other negative trends, in particular, deterioration of personnel's age structure which will be considered below.

On the whole, it can be stated that a downward trend in the overall R&D employment is stable. At the same time the rates of reduction of a number of specialists conducting research and development somewhat decreased in recent years (from 16% in 1991-1992 to 1% in 2001-2002), yet it must not bring about optimism, since other factors are becoming increasingly facilitating for degradation of scientific potential of Ukraine.

Intricate socio-economic situation of specialists in Ukrainian science largely determines a fashion whereby main (or academic) responsibilities are combined with other activities that, unfortunately, are not research or training activities. A number of scientists combining their jobs doubled in 2002 in comparison with 1991 (grew by 98.9%) and amounted to 57.3 thousand specialists. In our view, it attests the crisis in existing institutional structures of Ukrainian science, within which one fails to organise comprehensive research process and to provide decent remuneration for research fellows.

Total R&D employment 2002 included 21.1 thousand doctors and candidates of science (or nearly 20 % of the overall R&D employment in Ukraine), as against 24.3 thousand in 1998 (or 18 % of the overall R&D employment in Ukraine), and

31.2 thousand in 1991 (or 10.6 %).

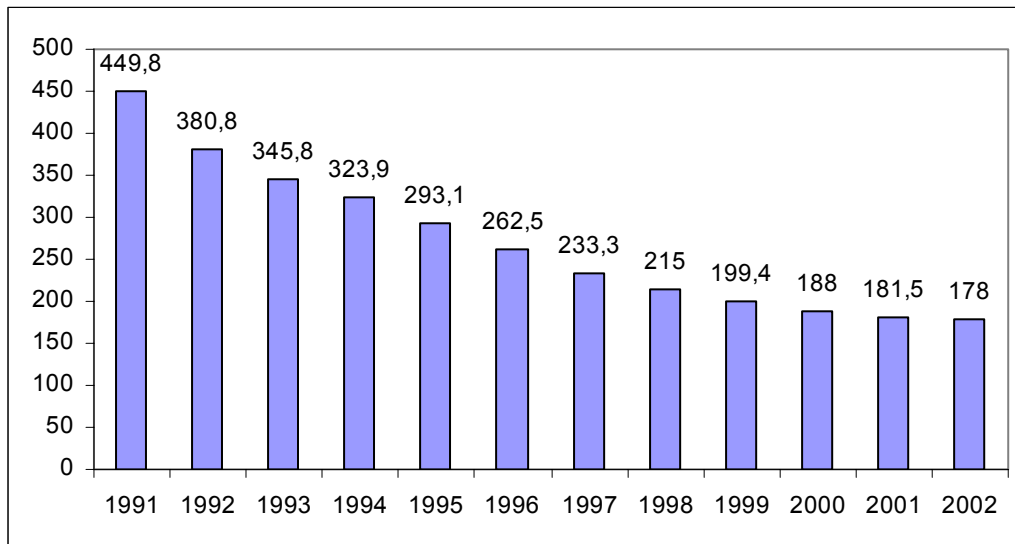
In 1999 for the first time during the years of independence the number of doctors of science who carried out R&D in science and technology organisations of Ukraine reduced by almost 8.4 % as against 1998. It is related primarily to the new standards for retirement plans adopted for research fellows, which allows a research fellow to retire saving approximately 80% of his or her wages. Nonetheless, middle age of doctors of science employed in R&D grew in 90-s years by one year on average every 2-3 years and in 2001, it was 60 years, i.e. "retirement ceiling". Obviously, subsequent aging of doctors of science will inevitable bring about a decline of creative potential of such category of scientists. Similar trend can be also seen in the dynamics of age parameters of candidates of science.

Apparently, the situations with the personnel in science area are alike in different regions of Ukraine. Comprehensive data analysis about the age structure of academic institutes of Kharkiv region reveals that it is very close to the average national structure: 61% of research fellows are over 50. A part of specialists under 40 makes up less than 23%. Candidates of science under age of 40 amount to meagre 8.1% of the total number of candidates of science, and doctors of science under age of 50 - 2.14% of the overall number of the doctors.

Age crisis in science will be hanging over Ukraine in the years to come. It is practically impossible to dodge it, yet the consequences can be somewhat alleviated. The point is that there is a "big gap" in the group of specialists (candidates of science) in age 30-50 years. These are the people who were the most active over the last decade in deserting science. Alongside with senior generations leaving active involvement with science, the shortage of skilled specialists in science will be more vivid. By inculcating urgent measures the processes of age unbalance of personnel structure can be halted, however the problem is complicated by the circumstance that it is very difficult to resume to research activities after several years break because of the very specific of this activity.

In particular, measures undertaken by the government to increase payments to research fellows are incapable of changing the situation radically, although crisis will be less acute.

Diagram 2 Dynamics of number of R&D personnel in 1991- 2002 (thsd.)



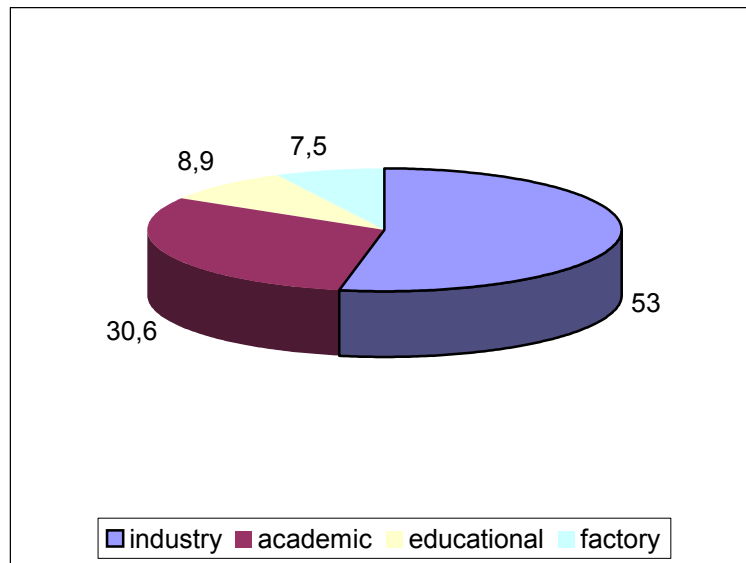
It is remarkable that critical structural changes are underway within the scientific system: as against 1995 that industry and factory science sectors suffered the most substantial losses, whereas share of academic sector grew nearly by 50% and university science virtually remained the same. Overall distribution of number of specialists in research organisations by science sectors is shown in diagram 3.

Concerning distribution of scientists by different specialities, the representatives of engineering sciences maintain their dominance in Ukraine: 60% of overall R&D employment. The situation still remains almost the same compared with 1991 when such specialists made up nearly 74%. However, the changes are obvious and most likely, the percentage of representatives of engineering sciences will keep falling down.

As statistic data indicate, three groups of institutes are best of all positioned in terms of decent labour conditions and relatively high wages.

- Industry institutes with stable links with large businesses in Ukraine and Russia. For example, Gazprom almost entirely funds activity of several project-design bureaus in gas industry.
- Institutes that set the mutually beneficial relationships with scientific establishments in developed countries, and whose employees regularly obtain considerable grants for conducting research, travel abroad and so forth. This group contains some institutes of biological profile of the NAS of Ukraine, Institute of Mathematics.
- Institutes of sociological profile that were contracted to conduct various studies and take part in political campaigns in some manner. Average wages in the institutes of sociological profile are about twice as high as in other institutes.

Diagram 3 Distribution of number of R&D personnel by science sectors in 2002, (%)



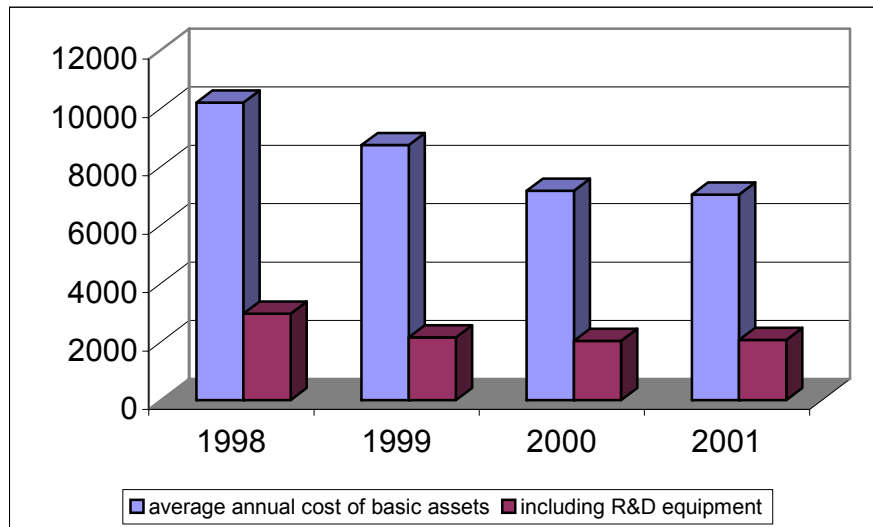
It is scientific establishments related to development of new industrial technologies and technological processes, especially in machine-building that tend to be marginalized.

2.2.4 Financial, material, and engineering components of scientific potential of Ukraine

Financial endowment of scientific area remains extremely unsatisfactory. For instance, the Supreme Council of Ukraine endorsed by the law the share of R&D expenditures in budget expenditures (1.7%) in the mid 90-s, but this decision has been never implemented. Official data state, R&D expenditures share within the GDP of Ukraine stayed at level 1.16-1.4% over the last five years. Yet the alternative computations testify that the percentage is considerably lower, after all such expenditures are included into R&D that have nothing in common with conducting research and developments. In addition, existing classifications facilitate the implementation of "double charges", especially when it concerns carrying out research works subject to the subcontract terms.

Effectiveness of science and technology activity depends largely upon the state of material and technical endowment of research organisations. In 2001 the average annual cost of capital assets in science and technology area in the state exceeded UAH 7 billion, which comprised machines and equipment to the amount of UAH 2 billion, or 29.3 %. The dynamics of the material and engineering base in Ukraine during four last years is shown in diagram 4.

Diagram 4 Long term assets in R&D organisations in Ukraine (UAH million) in prices of corresponding years 1998-2001 (%)



Scarce 2% of research equipment of Ukrainian science and technology establishments cater for current world standards. Such a circumstance substantially complicates conducting of studies and decreases competitiveness of scientific outcomes of Ukrainian scientists. Total area of houses and premises owned by research organisations in Ukraine totalled to 17.6 million sq.m. in 2001. Out of the total area of premises designated for science and technology activity, 1092 thousand sq.m. or 6.2 % are officially leased out. Many premises of research organisations are used not for their immediate purpose. At the same time, the newly founded, publicly owned scientific establishments are compelled to search for a place and pay heavily for the lease. This problem needs an urgent solution.

Furnishing information to science and technology establishments continues to be a big problem. Ever since 1991, a situation with acquisition from leading scientific libraries remained extremely disappointing. Only a limited number of foreign titles was available thanks to swapping. Number of scientific titles decreased, which is especially true for engineering and natural sciences. Not every scientific establishment, especially in regions, has the access to Internet.

2.3 Indicators of scientific research effectiveness

The indicators of scientific performance in Ukraine are largely neglected. Experts predominantly analyse the dynamics of resource indicators of science, primarily the state of funding and personnel endowment instead of indicators of effectiveness of scientific activity. Efforts of authorities are also focused on adjusting values of resource indicators. It is largely related to objective difficulties of estimating R&D results and determining contribution of science into socio-economic growth. Numerous attempts to define quantitatively this contribution based on econometric models in 1970-1990 resulted in ambiguous conclusions. The problem with evaluating scientific performance is difficult enough since not all R&D results are market-oriented. Besides, economic effect from the use of R&D outcomes is adjoined and, as a rule, it is not limited to one enterprise or a company. R&D results can be used in various economy sectors, whilst some effects certainly

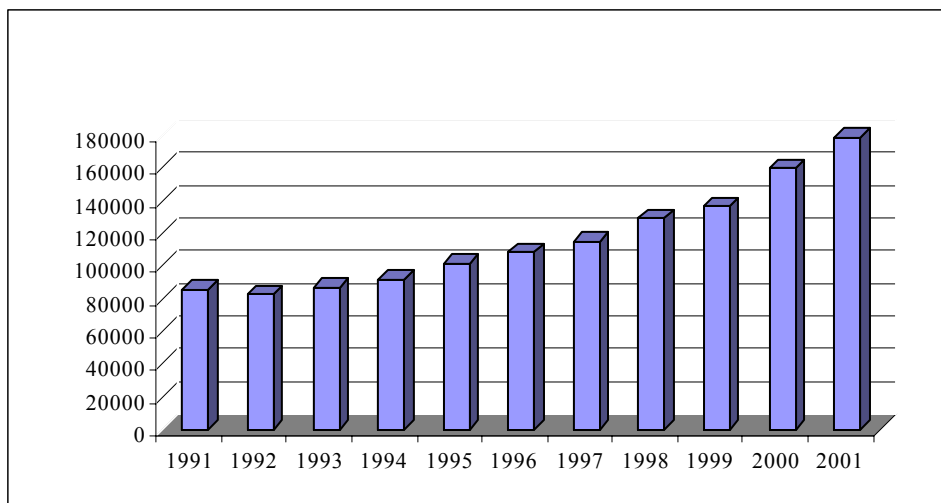
cannot be correctly displayed in a money form. For this very reason to estimate effectiveness of scientific activity informal methods were applied, specifically peer review. Furthermore, to describe the effectiveness of science two groups of indicators are usually used - publication activity and patent and licensing activities.

2.3.1 Publication activity

However incomplete, such indicators of publication activity as the number of publications and level of quotation remain one of the few acknowledged quantitative characteristics of effectiveness of scientific performance, especially in the fundamental science area.

As it is seen in diagram 5, total number of scientific publications in Ukraine in 1991-2001 had a unwavering upward trend regardless substantial cutback of R&D employment. An increase in printed output was remarkably considerable in 1991-2001.

Diagram 5 Dynamics in publication activity in Ukraine 1991-2001, units

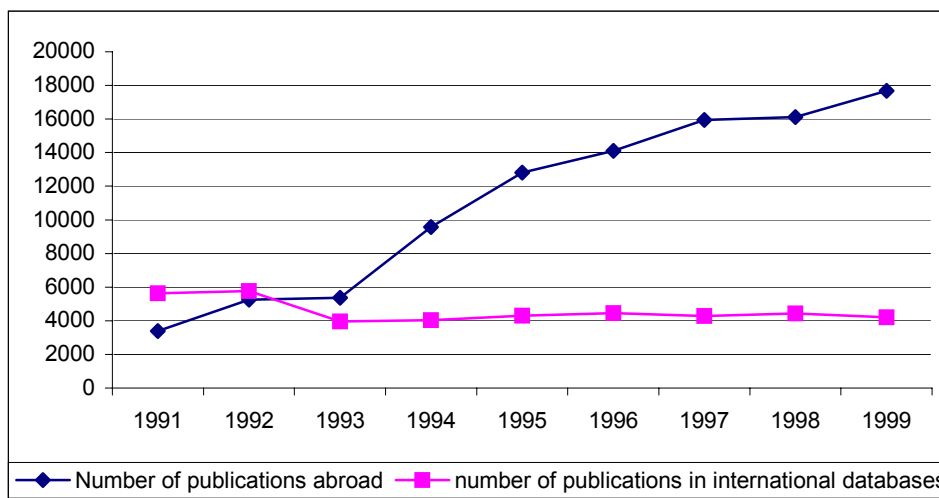


In addition, aggregate amount of scientific publications growing rapidly, number of publications increasing on specific subjects in some regions of Ukraine, are noteworthy. Thus, it is essential to note that this process occurred against the background of continuous underfunding of research activity: in recent years, a lion's share of R&D allocations was spent not on scientific experiments but on personnel remuneration and payment of public utility costs.

One of the most important reasons for such state of affairs is virtually nonexistent control over the results of statistical information processing as regards publication activity.

It can be noted that scanty 20-25% of the articles inventoried by domestic Ukrainian statistics are registered by world databases. Graph 1 shows the data on the dynamics of magazine papers published by Ukrainian scientists in 1991-1999. Data for the last several years were not gathered by the State Committee for Statistics (Derjhcostat) of Ukraine.

Graph 1 Dynamics in number of publications abroad and ISI magazines 1991-1999



Differences in the dynamics of these indicators are clear. Decreasing number of publications in rating magazines of the ISI database to some degree was brought about to some extent by the exclusion of several Ukrainian magazines from it in 1990-1999. This happened not because of somebody's wicked intention, but owing to transparent criteria applied, among which the level of quotation of scientific magazines is the top priority. Eight Ukrainian magazines were included into the ISI database (all magazines are published by the National Academy of Sciences) in 1999, whilst there were thirteen magazines in 1990. It should be noted here that interest of foreign colleagues in Ukrainian magazines was waning against the background of increasing number of scientific editions. For instance, 71 scientific magazine were published in Ukraine in 1991, whereas number of magazines exceeded 1000 in 2002. This number actually includes various scientific collections that turned into periodicals, but their percentage is not high.

The number of papers published by Ukrainian researchers is growing, however owing primarily to publications rated rather low according to international standards.

2.3.2 Patent and licensing activities

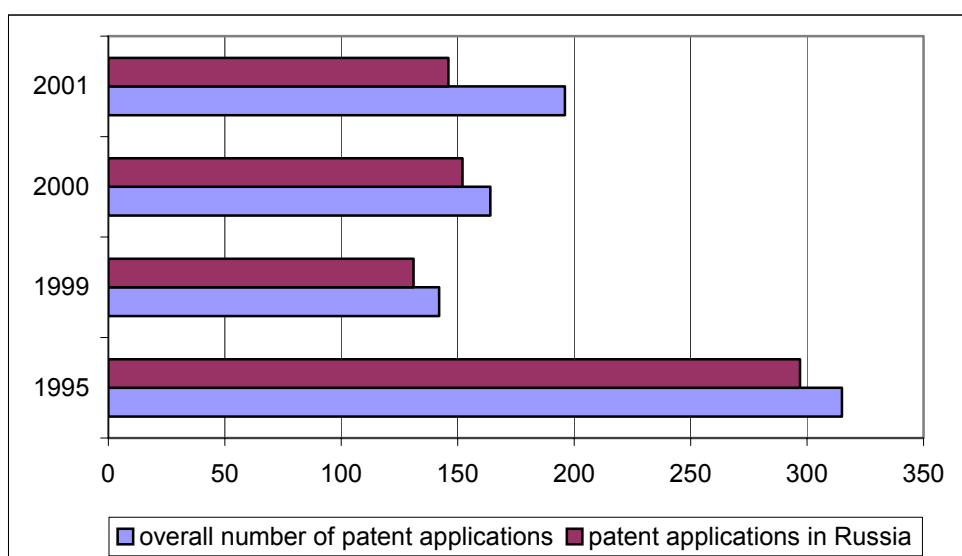
From the formal point of view patents are not necessarily the result of scientific research, however, virtually all patents are based on some scientific research. Number of patents rather demonstrates effectiveness of the applied science and degree of internationalization of domestic intellectual property market.

In Ukraine, like in some other developing countries, nearly the whole pool of patents is made up by the patents of multinational corporations, obtained by their affiliations in other countries. As a research of patent activity in the countries of

East Europe and Russia proved, the index of domestic patents is more important for transitional economies than internationally acknowledged index of patents obtained the USA. Such indexes are poorly adaptable for international comparisons although indicate the level of domestic efforts to ensure protection of intellectual property rights.

It is difficult to develop indicators for Ukraine displaying the level of patent activity compared with other countries. Only 196 applications were submitted to the patent agencies of other countries in 2001. It is almost two times less than in 1995, but substantial growth can be noted compared with unfortunate 1999 (see diagram 6).

Diagram 6 Number of patent applications of Ukrainian scientists in foreign countries, 1995-2001



It worth mentioning that *Derjhcostat* produces data on the number of the applications submitted by legal entities only, i.e. it allows for only half of the overall number of patents registered in Ukraine.

Based on the information of the National Patent Bureau (*Derjhpate*nt), the conclusion can be made that part of patent applications in Russia is gradually decreasing: from 1995 until 2001 it decreased from 94.3% to 74.5%. Generally, not only the quality of submitted applications, which is low in many cases, but the need to pay substantial patent registration fees as well, builds up a barrier on a way to patenting in foreign countries: it amounts to nearly \$20.000 in the US and over \$30.000 in EU countries.

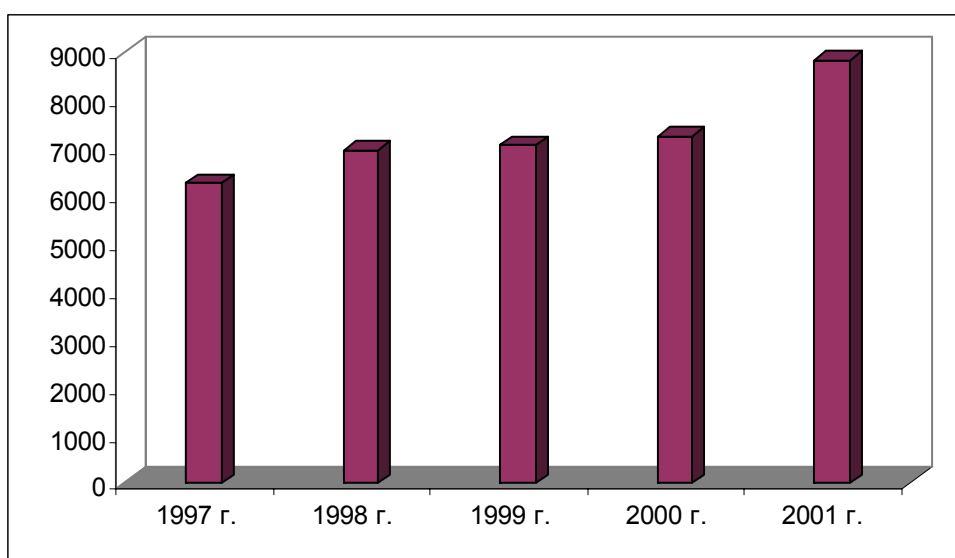
The percentage of so-called "declarative" patents, or patents that do not substantiate the novelty of patented idea increased over last years in Ukraine. In 2001, it was nearly 80% of the aggregate number of patents. This fact cannot be considered as purely negative, especially if a small enterprise or a natural person is a patentee. However, it is perfectly understandable that it is unlikely to obtain

foreign investments for such patent: international practice does not consider it as a valuable asset.

Concerning domestic Ukrainian patents and taking into account the differences in national legislations of various countries, these data are not usually used for international comparative analysis of patent information. It is necessary to implement as soon as possible mechanisms that will enable more active patenting of Ukrainian developments abroad, and EU and the US in the first place, and to give up "declarative" patents. Taking into account limited financial resources available in the state, it would facilitate to implement the schemes with international organisations and specialized agencies involved. It would be then like, for example, the Ukrainian Science and Technology Centre, where owing to the foreign sponsors' support it is possible to obtain a patent abroad on certain conditions. With such support, active patent retrieval in the international databases could be more energetic. Yet Ukrainian inventors every now and then do not have sufficient money for this.

It is necessary to note that overall number of patents in Ukraine is growing (see diagram 7) all the time. This is an indirect indicator of general growth of innovative activity in a country, although, as some experts state, "patenting and licensed trade is too much degraded".

Diagram 7 Number of new registered patents in Ukraine, 1997-2001 (data of Derjhpament)



The number of licences sold is negligible and does not influence much the innovation activity in a country. This indicator characterizes the scientific activity even less; therefore, we will not consider it here in detail.

Evidenced by the data, there are many problems in estimating science performance

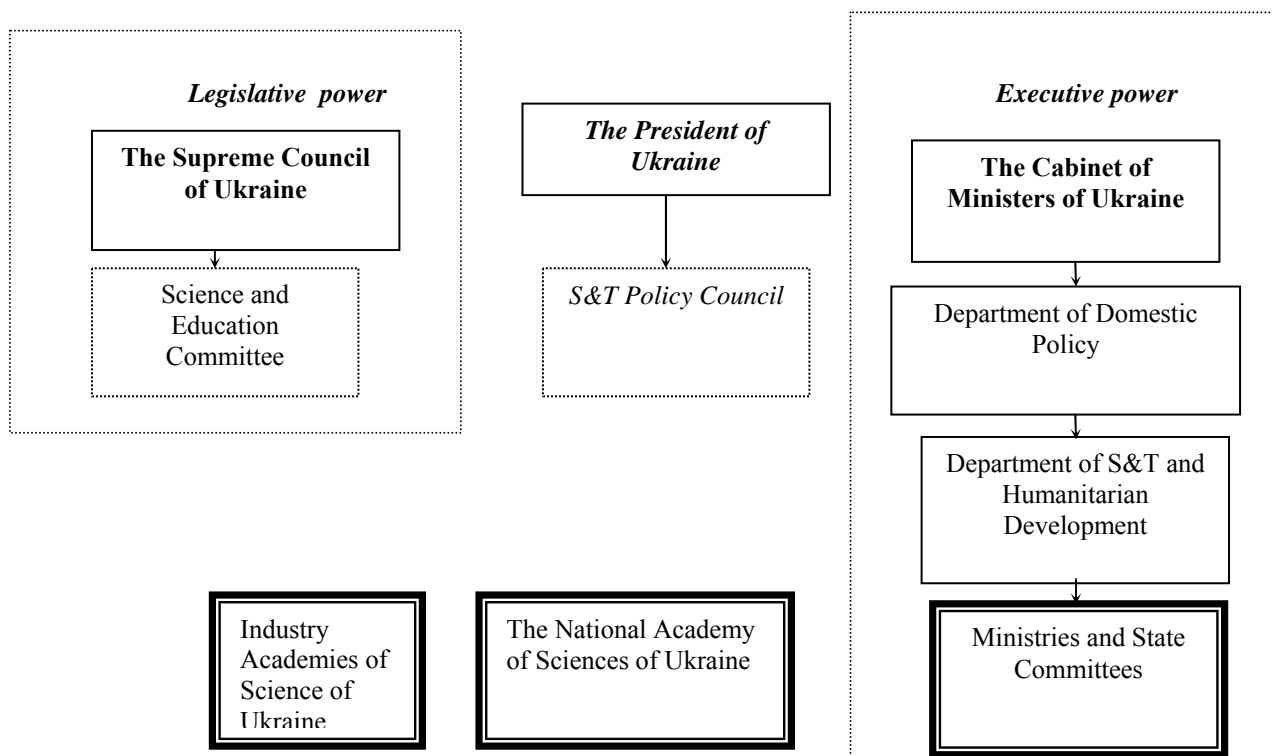
in Ukraine. The gravest one is to ensure authenticity and comparability of information used. Some statistical forms contain surplus data from international statistics' standpoint. On the other hand, the data partially did not abide by international standards.

It would be sensible to bring data standards to conformity with the OECD standards that the majority of the countries operate around the world. Thus to receive additional information and make specific estimations of achievements of any scientific establishment peer review procedure and special examinations can be applied. To ensure appropriate objectivity it would facilitate to bring in experts from foreign countries. Moreover, such practice is widely used throughout the European countries. In Czech Republic, for example, to appraise performance of the institutes of the Academy of Sciences in the middle of 1990-s, approximately 200 experts were involved from 22 countries. In any case, data officially published about performance of the national scientific system of Ukraine are far from accurate in displaying actual situation, which, in its turn, does not ensure reasonable decision-making.

Section 3 Science policy

3.1 General information. Organogram.

Representing scientific policy as an arrangement of actions to control process of formation and operation of research potential, one can assert that in Ukraine there are numerous "players" with different powers and capacities to influence decision-making process as to further development of scientific potential. In general terms the system of state administration is intended to make and pursue public science and technology policy (see picture 3.1).



Picture 1 S&T administration system

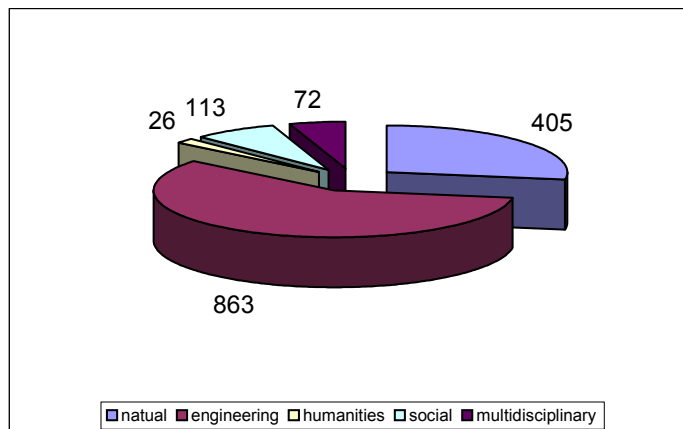
The Supreme Council of Ukraine (*Verkhovna Rada*) as the legislative branch of power implements public administration in the science and technology field; forms and approves the regulative framework wherein the science and technology system operates; defines basic principles and directions of public policy in the field of science and technology activity; approves priority directions of development of science and technologies as well as national programmes of science and technology development of Ukraine; executes other powers which according to Constitution of Ukraine are assigned to its jurisdiction. One of committees of Supreme Council is the Designated Committee of the Supreme Council responsible for education, science and innovations. Regardless constant changes in its personnel, the Committee prepares the projects of the relevant drafts and tend to protect interests of scientific community in the Parliament. Unfortunately, in many cases actual capacities of the Committee and the Supreme Council prove to be rather dwarfed. The executive power authorities hinder implementation of pertaining decisions by referring to objective difficulties. Some documents adopted by the Parliament are not implemented.

The *President of Ukraine* has his powers in administering science and technology activity. Specifically, the President determines the system of executive power authorities performing administration in the science and technology area in Ukraine; ensures control over establishment and operation of public administration system in science and technology area; executing his powers in science and technology area, establishes the advisory council responsible for science and

technology policy, that facilitates public policy making as regards development of science, determines priorities in science and technology area, develops strategies of science, technology and innovation development, considers suggestions as regards the effective use of funds of the State budget of Ukraine intended for development of science, technologies and innovations, as regards the improvement of structure of science administration, training and certification system. The S&T Policy Council has status of advisory authority for the President of Ukraine. However, the Council is performing extremely poorly. Last meeting of the board was held several years ago. The Cabinet of Ministers of Ukraine as a higher executive authority makes science and technology policy; gives to the Supreme Council of Ukraine proposals on priorities of science and engineering development and its logistical support; implements national science and technology programmes; approves the government (interdepartmental) science and technology programmes according to the priorities of S&T development adopted by the Supreme Council of Ukraine.

In addition, every executive authority has a department responsible for administration of science and technology within its jurisdiction. Such departments are responsible for administering scientific and innovative activities and for the level of science and technology development of the pertaining industries. They determine directions S&T potential development, supervise and control activity of subordinate research organisations; take part in forming priorities of S&T development in Ukraine, state science and technology programmes and concluding government contracts; establish the programmes of science and technology development of the industries and organise their implementation; arrange development and production of competitive products based on the innovative technologies, equipment, materials, information provision; prepare proposals as regards improvement of economic mechanisms fostering S&T development in the industries; execute other powers according to the laws of Ukraine. Priority directions of S&T development and mechanisms of their implementation like state science and technology programmes that assume a central place, are considered below.

Diagram 8 Distribution of R&D organizations by research conducted in 2001



Distribution of science and technology organisations according to their basic activities is shown in diagram 8. It illustrates only those types of S&T activities into which relatively large number of organisations were involved. It should be noted that this diagram the pool of engineering science organisations includes organisations that do research in transportation and construction industries but does not include organisations engaged in architecture and special sciences. As it is seen, engineering sciences distinctly prevail in an organisational component of scientific potential of Ukraine.

Over last years new forms of S&T organisation are developing, in particular, three tehnoparks have been founded on the basis of leading institutes of the National Academy of Sciences. Pursuant to the plans of implementing the programme of coal industry development in Ukraine, yet another technopark has been established, wherein besides research establishments of the NAS several industry institutes and design bureaus will be included. State Foundation for Fundamental Research is becoming increasingly significant. The Foundation supports individual and collective research efforts of Ukrainian researchers. Overall expenditures of the Foundation exceeded UAH 9.000.000.000 in 2001. In 2001 the Foundation focused on funding the projects in which specialists from different science sectors take part. It is supposed to result in higher degree of integration of science and technology establishments. Yet it is necessary to note that such funding is insufficient. Funds allocated to the Foundation are insignificant in comparison with the state R&D funding.

3.2 Legislation in science and technology.

System of legislative acts and regulations regulating various social relations makes up the legal framework for science and technology activities in Ukraine. Political and legal aspects encouraging scientific activities and innovations are stated in the State Sovereignty Declaration of Ukraine of July 16. 1990. Pursuant to the Declaration, the entire economic and science and technology potential created in the territory of Ukraine constitutes the material basis of the state and is intended to

satisfy material and spiritual needs of citizens.

Ukraine independently implements financial, budgetary, fiscal, price, investment, science and technology as well as external economic policies, which is regulated by the Law of economic independence of August 3, 1992.

The Constitution of Ukraine, the law "On the fundamentals of public policy in the sphere of science and technology activities" of December 13, 1991, the law "On innovation activities", July 2002, the law "On science and technology activities", 1998 play central role in legal framework for the innovation activity. It defines basic provisions pertaining to the forms and techniques of regulating S&T development, use of science and technology outcomes to modernize production and satisfy needs of people, primary objectives, directions and principles of public science and technology policy, determines powers of public authorities, economic and legal guarantees of S&T potential development in Ukraine.

This Law is distinguished with the standards that ensure scientific validity of organisational and legal forms along with the most promising ways to accelerate science and technology progress. By this token determining and implementing priority directions of science and technology development became the most important element of public S&T policy. To formulate those one should proceed from the "Comprehensive forecast of socio-economic growth and science and technology development of national economy of Ukraine" as well as industries, the analysis carried out for various development scenarios, independent evaluation and public discussion.

To execute provisions of the Law of Ukraine "On public policy in the field of science and technology activity" the Cabinet of Ministers of Ukraine establishes science and technology programmes of various levels: national, state, international, industry or interdisciplinary, regional. The Cabinet also defines science and technology components of national, investment, social and other programmes, the order of forming, funding and implementation of which is established by certain arrangements.

According to the law organising R&D is purposed to concentrate efforts on priority directions of science and technology progress and solving acute socio-economic, scientific, engineering, environmental problems of development of Ukrainian industry on the basis of innovative technologies and materials with effective assistance rendered by the state to this process.

Preparation and implementation of the state science and technology programmes constitutes important form of public S&T policy implementation.

State science and technology programmes are to make up the system of coordinated innovation projects. Those need to commence with scientific research, be subsequently estimated and pass on to implementation and production. Appropriate tax and other benefits are legally ensured. In reality, as it was shown in Section 2.

the programme objectives remain declaratory - to attain those limited funds are allocated.

Legal status of the state science and technology programmes can be assigned to science and technology programmes that are implemented at the expense of legal entities after appropriate S&T evaluation.

Certainly, the Law "On the fundamentals of public policy in the field of science and technology activity" does not address all problems of innovative activity. Specifically, it does not establish certain measures in science development, producing and implementing innovations, mastering high-tech production and making competitive products.

Abovementioned issues along with numerous others are adjusted in other laws of Ukraine, that can be grouped as follows:

- a) legislation regulating diverse domestic economic relations and implementation of innovative activity in different economic, science and technology, informative and other activities;
- b) legislation intended to ensure structural, functional and environmental framework for innovation activity;
- c) acts of legislation, which determine the features of implementation of innovative activity on particular territories and economic areas;
- d) acts of legislation, that determine rights an author and contiguous and about the information provision;
- e) laws regulating external economic relations.

Among the acts of the first group it is necessary to identify above all things Law of Ukraine "On ownership" of February, 4 1991 p.

The law of Ukraine "On enterprises" of March, 27 1991 (with the subsequent amendments and supplements) states provisions pursuant to which the state is held responsible for ensuring favourable conditions for enterprises which implement advanced technologies, create new jobs, use labour of citizens who need social protection.

According to Law of Ukraine "On the enterprise" of February, 7 1991 (with the subsequent amendments and supplements) the state is to encourage economically means (special subsidies, tax benefits) of technology modernization, development of new products and services, grants purposeful credits and other assistance.

The law of Ukraine "On investment activity" of September, 18 1991 establishes the legal, economic and social framework for investments, ensures equal opportunities for agents of scientific activity and innovation process as regards implementation

and protection of their rights, facilitates effective investing into national economy on the basis of innovative technologies, international cooperation development. This law regulates, in particular, innovation activity as one of the forms of investment activities undertaken with the purpose to implement science and technology progress in manufacturing and social sphere. Innovation activity encompasses release and distribution of vanguard technologies, original inter-industry structural changes, implementation of the long-term science and technology programmes with the considerable payback period, funding of fundamental research to transform effectively productive forces, development and introduction of advanced technologies in order to improve social and economic situation.

Until 1999, the State Innovation Fund played essential role in development of scientific innovative activity. The Fund was founded following the resolution of the Cabinet of Ministers of Ukraine of February, 12 1992. Its purpose was to provide financial, material and technical support for regional and other science and technology programmes, innovation activity of enterprises and organisations, apply scientific developments in the industry, create “now-how”, expand the application of advanced technologies, develop competitive products and so forth. It was supposed that such fund would assist in further progress of science. To that end, the sources of the accrual of its funds were established. The sources were budgetary appropriations allocated for scientific research, raising funds of enterprises, associations, organisations at the rate of 1% of sales, free-will contributions of legal entities and natural persons concerned. In reality, the Fund's activity was the utmost failure. Allocations of enterprises became its practically sole source of funding. To solve financial problems the government almost every year misused the funds (for example, to pay salary arrears to the workers on budget payroll), explaining it with higher goals. Lion's share of credits of the Fund was not returned in time, and today the prospects to return those look ethereal. In simpler terms, the bulk of money was plundered as a result of application of various money laundering schemes. In 1999, the State Innovation Fund was replaced with the State Innovation Company that was established following the government's resolution.

The State Fund of Fundamental Studies of Ukraine facilitates research activities. The Fund pools the funds of the state budget, voluntarily payments of legal entities and natural persons and other special-purpose contributions. The funds are set aside for funding of research and design works. The Fund supplies conducting research by scientific establishments and organisations, higher educational establishments and particular scientists in the areas of humanities, environmental and engineering sciences. In particular, the Fund provides purposeful funding for fundamental developments and explorations, initiative research selected on competitive bases following independent evaluation, facilitates establishment of scientific centres, research equipment and other tools intended for advancement of fundamental research, renders support to the centres of science and technology

information, scientific libraries, takes part in funding scientific research of young scientists, facilitates international cooperation in this sphere, funds conferences, seminars, workshops, congresses, symposia in the area of fundamental studies with participation of scientists of Ukraine.

The Cabinet of Ministers of Ukraine, executive authorities, in particular, the Ministry of Education and Science of Ukraine are held responsible for the organisation of scientific and innovative activities in Ukraine. Over the years of independence, the Ministry was undergoing several reorganisations, which, for sure, did not add to its performance.

The tax legislation is important for high performance scientific and innovative activities. Legal regulation of tax framework is implemented as general and special laws. For instance, overall legal frameworks as regards establishment of privileges and indemnifications are contained in the Law of Ukraine "On the fundamentals of public science and technology policy". In particular, pursuant to the law, the income of enterprises and organisations, which they gain from implementation of the science and technology programmes and programmes which are financed from budget funds, are exempt from taxation.

The law of Ukraine "On taxation of incomes of enterprises and organisations" determines that the income of research enterprises is taxed 50% of the tax rate for other Ukrainian enterprises.

State Fund of Fundamental Studies, innovation foundations and other registered state innovation structures are exempt from taxes, and enterprises, establishments and organisations that made free-will payments into these funds pay taxes reduced by certain amount.

Incomes of joint ventures created on the territory of Ukraine with foreign investments in the areas of manufacturing, agriculture, provided the share of an investor in authorized capital stock totals 30%, enterprises owned by such investors along with profits they gain from money transfers abroad, were subject to taxation at the rate 15% for a long time, unless other was provided for by international agreements with Ukraine. Only in 2001 the proper changes were introduced into the legislation, that put foreign enterprises on a par with Ukrainian companies.

According to the law of Ukraine "On foreign investments" of March, 13 1992 (with further amendments and supplements) enterprises with foreign investments and share of Ukrainian capital, except for the enterprises in wholesale and retail business and agent business, were exempt from income tax for 5 years from the day of their first reported income and further on they pay 50%. Commodities, works, services of the said enterprises were exempt from value added tax for 5 years beginning the date of enterprise official registration to the amount of currency deductions from own science and technology activity to the State

Exchange Fund of Ukraine and exchange funds of local responsible authorities. In 2000 the alterations were introduced to this law that the said privileges were actually reduced to zilch, but presently the laws that will meet investors' interests are being developed.

The Decree of the Cabinet of Ministers of Ukraine "On the system of exchange regulation" of February, 19 1993 ensures state's financial and credit inputs aimed at establishing conditions for effective implementation of science and technology activities. This decree was not always abided by. During several years, Ukraine did not made required payments to the budget of the INTAS programme. It resulted in that the implementation of many scientific projects was jeopardized. Last severe misunderstanding arose at the end of 2002 when government did not pay to STCU's budget. The conflict was settled only after higher public officials intervened.

The first steps have been made to the structural-functional provisions to innovative sphere. Thus, the President of Ukraine L. Kuchma sustained the initiative of establishing the network of technoparks and other innovation structures in Ukraine, which are legal and organisational entities seeking to support innovations and produce knowledge-intensive products (the Decree of the President of Ukraine of January, 23 1996 "Establishment of technoparks and innovation structures of other types"). The range of appropriate directives was adopted: the decree "On establishing and regulating technoparks and innovation structures of other types" (of May, 22 1996 № 549) and the decree "On interdepartmental Council of coordination of activity as regards establishing and regulating technoparks and innovation structures of other types" (of April, 29 1996 № 471).

Regulations determining the features of implementation thereof on particular territories and in economic zones are assigned an important place in the legislation system pertaining scientific and innovative activities.

According to the law of Ukraine "On the fundamentals of establishment and operation of special (free) economic zones" of October, 3 1992 (with amendments and modifications introduced in 1996. 1998 and 2001), the primary objectives of establishment of these zones are to attract and encourage foreign investments, with foreign investors involved build up export of goods and services, supplies to the domestic market of high-quality products and services, implement new technologies, market methods of management, develop market infrastructure, improve the use of natural and labour resources, and boost socio-economic growth. This law also determines types of special (free) economic zones, in particular technology parks, technopolices, complex production zones, expert, transit zones and the like.

Within the legislation framework, regulating innovation activity there is a range of regulations, which determine contiguous rights and copyrights. Thus, the law of Ukraine "On copyright and contiguous rights" of December, 23 1993 ensures

protection of the individual rights, their assignees pertaining to the receiving and use of works of science, literature, arts, as well as the rights of authors, phonogram makers and broadcasting organisations.

Standards in legal protection of copyright and contiguous rights are essential. In this area there have been adopted the laws of Ukraine "On the protection of rights to marks of goods and services", "On the protection of rights to inventions and valuable models", "On the protection of rights to the industrial prototypes". They guarantee to the authors of marks for products and services, inventions, valuable models, samples and encourage them to take part in the innovation activities .

Information provision is significant in the innovation process considerable. According to law of Ukraine "On information" of October, 2 1992 science and technology information is considered one of the basic information activities. The state is held responsible for facilitating establishment, operation and development of the information systems, databanks and databases.

The law of Ukraine "On science and technology information" of June, 25 1993 defines the legal principles of receiving and use of science and technology information, establishment of the national information system which is to be formed on the basis of sources domestic and foreign sources; receiving, processing, saving, distribution and use of the information produced by legal entities and natural persons in the process of research, technology development, production and design works.

Most likely, other legal fields include the standards of scientific and innovation activities, in particular on standardization and certification, licensing, auditing, environmental legislation – the whole range of Ukrainian laws from "On protection of natural environment" and "On protection of atmospheric air" to privatization legislation and legislation about securities and the suchlike.

Elaboration of legislation has obviously taken up traditional pattern: differential legal norms including standards on innovations were adopted in the beginning and then comprehensive legal regulations were developed (when quantity converts into quality).

Several important conclusions can be derived from this section.

- Firstly, the legislation in science and technology area is quite developed. In terms of number of laws, Ukraine goes abreast with its neighbouring countries.
- Secondly, not all of these laws are the direct action laws, which brings about the necessity to adopt numerous regulatory bylaws, which do not always comply with the idea of legitimacy and establish regulatory environment favourable for bureaucracy.

- Thirdly, implementation of laws is not always an easy process. After all, there is a lot of powers that would try to use privileges intended for scientific and innovative organisations for their benefit. It occurs whilst privileges are granted to tehnoparks in particular. The examples of such gerrymander are plentiful, but relatively few of them are brought to court.

Fourthly, in spite of certain legal procedures, the laws are adopted in rather disorganized manner, every now and then they address somewhat narrow issues. It proves not only insufficient qualification of people's deputies, but this, in our view, provides evidence on the efforts to lobby specific interests of particular groups, companies and regions. For example, it is the case with laws on special economic zones, amendments to the law on tehnoparks and suchlike.

3.3 Planning and co-operation with government

Transition to the market economy requires from Ukrainian government to apply novel approaches to co-operation in science and technology area. Taking into account the everlasting shortage of budgetary funds, development of science and plans of industrial implementation of scientific achievements are to be realized using national priorities. Ukraine having one of the biggest number of researchers in the world, is developing up to now without the wide application of scientific research results.

State science and technology programmes are the basic tool of implementation of priorities of S&T development. In Ukraine, the state science and technology programmes break down into:

- *national programmes;*
- *state (interdepartmental) programmes;*
- *industry (diversified) programmes;*
- *regional (territorial) programmes.*

Pertaining parts of the national of economic, social, cultural development and environmental protection programmes have also held the status of the state (interdepartmental) science and technology programmes.

The state science and technology programmes are founded by the Ministry of Education and Science on the basis of dedicated projects and programmes which are selected on competitive bases.

Among priorities of S&T development (for the period until 2006) along which the state S&T programs are implemented are as follows:

- **Fundamental studies on most urgent issues of natural, social sciences and humanities;**

- **Issues of demography policy, human potential development, formation of civil society;**
- **Environment preservation and sustainable development;**
- **Innovation biotechnologies, diagnosis and treatment techniques for widespread diseases;**
- **New information technologies and computer facilities;**
- **New technologies and alternative technologies in power engineering, industry and agriculture;**
- **New materials and substances**

Alternative technologies. The range of the high-tech developments of this dimension made over the last years in Ukraine, provided they are implemented large-scale can produce a substantial economic effect and promote competitiveness of domestic products. These are, in particular, technology of incineration of ash-rich low-grade coal in a circulatory boiling layer, breakthrough gas-fuel equipment. Taking into account the limited resources of fuel and energy complex, these scientific achievements are urgent in Ukraine in view of its effective operation and positive influence on national economy. Numerous developments made by scientists of the country are aimed at achieving emission-proof coal mining and use of effective techniques in fighting unpredicted discharges of coal, rocks and gas. Similarly, high-performance coal mining from thin and inclined beds with applying the automated complexes would be an advanced technology of the future. The complexes of a new generation will facilitate 3-5 times increase of labour efficiency and growth of mining capacity from thin and inclined beds. This, accordingly, will ensure profitability of mines. Scientists of the NAS of Ukraine implemented a range of effective projects aimed at fuel saving in manufacturing and public utilities. Thus, heating of industrial furnaces by means of flat-flame gas-rings, that ensure more effective heat exchange, allows to decrease the fuel consumption by 15-20% and hazardous emissions two times. Module stream recuperators of radiation and convective types have been developed to utilise heat of waste gases of industrial furnaces by 20-30%. It will cut costs of natural gas needed to heat furnaces. This will facilitate reduction of energy dependence of Ukraine.

Owing to the scarceness of energy resources alternative energy sources are recognized as the one of the top priorities in the developed world. Such research and implementation of findings nurtured in Ukraine. The systems of complex utilization of thermal waters, geothermal heating supply, annual heating and cold supplies with the seasonal accumulator of solar energy, seasonal accumulation of heat, use of heating from incineration of solid residential wastes have already been developed. All these developments seek to improve power supply of particular regions of the country, its centres and villages, i.e. to establish decentralized system of power supply connected with plentiful sources of natural energy - wind, sun, water and the like. Thus, new technologies of accumulation of solar energy with utilizing reaction of methane conversion enable better accumulation of such energy due to 20-25 percent increase of heating value of natural gas.

New materials and products. Over past years rating of achievements of Ukrainian scientists is growing in the field of nanotechnologies. The technologies enable constructing of objects capable of introducing drastic changes into production processes, improving radically properties of materials and increasing productivity of devices and equipment with molecular precision.. New materials with fundamentally new properties and outstanding characteristics are developed by means of the nanotechnologies. Fine-grained materials the sintered barium titanate of relative density 99.9% and grain size of 0.3 mcm was obtained for the first time in the world practice in the institutes of the NAS of Ukraine by means of the nanotechnologies. Parameters like these enable high prospects for ceramics to miniaturize multilayer condensers. By forming specific graphite-like nanostructure, the possibility was proved of obtaining super hard carbon films, which are to be promising material to be applied in the friction units of recording and reading equipment.

Such developments of Ukrainian scientists as a semiconductor scintillator of the new type for high-speed x-ray introsopes, tomographs, dosimeters with the high dosage capacity, are privileged and promising. In the process of chemical sciences advance, new methods of obtaining nano-composites are developed based on electroconductive polymers. The possibility to obtain matrix electroconductive polymeric anticorrosion coatings electrochemically was established. In general terms, constructional and composite materials are increasingly becoming a priority in the material basis for manufacturing. Application of new technological means to modify scandium alloys based on aluminium will facilitate weaker dependence of Ukraine on strategically significant metal imports. On the whole, for the national economy to grow and renew on the basis of innovation model it is essential to use the results of domestic scientific research intended for the development of scarce import replacing substances and materials.

Ukraine has high potential as regards development of organic luminescent materials with new properties having diversified applications along with advanced technologies of production using raw material available. The programme of making of basaltic fibres, fabrics and composites on basis thereof, is no less topical. Application of these materials will enable large-scale manufacturing of basaltic continuous fibres and products, by means which Ukraine can dispose of the deficit of wood, metal, fibreglass as well as remove carcinogenic earth-flax completely. Producing high-quality, heat-resistant and high-strength materials is important engineering prerequisite for making new competitive products, to be offered at mass market and sold in foreign and domestic markets. Aircrafts TU-334 and An-70 is typical for, gas-turbine power-station EG-1000-1000. new models of diesel cars, minibuses, diesel engines and many products of easy and other industries of industry, that is commodities of consumer purpose, that are in demand of population are distinguished with reliability of such new products.

Biotechnologies. In this priority technology direction Ukraine has promising developments. Owing to the fundamental studies in biotechnology as well as

development and implementation of the findings obtained the new medicines and biologically active substances were received. For instance, the antineoplastic medicine "Mebioron" has already been tested in clinical conditions. It will be necessary further to focus efforts to secure market success of these medications.

Considerable attentions of Ukrainian scientists and specifically scientists of the NAS, is drawn to priority scientific developments needed by the agrarian complex of Ukraine. In particular, such developments are in the limelight as acclimatization of plants, radiobiology, hydrobiology, biology space and gravitation, rational use of resources of living nature, environment, and biodiversity. Development and implementation of new biotechnologies offer the improved diagnostic methods in medical treatment of various human diseases; new varieties of high-quality and high-yield winter wheat, ryes, corn, triticale, soy, some sorts of fruit, forage, spice, vegetable and floral cultures. Viability and productivity of widespread sorts of agricultural plants expands owing to biotechnologies.

On the whole, research in biotechnologies possess high economic potential: over first two years of implementation 25% increase of the capital invested is anticipated and 50% in the years to come.

3.4 Technologies of Defence Industrial Complex

One of basic ways of Ukraine's economic growth is the use of unique innovation potential of its defence industrial complex (DIC). The holders of such potential are the experts from numerous research institutes and design bureaus. World famous domestic scientific schools presented in DIC are an exceptional intellectual resource which the state is to involve effectively in economic growth.

Amalgamation of scientific potential of the country with its DIC's capacities, selection of scientifically valid priorities of technological development of the DIC, focusing resources in priority directions of development are the basic principles of reforming Ukrainian defence industrial complex to facilitate transforming it into high-tech and science-intensive industry.

Regardless insufficient budgetary funding of the industry, owing to the balanced foreign economic activities and the use of alternative funding sources, enterprises and establishments of DIC Ukraine managed not only to preserve but also to develop particular directions critical for development of high-tech products virtually without any public investments. Limited with solely off-budget investments, modern project and design technologies were implemented and certain outstanding technology cycles were developed.

Works are being carried out to preserve existing and cultivate advanced S&T and production potentials that are critical to develop competitive special technologies and equipment. Major activities in this direction are as follows:

- information technologies;

- technology of millimetre range of waves active and passive (including thermal);
- optoelectronic systems of visible, short and long -ranges;
- radiolocation systems of different frequency ranges;
- rocket technologies;
- aviation technologies and the like.

The majority of DIC's enterprises implementing the said directions already invest their own funds in the applied science and new developments within the scope of diversification programmes. Among the examples are OJSC Motor-Sich, Design Bureau *Progress*, Central Design Bureau *Arsenal*, Design Bureau *Luch*, Research institute *Kvant-Radiolocation* etc. Under new conditions science and technology capacities are created anew in fact, and some of those are truly of the world level. However, there are already negative trends in DIC development typical for civil economy sectors. These are depletion of the pool of specialists, functional depreciation of unique equipment, slowing down pace of developments, freeze of R&D due to the insufficient funding. An actual gap between funding of particular technology development directions of Ukraine and leading economies can be measured in several technology generations.

Under such conditions, it is necessary to be more responsible in developing the cycles of development and production of science-intensive military (including defence) technologies closed within the borders of one country. Concentration of resources within scientifically sound directions of technology growth is needed, which is able to ensure a substantial increase in level of science-intensive domestic defensive products. Certainly, under such conditions it is necessary to have reasonably limited number of priorities of the technology development in that area.

Priority S&T works to be publicly funded in scarce resources environment are to be those critical for development of several types of armaments which the state is enforced to develop, using its own resources and abiding by the requirements of national security and defence. It is thus expedient to spend public funds to support only the technologies which cannot thrive on private investments including foreign foreign.

Basic motive forces of Soviet approach to organise scientific and experimental activities evaporated, however institutions that promoted such approach are changing very leisurely. There are discrepancies in the ways how science and education develop with those of community development. It certainly delays the switch to innovation way of development. One of approaches to resolve such problem is to enable the government to make political decisions within bounds of the concerted strategy of public transformation, proclaimed course towards the

innovative economy development. To accomplish such a task in other transitional economies the concept of “learning government” is increasingly used over the last years. This concept enables to solve the problem of concordance of approaches to understanding and use of instruments of transformation during transition from totalitarian regime to democratic one. A path towards the open government is paved with learning. In order to ensure the processes of community transformation via “learning government”, it is necessary to carry out the pertaining research and analyse the character of changes in organisation and filling of the education and science system. This concept combines logically with the concept of community innovative development. In this context the following tasks of co-ordination science and technology activities and education seem to be completely justified:

- continuous stating and clarification of aims of science and education development as regards priorities of community transformation;
- development and implementation of innovative development strategy;
- making models for managing changes and schemes of co-operation of science, education, and innovation development;
- organisation of consultations with public, public discussions of strategy;
- establishment of legal framework for the markets of educational and intellectual services.

Section 4 Funding of science and technology activities.

4.1 National R&D spending

Assignations on research and developments in the fixed prices of 1991 decreased from UAH 5331.1 million in 1991 to UAH 2132.9 million in 2001. It means that the real R&D expenditures accounted to only 40% of 1991 level. Several important issues are thus to be addressed.

Firstly, R&D expenditures were dropping down over the whole 1990-s, except for 1998 when the expenditures grew from UAH 1877.9 million to UAH 1969.3 million (in the fixed prices for 1991) and resumed slow climbing in 2000-2002.

Secondly, the rates of a R&D decrease in 1990-s exceeded the rates that the Ukrainian GDP was decreasing. The problem consists in that the expenses of R&D organisations for lease payments, electricity and utility payments grew at higher rates than other costs. Wages share in R&D expenditures exceeded 50% in some sectors. At the same time expenses to upgrade equipment, purchase new tools and reagents did not exceed 3%-5%.

Table 1 Dynamics of R&D expenditures in Ukraine (% of GDP)

	1994	1995	1996	1999	2000	2001	2002
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Actual science expenditures from state budget	0,41	0,57	0,31	0,22	0,28	0,37	0,31
Overall R&D expenditures	1,4	1,16	1,21	1,22	1,14	1,19	1,13

Part of the budgetary funding goes down constantly, as it is seen from table 4.1. Achievement of Ukrainian science can be accounted for by the reserve accumulated over previous years. One more important matter is to be considered: the number of science and technology personnel was shrinking slower than general R&D expenditures, i.e. the "human load" that would burden the money remaining in R&D was ever-growing. To some extent, it was offset by means of internal redistribution of funds and growing share of salaries in general R&D expenditures. Yet substantial degeneration of material and technical component of science and technology potential along with the declining capacities for experiments and developments was the price for such "social adaptation" policy. Depreciation of material basis for conducting research took place at slower pace than research personnel was reducing. Such process in the nearest future would ultimately convert considerable part of research establishments in the fashion of welfare institutions: engineers and researchers would have relatively small remunerations yet combined with the inability to conduct real scientific research.

Table 2 Annual expenditures per one researcher

Ukraine	3,5
Russia	8,0
Brazil	48
South Korea	92
France	174
USA	195
Japan	142

Establishment of favourable conditions for development and use of creative potential of researchers is the most appropriate and shortest way to introduce positive changes in S&T and innovation areas. Owing to conditions that would comply with the world standards, scientists can be preserved and at least a part of those who went abroad can be encouraged to return. In table 2 data are seen on annual science expenditures per one researcher. The level of relative expenditures established in Ukraine is obviously incapable to ensure efficient research works because the funds are barely suffice for inadequate wages and utility payments.

4.2 Government and non-government R&D expenditures

In accordance to the law, science and technology expenditures are secured expenditure items of the State Budget of Ukraine. Scientific studies are funded from the budget pursuant to the basic and programme-oriented procedures. Basic funding is made available to carry out:

- fundamental scientific research ;

- research in the most essential for the state directions, including national security and defence R&D;
- development of S&T infrastructure;
- preservation of scientific objects of national property;
- research personnel training.

The list of scientific institutions and higher educational establishments to which the budgetary funding is made available to carry out S&T activities is approved by the Cabinet of Ministers of Ukraine.

Budgetary expenditures to carry out R&D and innovation activities dropped down lately both because of a gap between the rates of growth of expenditures by such budget items and nominal rates of GDP growth and due to the deficient implementation of government obligations before science and technology area as well. Thus, in 1998 the government defrayed R&D and innovation expenditures only to the amount of 50% from the planned level and 77% in 1999. Even in years of rapid economic growth (2000-2002) the level of R&D allocations from the state budget was below 100%.

By the funding sources the "clients of Ukraine" held first place in 2001. Usually publicly or privately owned industrial companies are named so. The Budget continues to play essential part (see diagram 10). At the same time, it can be noted that for publicly-owned enterprises the funds of "clients of Ukraine" and funds from the state Budget can partly overlap, which results in double calculations.

Structural and evolutionary features of R&D funding in Ukraine, and specifically implementing R&D, the parts of public and private sector virtually did not change over 1996-2001: private sector's share grew by 1.3% whereas that of public sector remained the same. R&D area remains in the state's care for the most part. Ukrainian entrepreneurs are not yet interested in forming their own scientific base (that is scientific departments of private firms), preferring to use services of state organisations (mainly former sector of industry science), thus a part of such orders is growing steadily.

The role of sectors as regards the sources of funds changed to a much greater extent: the role of the state fell down by 11.6% by contrast with the business sector and foreign investments that rose by 8.1% and 3.4% accordingly. There is a substantial increase in foreign funding: by 3.7% over the entire period.

R&D in a private sector are yet funded from private sources and primarily focused on implementation of developments. Part of the external funding (bank loans, dedicated funds etc.) amounts to several percent only. Such industries as black metallurgy, gas and oil extracting industry, machine building enjoy the topmost funding. The last secures relatively large part of R&D funding in the overall

funding of research and developments owing to the support from the Ministry of Industrial Policy in the first place.

The cutback of the state spending took place mainly due to the reduction of amounts of the state funding to maintain publicly-owned S&T organisations. If for 1996-2000 reduction made up 11.9%, over 2000-2001 an increase was 2.6%. Domestic expenditures growth became obvious in the increase of expenditures of industry sector. Thus, the positive changes in the structure of funding indeed happened, however in a very insignificant scale.

4.3 Structure of R&D funding.

Analysing official data over the last several years a conclusion can be made that overall science expenditures in 2001 (overall amount of science and technology funding) in Ukraine as against 2000 on the whole grew by 10.8 % (UAH 2432.5 million in current prices).

Table 3. Structure of funding sources for R&D organisations, 2000 p., %

Sources of funding	Ministry of Industrial Policy	Ministry of Agrarian Policy	Ministry of Healthcare	Ministry of Fuel and Energy	Ministry of Education and Science	Academy of Medical Sciences
Budgetary funding	16,9	60,8	71,9	15,7	68,5	84,5
Ukrainian public science foundations	1,3	0,6	1,7	3,0	1,3	2,0
Foreign science foundations	2,4	0	0	1,7	6,8	0
Contracts with public enterprises	34,6	9,6	14,1	62,0	9,2	6,4
Contracts with private enterprises	27,9	2,8	5,8	7,6	12,0	1,2
Leasing premises	8,8	2,6	1,7	5,8	1,0	1,4
Other sources	8,1	23,6	5,6	4,4	1,3	1,7

Here the academic sector and higher education sector are funded from the state budget mainly, whereas R&D organisations that associated with industry sectors are funded subject to the agreements with customers. Here in the case of industry sector a primary the foreign investments play primary role.

In 2001 the trend was finally changed, when into the science of industry sector (it was typical for 1999—2000) the majority of budgetary expenses were directed to. At the moment, 46.9% of budgetary funds are assigned to the academic sector, which complies with view of state support for science and technology activities.

The analysis also shows that institutes of the Ministry of Agrarian Policy, the Ministry of Healthcare and the Academy of Medical Sciences do not have grants from foreign scientific funds. Comparisons of data for 1995 and 2000 show certain changes in the structure of sources of funding of industry institutes. For instance, part of such sources as budget and national scientific funds went down in the institutes of the Ministry of Industrial Policy, the number of contracts with state enterprises somewhat decreased whereas increased the number of contracts with private enterprises, premises leasing and other sources was multiplied. On the whole, the data on distributing funds among scientific institutions of different subordination is shown in table 4.

4.4 Regional aspect

Regional science and technology activities are predominantly funded within the scope of regional science and technology programmes. The Cabinet of Ministers of Ukraine agrees on systems of science and technology programmes of regional scale, whose arrangement procedures, funding and implementation is determined by special regulations.

Over two thirds of general amount of S&T funding in Ukraine are traditionally concentrated in four economically developed country's regions.

4.4.1 Capital region.

Overall amount of science and technology funding in a capital region (Kiev and Kiev oblast) significantly increased both in absolute and relative terms and remained the largest as against other regions in 2001. The amount totalled to UAH 987.6 million or 40.6% of general amount of funds nationwide. UAH 420.5 million was assigned from the state budget (it amounts to 42.6 % of S&T assignments in the region and 55.9 % of all assignments from the state R&D budget in Ukraine). Funds received from Ukrainian clients amounted to UAH 231.6 million (23.4 % of current year R&D assignments in the region and 29.3 % of the overall current year assignments from domestic clients nationwide). Under foreign contracts, UAH 244.3 million was invested (24.7% of all investments in the region and 44.0% of foreign investments nationwide).

4.4.2 Kharkiv oblast

Overall amount of science and technology funding in the Kharkov region insignificantly increased in absolute terms (diminishing relatively) and made up UAH 401.6 million, i.e. 16.5 % from the overall science funding in Ukraine in 2001. The state budget assigned UAH 119.7 million, which is less than the previous year and amounted to 29.8% of all assignments in the region or 15.9 % of all budgetary R&D funds in Ukraine. Domestic investments amounted to UAH 166.0 million *en bloc* (41.3 % of all investments of the region and 21.0 % of all S&T investments that came from domestic customers nationwide). There was

UAH 80.57 million worth of investments (20.1% of all investments in the region and 14.5% of foreign investments nationwide).

4.4.3 Dnipropetrovsk region

Overall science and technology funding in the Dnipropetrovsk region amounted to UAH 188.7 million in 2001 (7.8 % of the amount nationwide). The state budget assigned UAH 43.1 million (22.8 % of current year R&D assignments in the region or 5.7 % of the overall state budget R&D assignments nationwide). Implementing research and developments, funded by domestic customers, amounted to nearly UAH 55.5 million (29.4 % of all science investments in the region and 7.0 % of domestic science investments). Owing to foreign contracts, UAH 50.5 million was invested (26.8% of all investments in a region and 9.1% of foreign investors nationwide).

4.4.4 Donetsk region

Overall science and technology funding in Donetsk region increased noticeably and amounted to UAH 143.6 million in 2001 (6.0% of the overall amount nationwide). The state budget funding thus totalled to UAH 21.8 million in the region (15.2 % of the current year R&D assignments in the region or 2.9 % of the overall state R&D budget). Domestic investments amounted to UAH 51.2 million (35.7 % of all current year S&T investments in the region and 6.5 % of all current year foreign investments nationwide). UAH 13.4 million was obtained in foreign investments (9.3% of all assignments in the region and 2.4% of foreign investments nationwide).

4.5 Funding by types of science and technology activity

Budgetary funding in Ukraine is distributed among the following sciences:

- **Engineering sciences**
- **Natural sciences**
- **Agricultural sciences**
- **Humanities**
- **Social sciences**

In 2001 to support *engineering sciences* the majority of funds was allocated, which is typical for the overall preceding period. Overall funding for engineering sciences made up UAH 1 692.9 million, or 69.6 % of the overall amount of science funding of Ukraine, which demonstrates falling of the overall funding of engineering sciences compared with 2000. Overall amount of the funds to support science in Ukraine made up UAH 1 556.9 million (64.0 %) in 2001. Per one researcher

specialising in the engineering sciences there was UAH 15.6 thousand of general amount of R&D funding.

Natural sciences are on the second place in terms of S&T funding. In 2001 the overall funding of natural sciences considerably grew and amounted to UAH 625.3 million (25.7 % of all funds intended for science in Ukraine).

The amount of funding provided for agricultural sciences in 2001 increased notably and made up UAH 115.0 million (4.7 % general amount of Ukrainian science funding).

In 2001 the general amount of R&D funding for *humanities* made up UAH 18.27 million (0.75 % of all funds allocated to science in Ukraine). The amounts of expenditures on science in per one researcher was UAH 7.0 thousand. In 2000 the general amount of R&D funding made up UAH 14.61 million (0.66 % all funds directed on science in Ukraine). The amounts of expenditures on science in a calculation on one performer R&D here were a UAH 9.3000.

The funds directed on implementation R&D in *social sciences* in 2001 notably increased and amounted to UAH 96.1 million (3.95% of general amount of funding of science and technology works nationwide). On the whole, it should be noted that relatively high wages in social sciences of Ukraine indicates on the need of society in these very studies whereas restricted number of organisations and researchers employed this sphere proves that public demand is not yet satisfied.

Section 5 Organisations and programmes

Public administration for science and technology organisations operating in Ukraine is implemented in a manner that do not violate their self-government in decision-making process and independence in scientific work. This is particularly true for academic establishments that account for the basic part of fundamental studies carried out in the country.

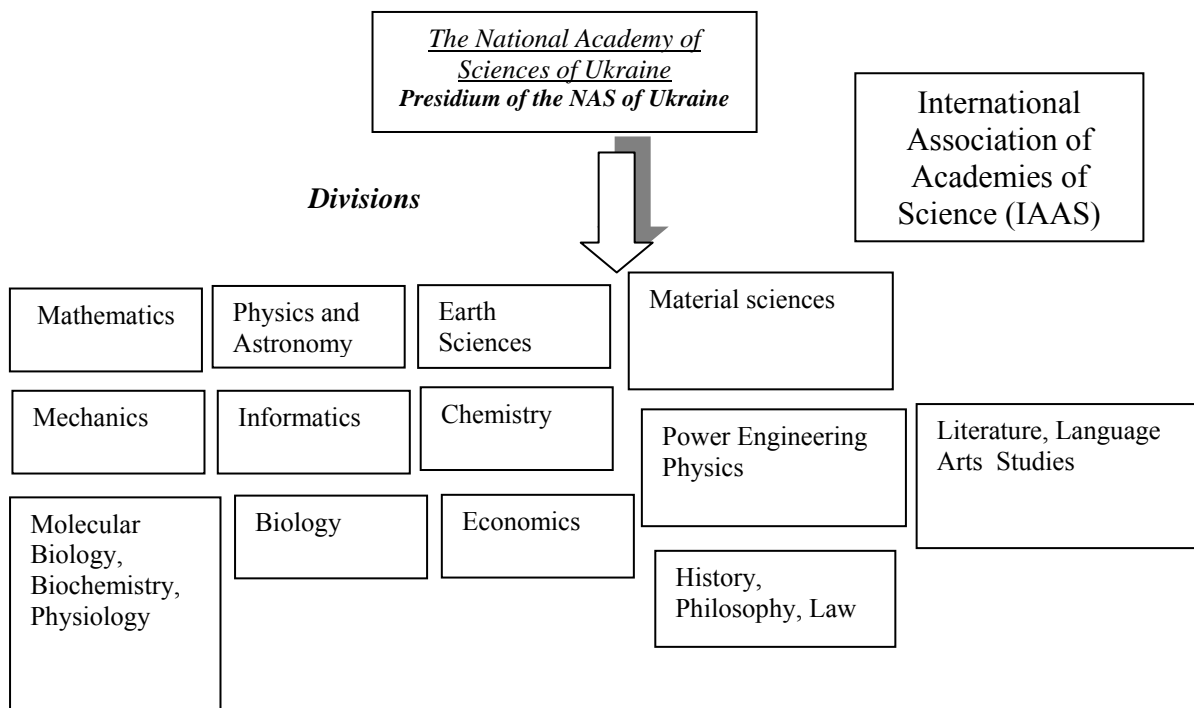
5.1 System of state Academies

Self-government of academies consists in independent determination of their research subject, structure, arranging their organisational, logistic, and personnel issues, implementation of international scientific communications. Academies execute the orders of public authorities on public policy making in the area of science and technologies, evaluate drafts of public resolutions and programmes.

Academies annually report to the Cabinet of Ministers of Ukraine about the results of their work and use of the funds distributed to them from Ukrainian S&T budget. The National Academy of Sciences of Ukraine is the higher research organisation of Ukraine that organises and carries out fundamental and applied research in the most important areas of natural and engineering sciences as well as humanities, coordinates implementation of fundamental studies in scientific establishments and

organisations, regardless whether they are public or private. The structure of the NAS of Ukraine is represented in picture 1. The Interdepartmental Council of Co-Ordination of Fundamental Studies in Ukraine was established at the National Academy of Sciences of Ukraine.

The National Academy of Sciences of Ukraine comprise research institutes with affiliated technology design organisations, research and manufacturing enterprises, educational establishments and other organisations of science.



Picture 1. Organisational chart of the National Academy of Sciences of Ukraine

The National Academy of Sciences of Ukraine pursues the following objectives:

- conducts, organises and co-ordinates fundamental research in the areas of natural history, humanities, social and engineering studies;
- is responsible within its jurisdiction for scientific policy-making in the areas of fundamental studies, specifically natural, social and engineering sciences and humanities;
- estimates the processes of social, science and technology and cultural development as well as environmental conditions in Ukraine, produces recommendations and advice on these issues;
- studies and generalises science achievements and assists to make the most effective use of these achievements for the benefit of development of Ukraine and satisfaction of political, cultural and socio-economic needs;

- unites scientists of the National Academy of Sciences of Ukraine, higher educational establishments and other research organisations in scientific councils, associations of the National Academy of Sciences of Ukraine.

The Academy provides scientific grounds to resolve vital national problems. Specifically, it has been developing *en masse* with the specialists of other institutions the Energy Strategy of Ukraine for the period until 2030 and further. Large-scale national monitoring of public opinion was conducted to cover the issues of the socio-economic and political development. With active participation of scientists of the Academy the foresight on the level of man-caused and natural safety systems available in Ukraine was developed and presented at the meeting of the State Security and Defence Council of Ukraine. In addition, efforts of some academic establishments are aimed at increasing effectiveness of the state system of monitoring of natural environment on the basis of cutting-edge information technologies, telecommunication systems and remote sensing of Earth. Existing problems with social and economic development of Ukraine largely determined further improvement of network of scientific establishments of the Academy. Specifically, among the newly established and reorganised institutions – The Institute of Physics of Mining Processes, the Institute of Coal Power Technologies, Institute of Demography and Social Research.

The Academy pays considerable attention to research support for basic industries. In particular, scientific principles are developed and the scheme of reusing of liquid slags is proposed whilst metal fusions are melted and treated. Such reengineering of technological processes of fusion production of cast-iron and steel can pay off for one year. An experimental unit of geothermal heat-and-power line *Sivaska-1*, first one in Ukraine, was installed in the Autonomous Republic of Crimea. Ordered by the agro-industrial complex of Ukraine new highly productive varieties of winter wheat *Columbia* and *Podolyanka* were developed.

The NAS of Ukraine instigates innovation activity of its institutions, that jointly with production facilities are implementing technological projects intended to develop new composite, polymeric and chemical materials, intellectual software-hardware means of recognition of linguistic signals as well as images, intensification of mine methane extraction and the like. Effective plants growth adjustors and first domestic pesticide were applied extensively in agriculture.

The Academy takes part in pursuing public policy at regional science and technology and innovative levels. The Advisory Council for prospective development of Ukrainian regions was established at the Presidium of the Academy as well as scientific centres in regions. There are such centres in the Western, Donetsk and North-Eastern research centres.

In 2001 with active participation of scientists of the Academy the large-scale experiment was launched to implement the Programme of science and technology development of the Donetsk region for the period until 2020. Similar programmes

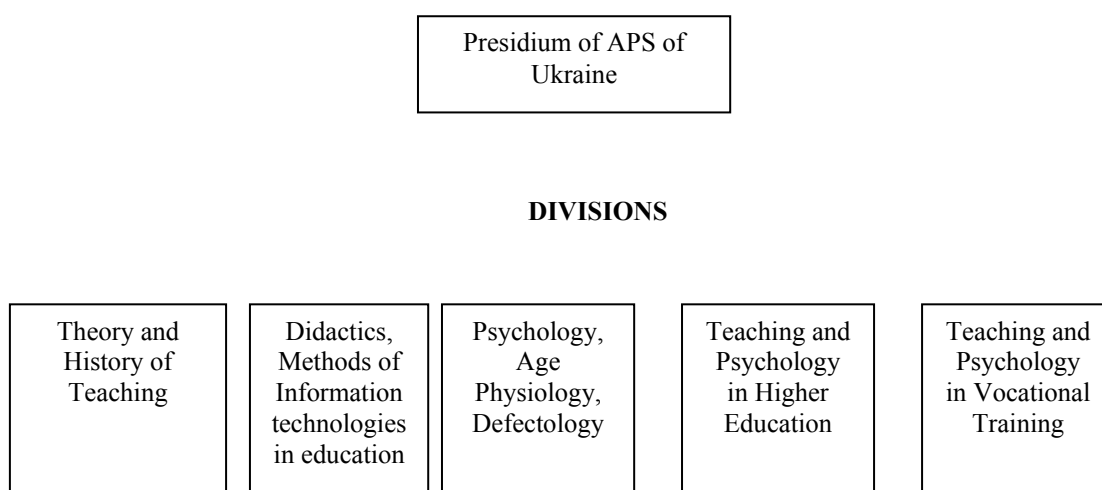
are being developed for Dnipropetrovsk, Zaporizhzhya that Dniprodzerzhinsk.

More than 100 co-operation agreements were concluded between research institutions of the NAS Ukraine and higher educational establishments in 2002. Over 1200 highly skilled researchers of the Academy are teaching in higher education establishments. The NAS of Ukraine provided helpful training facilities to the National Technical University of Ukraine "KPI" and Shevchenko Kiev National University.

Two more academies funded from the state budget are worth scrutinizing.

5.1.1 The Academy of Pedagogical Sciences

The Academy is public sector research organisation that is responsible for education, training and psychology. The Academy of Pedagogical Sciences of Ukraine was founded in accordance with the Decree of the President of Ukraine of March, 4 1992. The Academy comprises the academicians – members of the Academy, corresponding members, honorary and foreign members elected by the general assembly of the Academy, and all researchers work in its scientific establishments as well. The Academy is geared in its work to the Ministry of Education and Science of Ukraine (MOS), other of central and local executive authorities, the National Academy of Sciences and other academies.



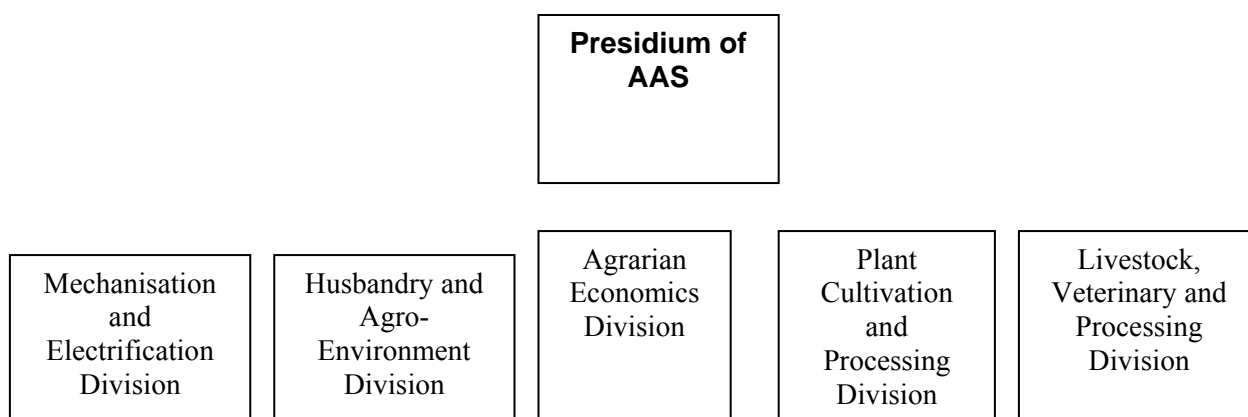
The Academy is a self-governed organisation which independently determines of their research subject, structure, arranging their organisational, logistic, and personnel issues, manages its international scientific communications.

The major objective of the Academy is to ensure methodological, theoretical and methodical development of the national education system. The Academy in every way facilitates the use and reestablishment of intellectual and cultural potential of Ukrainian people, priority development of humanities, strengthening human and national values and fosters proactive development of pedagogical science with taking into account the prospects of socio-economic development of Ukraine. The Academy pursues the following objectives:

- organises, co-ordinates and carries out research in the area of education, training, and psychology, informs community about their findings;
- determines basic directions of studies of its research institutions;
- estimates achievements of pedagogical and psychological sciences and studies the state of education in Ukraine, develops advice and recommendations on these issues;
- studies and summarizes achievements of pedagogical and psychological sciences, facilitates their implementation in pedagogical practices and community life;
- unites the scientists of the Academy, other research organisations, employees of higher educational establishments in scientific councils, associations, and alliances;
- organises and carries out professional development areas for the employees of scientific establishments, teachers of pedagogy, psychology of higher educational establishments, administrators, as well as employees of method services and establishments of post-graduate training, teachers, practical psychologists;

5.1.2 The Academy of Agrarian Sciences

The Ukrainian Academy of Agrarian Sciences was founded according to the Decree of the Council of Ministers of Ukraine of September, 22 1990. The Academy is a public research organisation responsible for scientific research for the agro-industrial complex of Ukraine. The Academy is a self-governed organisation which independently determines its research subject, structure, arranging their organisational, logistic, and personnel issues, manages its international scientific communications.



The Academy executes orders of public authorities to facilitate public S&T policy-making in agro-industrial complex and evaluates governmental resolutions and programmes together with the National Academy of sciences, Ministry for

Agrarian Policy, other responsible central and local executive authorities, determines basic directions of research, co-ordinates, organises and carries out research for the agro-industrial complex (AIC), facilitates their industrial implementation, provides training for research personnel. Basic directions of the Academy's research efforts are as follows:

- biotechnology studies;
- development of the optimal structure of agro-landscapes and adapted systems of land use capable of restoring the crop capacity of soils and their preservation;
- selection of agricultures and development of technologies of their cultivation, protection of plants;
- development of livestock farming production systems based on new selection and other technologies;
- development of livestock protection systems;
- development of new technologies and equipment to manufacture food products;
- economic studies in AIC, development of land relations in rural areas;
- development of methodological and organisational framework for agrarian industry.

5.1.3 The Ministry of Education and Science

The establishment that directly implements public policy by the sphere of science and technology, there is Department of education and science of Ukraine (MES of Ukraine). MES of Ukraine is the central executive authority, whose activities are governed and co-ordinated by the Cabinet of Ministers of Ukraine. MES of Ukraine is a major (leading) authority in the system of central authorities of executive power from providing of implementation of public policy in the field of education, activity and intellectual property scientific, science and technology, innovative. The structure of MES of Ukraine is shown in picture 2. Functions of MES of Ukraine in industry of science and technology encompass:

- participates in making and implementation of public policy in the fields of education, S&T, intellectual property, innovations;
- determines the prospects and priority directions of development in the fields of education, S&T, intellectual property, innovations;
- ensures integration of national education and science into global system with protecting national interests.

Further information about some structural subdivisions of the MES of Ukraine

S&T Department

Besides other tasks, the Department is responsible for filing procedures at central office units of the Ministry, as well as it supervises filing procedures at subordinated organisations.

International Cooperation Department:

1. Assists in co-operation with educational establishments, research facilities, NGOs, funds of other countries, presents the interests of Ukraine in the areas of education and science in the international relations.
2. Concludes and ensures implementation of international agreements in the areas of education and science, training, retraining and professional development of foreign citizens in Ukrainian educational establishments.
3. Co-ordinates work of ministries, departments and educational establishments in the areas of training of specialists for foreign countries.
4. Creates legal and economic framework to protect all forms of foreign economic activities of educational establishments, assists them in establishing direct links with foreign collaborators.

Economics and Social Development Department

Its basic objectives and functions in science and technology areas are as follows:

1. to participate in development of projects of the government programme of economic and social development of education and science, determination of amounts of the state budget funding for educational establishments in the area of responsibility of the Ministry;
2. agrees with the Ministry of Economics on the government contracts on S&T products, the most important developments intended for creation of innovative technologies and products;
3. assists in development of social framework for education and science, improvement of material and housing conditions of students, pupils, education and scientific employment conditions, organisation of public catering services, medical and household service.

S&T Development Department consists of the Office for S&T Development, Office for S&T Programmes and Office for Co-ordination of Scientific Research .

Office for S&T Development includes such units:

- Strategic Planning, Information and Analytical Provision Division

- Section assisting the Council of S&T Policy at the President of Ukraine and the Commission of the Cabinet of Ministers of Ukraine in the areas of science and technology development.
- Science and Technology Potential Monitoring Division
- Social Problems Monitoring Section

Office for S&T Programmes comprises such units:

- Science and Technology Programmes Division
- Division of Government Contracts and Critical Technologies
- Fundamental Studies Section
- Information Technologies Section

Office for Co-ordination of Scientific Research includes the following units:

- Division of Co-ordination of Scientific Research in Higher Educational Establishments
- Division of Co-ordination of Scientific Research in Affiliated Organisations

Innovation Development Department

Primary objectives of the Innovation Development Department are:

- to make and implement public policy in the fields of planning of strategic S&T development, innovation activity and technology transfer;
- to conduct complex analysis of conditions and forecast trends of development of national and global science and technologies, their links with educational, economic, social and defence areas;
- to develop proposals concerning priority directions of S&T development, priorities of innovation activities in Ukraine and mechanisms of their implementation;
- to provide organisational and procedural control for the system of information, analytical and forecasting framework of S&T development in Ukraine, innovations and technology transfer;
- to ensure operation of the national system of science and technology information;
- to develop legal framework of the science system, innovation activities and

transfer of technologies;

- to support integration processes in the field of science, technology and innovation activities with protecting national interests.

5.2 The National Space Agency

Space activities in Ukraine are carried out on the basis of the National Space Programme of Ukraine which is developed for five years and approved by the Supreme Council of Ukraine following the representation of the Cabinet of Ministers of Ukraine. National Space Agency of Ukraine jointly with central executive authorities and the National Academy of Sciences of Ukraine are responsible for the development of the National Space Programme of Ukraine based on the purpose and basic principles of space activities in Ukraine.

NATIONAL SPACE AGENCY OF UKRAINE	
Science and Technology Council	Director General
Board	
Deputies of the Director General	
Department of Space Programmes and Scientific Research	International Cooperation Department
Department of Space Complexes	Administrative Department
Department of Special Programmes	Department of Administration Service and Employment Policy
Department of Economics and Finance	Security Department
Department of Industrial Development	Legal Department
Department of Capital Construction	Inspection Department

Picture 5 Structure of the National Space Agency of Ukraine

First Ukrainian space programme operated in 1994-1997. Legal framework for space activity in Ukraine was developed and a number of laws were adopted for the government to regulate the activity. The first Programme was intended for preserving scientific and production potential in the space industry for the benefit national economy and security of the country as well as to facilitate Ukraine entering international markets of space services. Ukraine was admitted in reputed international agencies whose activities are related to either development or use of space. There are UN Committee on Peaceful Use of Space (COPUOS), World

Committee on Space Research (COSPAR), World Organisation for Satellite Research of Earth (CEOS), International Astronautic Federation (IAF). Framework agreements on co-operation in space research industry were signed with Russian Federation, the USA, China, Brazil, India and other countries, memorandums with 23 states.

The second Programme (1998 – 2002) was aimed at forming domestic market of space services, entering international space market with products and services of home origin (including rocket complexes and space vehicles, information from space, space system components), integration of Ukraine in international space community.

Effective presently the National Space Programme of Ukraine for 2003 – 2007 was adopted by the Supreme Council of Ukraine as the Law of Ukraine on October, 24 2002. Objectives of the third Programme are to implement unique state approach to space activity and effective use of S&T and production potentials to ensure the level of space activity complying with Ukraine's geopolitical and economic interests.

The Programme structure consists of dedicated space programmes:

1. Scientific Space Research.
2. Remote Sensing of Earth.
 - Satellite Systems of Telecommunications;
 - Development of the Ground Infrastructure of Navigation and Special Information Systems;
 - Space Complexes;
 - Development of Basic Units and Progressive Space Technologies;
 - Development of Research, Experiment, and Production Framework of the Industry.

Within the scope of the dedicated programme Scientific Space Research the priority is given to the research of Earth and circumterrestrial space, astronomic and astrophysics ground-space projects, research in the areas of space biology, physics of weightlessness. Establishment of the space monitoring system of “space weather” is stipulated, studies of “space garbage” problem solutions and asteroid danger, Lunar studies, small bodies, planets of the Planetary system.

The programme Remote Sensing of the Earth is basically focused on improving the efficiency in the use of space facilities to ensure the rational nature management and environmental and man-caused safety. The development of national *Sich* Earth

observation system and crisis-proof space monitoring system, upgrading of the ground software and hardware for data reception and processing in the interests of multiple users, are scheduled.

Development and operation of space-based *Sich Earth* observation system

- Development and operation of the space-based *Sich-1M* Earth-observation system (*Sich* Project)
- Development and operation of *MC-1-TK* spacecraft (*Microsatellite* project);
- Development of the space-based *Sich-2* optoelectronic observation system

Updating and use of ground software and hardware complexes

- Upgrading of the ground complex for reception, archiving, processing and dissemination of aerospace data (*Monitoring* Project)
- Development and use of the system for geo-information space provision;
- Development of operational information analytical centre (*Anticriz* project)
- Development of the Ukrainian network for utilization of aerospace observation data (*UMAKS* project)
- Optimization of aerospace remote sensing technologies to address the customers' needs (*Kosmokarta* project)

Dedicated programme the “Satellite systems of telecommunication” stipulates establishment of national space segment of the systems of satellite communication and broadcasting, and also development of the ground infrastructure of the satellite systems of communication, data communication and broadcast is foreseen.

Establishment of national space segment of the geostationary system of satellite communication and broadcasting

- establishment of space segment of the geostationary system satellite communication (*Libid – M* project);
- introduction of the state system of satellite broadcasting (*Libid-R* project);
- development of and international legal framework for national satellite networks (*Libid-GSO* project).

Development of the ground infrastructure of the satellite systems of communication, data communications and TV-radio broadcasting

- development of the state system of the satellite digital broadcasting and

integrated service (*TV Signal* project);

- establishment of the agency telecommunication network of the integrated service for space infrastructure (*Mereja-V* project).

The dedicated programme "Development of the Navigation and Special Ground Informative Systems Infrastructure" stipulates the establishment and implementation of the space navigation-temporal provision system for Ukraine, development of equipment and technologies of the operative information provision to ensure safety of stationary mobile and remote objects by means of space navigation and communication systems, establishment and implementation of the automated systems of collection and processing of geophysical information, control and analysis of space situations, ballistic provision of space vehicles flights.

- development of the ground infrastructure of the informative systems navigation and special establishment of the systems of the space navigation-sentinel providing of Ukraine (*Navigation* project);
- development of equipment and technologies of the operative information provision to ensure safety of stationary mobile and remote objects by means space navigation and communication systems of (*Safety* project);
- development of the automated system of collection and processing of geophysical information (*Geonetwork* project);
- development of the system to control and analyse space situations, ballistic provision of flights of the space vehicles, space systems being developed in Ukraine (*Observation* project);
- modernization of existing double-purpose functional centres, complexes and systems of the NSA for special information provision (*Modernizatsiya-S* project).

Dedicated programme the Space complexes stipulates subsequent development of launch vehicles, in particular, light carrier rockets, modernization of the ground infrastructure of space complexes, and also development of space vehicles for implementation of the pertaining projects.

Launch Vehicles

- Development of a new space rocket complex of light class *Cyclone-4* (*Cyclone-4* project);
- prolongation of the term of operation and re-establishment of *Cyclone* carrier rockets production (*Cyclone -TE* and *Cyclone* projects); carrier rocket *Zenith* (*Zenith – M* project);

- modernization of the carrier rocket *Dnipro* (*Dnipro* project).

Space vehicles

- Development and operation of space vehicle “Sich – 1M” (*KA Sich-1M* project);
- operation of microsatellite “MC–1–TK”
- development of the microsatellite “MC–2–8” (“KA– 2 *Sich* project).

Within the scope of the dedicated programme Development of Basic Units and Progressive Space Technologies space instrument-making industry, propulsion engineering, material science and other applied research will be subsequently developed for the benefit of rocket space technology progress.

Space instrument-making

Development of the advanced control systems for space vehicles and carrier rockets, measuring devices for carrier rockets and space vehicles (*Wave, RSA, Prylad, Vymir, Ros-1-1* projects).

Space propulsion engineering

Development of engines and propulsion systems to improve of energy/mass and manoeuvring capacities of a carrier rocket upper bus, boost blocks and space vehicles, expansion of their functional capacities and increase of their market value (*Polum`ya, Forsage, Ammiak, ERDU* projects).

Material science and technologies to develop space rocket systems

To develop innovative construction materials and improvement of existing ones, research to work out cutting-edge production technologies of materials with unique properties and import-replacing materials, overcome unfavourable effects of space conditions of (*Krona, Tehma, Technologist, Ros'* projects).

Research and Development

develop and implement new technology solutions, explore ways of attainment of advanced level of engineering and operation capacities of space vehicle units, to ensure high technological level of their production and reliability (“Torch”, *Progress, Stereo, Model, Energy, Compozit, Automation, Cluster* projects).

The NSA works actively to organise co-operation with EU member states along such framework directions:

- Development of joint projects on restructuring of space industry of the country within the framework of collaboration in the field of high

technologies and industrial conversion;

- Development of the Global navigation satellite system;
- Development of collaboration in space science, life sciences and micro gravitation sciences, exploration of the Earth from space;
- Exchange of information of the remote sensing of Earth in emergency situations;
- Furnishing control data on space situation and seismic supervisions;
- Joint use of information incoming from space vehicles of Ukraine and the EU member-states and exchange of information from space satellites;
- Joint use of the existing ground-based space infrastructure of Ukraine and the EU member-states;
- Participation in conferences, symposiums, seminars on space issues held under the EU's aegis.

5.2.1 Examples of international cooperation of Ukraine in space industry

Ukraine-Brazil

Joint Ukrainian-Brazilian project *Cyclone-4 — Alcantara* is anticipated to become mutually beneficial for Ukraine and Brazil. It was named after a carrier rocket from the "Cyclones" family which is developed in Ukraine, on the one hand, and Brazilian space centre "Alcantara", located on the coast of the Atlantic ocean, on the other. This area, by contrast with the space centres of other latitudes, enables launching onto orbit vehicles carrying greater payload. The Cabinet of Ministers of Ukraine adopted the Decree, according to which the development of carrier rocket "Cyclone-4" is ascribed to the pool of priority directions of innovative development of high-tech industries in Ukrainian economy. Development of this rocket became one of key components of the third 2003—2007 national space programme of Ukraine Rights and obligations of the parties to interstate project *Cyclone-4 — Alcantara* are divided equally. Completion of the rocket is scheduled for 2006. Ukrainian enterprises will produce the systems and components for engineering and launching complexes. Tens of Ukrainian organisations and enterprises will take part in implementation of the project, in particular, Dnipropetrovsk Design Bureau *Pivdenne* and Production Association *Yugmashzavod*, Kharkiv Joint Stock Company *Hartron* and Joint Stock Company *Research Institute of Radio Sets*.

Multilateral collaboration, Sea Launch

Sea Launch Company is the example of successful multilateral collaboration of

Ukraine. The Sea Launch is the limited partnership, with its headquarters at Long-Beach, California. The company is owned by *Boeing of Placetle* (Washington) (40%); space rocket corporation *Energy* (Russia) (25%), *Kvaerner* Oslo, Norway (20%) and Design Bureau *Pivdenne* /Production Association *South machine-building plant* (15%). The company is financed from shareholders' funds of and loans from Chase Manhattan Bank, New York.

Owing to a number of design solutions Ukrainian-Russian carrier rocket Zenith-3SL will be able carry into orbit up to six tons payload. First and second buses of the rocket Zenith-3SL are of Ukrainian make. They were developed by the design bureau *Pivdenne* and produced by the State enterprise Production Association *South Machine-Building Plant*. Third bus (launching block DM-SL) was designed and produced by Russian space rocket corporation *Energy*. The carrier rocket Zenith-3SL carried onto the orbit of Earth the satellite *Thuraya-2* weighing 5177 kg on 10.06.2003. Space vehicle was produced by the US company Boeing. The rocket was launched from the floating platform *Odyssey* in the Pacific ocean nearby the island of Christmas. This is second launch of satellite for the company *Thuraya Satellite Telecommunications Company* (United Arab Emirates). First satellite *Thuraya-1* was carried onto the orbit in October, 2000 by means of Ukrainian-Russian launch vehicle Zenith-3SL as well under the Sea Launch programme. For additional details about the Sea Launch programme see <http://www.sea-launch.com/organization.htm>

Ukraine – India

India and Ukraine signed the protocol of intentions in the areas of collaboration in a space industry. Protocol that NSA and Indian Space Research Organisation concluded stipulates participation of enterprises of Ukrainian space industry: NSA, Design Bureau *Pivdenne*, Production Association *South machine-building plant*, State enterprise *Pavlograd Chemical Factory*. In accordance with the Protocol, co-operation will progress along the following directions: development of rocket engines, production of components and devices for space vehicles, research and production of rocket fuel of different types.

5.3 Private sector

Structural-transformation changes resulted in the reduction of scale of science sphere, employment, and R&D scope. Dramatic changes also occurred in correlation of traditional sectors of research and new sectors appeared. According to quantitative indicators, the most substantial reduction happened in the public sector of science. At the same time, private research sector within industries and sector of science-intensive small and medium enterprises established and started to expand at rapid pace. Significantly shrunk the R&D sector oriented on military industrial complex. Changes in socio-economic status of scientific sphere of

Ukraine were severely affected by such factors as deepening economic crisis, unfavourable investment and innovative climate.

In condition utter deficit of budgetary funds, the need to overhaul the system of R&D funding based on implementation of comprehensive funding mechanisms, competitive selection of scientific projects, selective use of sources of funding, is becoming increasingly urgent. The government, whilst preserving the role of main centre of making and implementation of science and technology policy, is to assume complete responsibility for development of fundamental studies and ensure national S&T security, whereas the responsibility for development of the applied research and implementation of innovations is to be borne by manufacturers, private and bank capitals, unprofitable organisations and foreign investors.

At the same time, taxation system in effect is to be overhauled to work out incentives for the agents of science, technology, and production activities, who refurbish production technologically and carry out R&D at the expense of production funds, take part in development of programmes and projects with inter-industry value and aimed at the progress of S&T infrastructure, increase of science-intensity and competitive capacities of production.

Business organisations that carry out R&D encompass all organisations and enterprises whose basic activity is related to production of goods or services for sale (different from services in higher education sector), including those in state ownership and private non-profit organisations that provide services to the said organisations.

Private sector also includes private non-profit organisations, i.e. organisations that do not intend to make profit (professional associations, unions, public organisations, eleemosynary corporations, and funds). Those exclude funds that more than by half are funded by the state that belong to public sector, and private individual organisations (see table 1). Privatization of research establishments in Ukraine goes on slowly. Even those organisations that formally are not state-owned, government's share usually exceeds 50%. Such situation is largely related to the comparatively low level of demand on S&T products from domestic customers.

Section 6 Training in science and technology sphere

6.1 Scientific research in higher education

In 2001 there were 163 higher educational establishments (Institutes) carrying out scientific R&D units. Share of higher educational establishments carrying out scientific research and experimental developments (in the structure of research organisations of Ukraine was 11% in 2000. In 1991 there were 146 higher educational establishments conducting science and technology activities. That is the share of “research” in higher educational establishments grew by 10.5%

compared with 1991.

One of the most promising directions of the use of information technologies in education is distance learning. Today the market of the distance learning services using of technologies is being shaping up in Ukraine by public and private higher educational establishments, business enterprises, organisations, state establishments, funds, research institutes, and also their associations and consortia. This spectrum of participants in the distance learning is so wide because of several reasons and trends in today's society development. On the one hand, educational establishments tend to render increasingly better educational services to win the competition in the marketplace. On the other hand, developers of telecommunication information technologies offer the enterprises effective innovative instruments and complex solutions for management and communications that affects development of educational technologies, transforms training, education systems, educational business. Ultimately, national governments anxious to secure worthy place for their nations in global community, that rapidly gaining traits of informative society and its economy becomes the knowledge-based economy, create favourable financial conditions, legal framework for scientific research, practical experiments and private initiatives in the educational services industry.

Private enterprises, corporations, state groups and establishments provide educational establishments, or their departments and associations, with reliable technologies and services to establish virtual educational establishments that execute functions and procedures typical for actual establishments: registration, book sale, electronic libraries, consultations, student unions activities, dean's offices, financial assistance and the like. The package of software products also includes courses and additions to them, software products for courses development and management.

The distance learning market in the world education is not yet fully formed. Telecommunication information technologies that make the groundwork of the modern distance learning are rapidly developing, in the meanwhile educational process undergoes continuous transformations.

Business, Medical and Telecommunication Coalition whose primary objective was to proliferate distance learning in Ukraine, was founded in 1998. In October of the same year it went public by taking part in videoconferences on Distance learning Technology (<http://www.uar.net/conference/>). In September, 1999 Centre for Technology Promotion of Lviv Institute of Management (LIM) took part in the international scientific conference "Topical issues of development of innovation activity in transition economies" (Alushta, Ukraine), that sustained initiative of proliferation of distance learning in Ukraine within the framework of Global University System.

In December 1999 during the First national CEUME conference "Development of

Management Training in Ukraine" under the direction of Centre for Technology Promotion of LIM workshop and meeting of workgroup were held, which defined the basic problem issues of distance learning development in business training in Ukraine: organisation of testing, legalization, accreditation, collaboration with The Ministry of Education of Ukraine, copyright protection, promotion of the distance learning in Ukraine, establishment of virtual educational environment, psychological and ethic aspects of the distance learning, and development of web-platforms for the distance learning.

UDLS - the Ukrainian Distance learning System

Successful extension of activity on proliferation of distance learning in Ukraine became the joint project of LIM <http://www.lviv.lim.ua> and Loyola College <http://www.loyola.edu>, Baltimore, Maryland, USA. The purpose of the project is to introduce state-of-the-art distance learning technologies in business and management education, science and business, expand the range of educational and consulting services, assist in the increase of efficiency, availability and co-ordination of scientific research in this area. UDLS will achieve its goal by establishing partnerships on regional and international levels, analysis of economic feasibility of the distance learning, establishment and distribution of packages of the distance learning courses and certified professional programmes, development of a web-platform for the distance learning, rendering services in professional development for the faculty of educational establishments in asynchronous and synchronous distance learning methods and technologies, and advice on multimedia application, telecommunication network technologies in the programmes and services of educational establishments, enterprises and organisations.

Initial portfolio of the distance learning courses UDLS was developed by teachers and administrators of such establishments: Lviv Institute of Management, Business School of the National University "Kyiv-Mohyla Academy", International Institute of Management, Ukrainian-Canadian Business Centre MBERIF in Ivano-Frankivsk, Kharkov State Polytechnic University, Kiev Polytechnic Institute, Agency of Business Development of Slavoutich, Azov Regional Institute of Management in Berdyansk, Dnepropetrovsk Academy of Management, Business and Law. The portfolio includes the following courses: Foundation and Registration of an Enterprise, Business Communications and Career Development, Operations Management and Development of New Products, Decision-Making and Risk Analysis, Project Management and Management by Projects, Marketing for Beginners, Global Marketing and International Business, Advanced Marketing, Project Expert as an instrument of financial simulation, Information Technologies Management, Technology Transfer.

6.2 Scientific degrees and scientific ranks in Ukraine

The procedure of granting scientific degrees and appropriation of scientific ranks is

determined by the Decree of the Cabinet of Ministers of Ukraine adopted on June, 28 1997 "On ratification of the procedure of granting scientific degrees and appropriation of scientific ranks". Pursuant to this Decree, the scientific degrees of doctor and candidate of science (the latter equals to PhD) are granted, and the scientific ranks of professor or associate professor or senior research fellow are appropriated to the persons who have higher education, comprehensive professional knowledge and considerable achievements in certain scientific or pedagogical activities. Granting scientific degrees of doctor and candidate of science, as well as the appropriation of scientific rank of senior research fellow, falls into the jurisdiction of the Higher Appraisal Committee. The appropriation of scientific ranks of professor and associate professor is within the jurisdiction of the MES of Ukraine.

The Decree on the Higher Appraisal Committee of Ukraine was ratified by the Decree of President of Ukraine on February, 25. 1999. The Higher Appraisal Committee of Ukraine (HAC of Ukraine) is the central executive authority reporting to the Cabinet of Ministers of Ukraine. The HAC of Ukraine pursues public policy in appraisal of scientific and scientific-pedagogical specialists of higher qualification, grants scientific degrees of candidate of science and doctor of science, a scientific rank of senior research fellow.

Major objectives of the HAC of Ukraine are:

- To develop and ensure operation of the appraisal system for specialists of higher scientific and scientific-pedagogical qualifications;
- To ensure unification of requirements to the level of scientific qualification of aspirants for scientific degrees or scientific rank of senior research fellow;
- To co-ordinate activities of executive authorities and supervise the work of research (science and technology) establishments and higher educational establishments that concerns appraisal of specialists of higher scientific and scientific-pedagogical qualification;
- To appraise specialists of higher scientific and scientific-pedagogical qualification;
- To facilitate international co-operation in the area of appraisal of specialists of higher scientific and scientific-pedagogical qualification.

Training of research specialists in Ukraine is carried out under the graduate studies and doctorate studies programmes at educational establishments and R&D establishments of the relevant accreditation level. Admission to graduate studies (training programme for candidates of science) and doctorate studies (training programme for doctors of science) is performed after the competition that is held annually in established time. Admission to graduate studies programme is

performed on competitive basis for persons with higher education and qualification of specialist or master's degree. To admit a student to graduate studies receiving special committee is set up. The members of admission committee are appointed from the leaders of institutes, departments, laboratories, and also scientific supervisors to be appointed for graduate students. Candidates to graduate studies programme pass entrance examinations on specialities (within a training programme for specialists or masters that complies with scientific speciality selected), philosophy and one of foreign languages at choice (English, German, French) within training programmes for higher educational establishments of IV level of accreditation and approved by the MES of Ukraine. Results of entrance examinations to graduate studies programme are valid during a calendar year. Candidates who by the time of admission to graduate studies passed all or several candidate examinations are excused from relevant entrance examinations and scores of the exams are filed.

In the system of the scientific personnel training quite a lot of problems amassed. Although in the last several years the number of graduate students grew in 1.5 times, efficiency of training of candidates of science is getting worse, students are increasingly leaving the programme. As sociological research shows, many graduate students use their time in graduate studies programme to work in other areas, they communicate little with research fellows, do not improve their scientific qualification. Improper growth of number of graduate students in higher educational establishments, many of which do not carry out sufficient fundamental scientific research and, as opposed, its reduction in research institutes, do not facilitate quality of research personnel. Ukraine has the established practice of planning and scientific personnel training that based not upon contemporary S&T priorities but upon availability of researchers.

Section 7 International science and technology co-operation

Ukraine co-operates actively in the S&T area with numerous countries such as USA, Canada, Germany, and international organisations like UN, UNIDO, NATO and the like. However, the key priority is given to co-operation with EU member-states with perspective to the Euro-integration processes in Ukraine.

Multiple and vigorous partnership relations that Ukraine established with a number of EU member-states differ in their scope and nature. For instance, the partnership with Germany covers the whole range of S&T and innovation cooperation, such as: information exchange, information support for international S&T activities, rendering conferences, workshops, fairs, training sessions, exchange programs, S&T consultancies, and joint projects in the fields of fundamental and applied research. Joint efforts of Ukrainian and German institutions are put forth, in particular, within the framework of the programme "Co-operation with Central and East European countries" (sponsored by the Volkswagen Foundation), programmes

of co-operation between the German Federal Ministry of Education and Research on the one part, and the Ukrainian Ministry of Education and Science, on the other.

Essential role in the international integrative process for Ukraine is assigned to co-operation with the USA via relevant international foundations and programs. CRDF plays a special part in developing S&T relations between Ukraine and USA. Programs of the Fund are intended for Ukrainian researchers to participate in joint R&D projects including those aimed at implementing research findings, exchange programs and holding scientific conventions.

Bilateral S&T links between Ukraine and South European countries, such as Spain, Italy, Portugal, and Greece are becoming increasingly active. An exemplary program is Black Sea Economic Co-operation Organisation (BSECO) established for the countries of the Black Sea basin. Furthermore, co-operation with Asian, African, Latin American countries is a strategically valid policy since those regions are estimated as promising markets for Ukrainian developments and technologies.

Traditionally, an important place in the international co-operation is assigned to Russia and other NIS countries. International Association of Academies of Science, international scientific centres in physics, mathematics, programming technologies, applied optics, International Institute of Cell Biology, Institute of Management, International school of Ukrainian Studies, along with a number of other institutions, promote international scientific contacts in the above direction. Direct co-operation with the Academies of Sciences of other NIS countries is on the surge as well.

Recent positive trends in the international co-operation development as a whole combined with the rising confidence inside Ukrainian scientific community are able to encourage investments into national science development, innovation growth, S&T potential preservation and growth, provided Ukraine complies with agreements and contracts concluded, and observes its liabilities, such as to pay fees (or its share) in the international organisations.

Success of international S&T co-operation, its growth rates and implementation of inter-governmental agreements are hindered by two major factors: on the one hand, the notoriously imperfect legislation that concerns S&T issues and its incompliance to the world standards, and, on the other hand, it is the relevant governmental infrastructure that yet fails to redirect S&T development of the country in line with the economic development.

Nowadays Ukraine tails only Russia in terms of co-operation within the scope of NATO research programmes. With regard to the priority directions of home S&T developments, Ukrainian researchers participated in 16 projects of the Research programme, 8 of those within the framework of the sub-programme Science for Peace, were intended to support the implementation of scientific developments consistent with economic growth and market environment. The projects

encompassed the areas of nanotechnologies, purification of waste waters, environmental monitoring, new materials and energy sources, i.e. the areas most topical for the worldwide context. Annual NATO investments in Ukraine within the Science for Peace programme amount to \$ 1.000.000. There was established a think-tank to coordinate joint Ukraine-NATO efforts within the Science Programme of NATO and CCMS concerned with the issues of science and environment protection.

To enhance the effectiveness of project proposals and encourage participation in the Science Programme of NATO, Ukraine supports particular research projects on the preparatory stage. It is primarily the point with projects on computer networks and environment protection. Today, Ukraine is more concerned with the grants quality rather than the number of those. In order to make an effective use of NATO grants and enhance co-operation in the future, Ukrainian party is currently involved to process national applications at early stages. The country also aspires to become better represented in international Advisory Boards.

Successful international co-operation specifically resulted in establishing institutional structures, the examples of which are the first Ukrainian-Chinese high-tech technopark founded in 2002 in the National Zsinan zone of high-tech development; Science and Technology Centre in Ukraine was founded by Ukraine, Canada, USA, and Sweden (which was consequently replaced with EU). The Centre aims at preventing proliferation of technologies and special knowledge related to mass destruction weapons – nuclear, chemical, and biological. The Centre's projects and activities seek to support Ukraine in its transition to market economy, assist research and development in peaceful purposes, enhance opportunities for scientists and engineers in armament industry to develop their professional competences, which increase Ukrainian research and design capacities.

Scientific partnership of establishments and organisations of Ukraine and EU countries includes different approaches and implementations. Scientific programmes of European Union take special place. It should be noted that basic part in such co-operation on European side is played by the framework programmes, supervised by the Directorate General on Science of the European Commission, as well as programmes, initiatives, associations which are not formally a party to these programmes but closely linked to those and sometimes share a general purpose and directions.

The framework programmes that unite EU member-states, are one of forms of co-operation that became available for Ukraine starting 1994, during Third framework programme (FP 3), when Ukraine signed Agreement about Partnership and Collaboration with EU.

Participation of the Ukrainian researchers in projects, initiatives and numerous measures related to implementation of the noted programmes is regulated by the intergovernmental and intergovernmental agreements. Partnership and

Collaboration Agreement between European Union and its member-states, on one side, and Ukraine – on the other entered into force on March, 1. 1998 after ratification by the Supreme Council of Ukraine. This document legally substantiates expansion of co-operation in trade, industrial, scientific and administrative areas. In particular, article 58 of the Agreement provides for collaboration in the area of science and technology. It is stated thereby that such collaboration includes “exchange of science and technology information, joint activity at industry of scientific research and technical developments (RTD), activity from professional training and programmes for researchers mobility, researchers and engineering personnel involved in RTD on either side”.

At the same time, problems that Ukrainian scientists run across are resultant from their ignorance of capacities of participation in European research structures. The majority scientific research in the countries of European Union is carried out by scientists thanks to extensive scientific framework programmes and many other programmes related also to support of research including its informative, publishing, exhibition provision.

In 2002 Sixth framework programme (FP6) - basic mechanism of co-ordination and funding of the European S&T programmes was launched in Europe. Special programme FP6-2002-INCO-Russia+NIS/SSA-4 opens new ways of collaboration between Europe, Ukraine and Russia and other countries of former Soviet Union in the areas of technologies and exchange of knowledge. It is not a single indicator that Europe understands the necessity of deeper co-operation with the scientists of NIS in order to win competition with Japan and the US in science-intensive technologies areas. At the general assembly of INTAS in December 2002 in Brussels it was declared that the European Commission made a decision to expand INTAS support to facilitate active participation of scientists from the former USSR in the programmes and measures of 6th framework programme. EU allocates to this organisation EURO 70 million. In its turn, organisational structures INTAS were obliged to develop and implement new initiatives within the framework of FP6.

Ukraine in 2002 concluded the Agreement with the EU on S&T cooperation. This agreement stipulates that co-operation can be implemented in research areas including fundamental studies, technology development and demonstration activities, along the following directions:

- Environmental studies and climate studies, including observation of the Earth's surface;
- Biomedical research and health protection studies;
- Agricultural research, forestry and fishery studies;
- Industrial technologies;

- Material science and metrology;
- Non-nuclear power engineering;
- Transport;
- Information society technologies;
- Social studies;
- S&T policy;
- Training and exchange of specialists.

Sub-programmes INCO stipulates funding of projects for Ukraine. Thus, the competition COPERNICUS 2 was included into the sub-programmes INCO II. Funding can also be granted for internships of young researchers within the scope of stipend competitions provided the candidate takes part in a project performed by a research group of a European Union member state.

Competitions of sub-programmes INCO engulf several directions: joint projects, concomitant activities, support of participation in conferences and internship. Competition COPERNICUS is held once during a framework programme, i.e. once in 5 years along certain scientific directions and stipulates participation of several research groups from of European Union member-states and other countries. Members of the "team" to carry out a joint research project are to be from different EU countries (or one group from EU country and one of the associated country) and two other from the NIS countries of (or one from NIS and one from CEE if it does not belong to associated countries). In the case when one research group represents a joint research centre it is considered as a group from the EU country. Competitions on the concomitant activities projects to support scientific infrastructure, information and organisational provision, are held more frequently: once in a year and a half or two years. Competitions on convention activities support are held on a permanent basis with the fixed time of submitting applications: once in 4 months.

7.1 PHARE and TACIS Programmes

During the Paris Summit in July, 1989 the leading developed countries appealed to European Commission with a request to co-ordinate the programme of economic assistance to Hungary and Poland. The programme PHARE (Poland and Hungary Assistance in Restructuring of Economies) was proliferated onto Czech Republic, Slovakia, Romania, Bulgaria, Albania, three Baltic countries of and some states of former Yugoslavia. Facilitation of process of economic and political changes in transitional countries is the primary theoretical objective of this assistance. Following the examples of the programme for the Central and East European countries PHARE, European Union set up the programme TACIS for the former

Soviet Union countries (Armenia, Azerbaijan, Byelorussia, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan) and Mongolia.

The TACIS programme provides technical and economic assistance to countries and supports the transfer of European “now-how” with the purpose of development market economy and democratic society in these countries. The TACIS programme operates in different sectors, basic ones are the institutional reforms, support of economic reforms and private sector development, energy and environment, nuclear safety.

Parallel with the TACIS programme formal agreements were concluded with some countries. The objectives of agreements concluded between Russia and Ukraine in June, 1994 are to establish free trade area and encourage development real market economy, stabilize currencies in two countries.

The Ministry of Education and Science of Ukraine and its educational establishments co-operate with European Union within the framework of the Programme of Trans-European Co-operation in Higher Education - Tempus (TACIS), and with the EU member-states on a bilateral basis (specifically with their Central state authorities responsible for education and educational establishments) in particular, according to the Agreement on Partnership and Co-operation Between Ukraine and European Union signed on June, 16. 1994.

For period of implementation of the Programme in Ukraine from 1993 until 2001, European Union invested over 24 million ECU in the process of reformation of national higher education. 107 projects were carried out in 37 higher educational establishments. Since 2002 Ukrainian universities are implementing 9 more projects. Over 7 years of the Programme being implemented in Ukraine, 360 project applications were submitted to competitions from over 1000 higher educational establishments of Ukraine and European Union member-states.

Major priorities that implemented within projects are: introduction of state-of-the-art educational technologies, development and application of the advanced methods of educational process management, restitution of close co-operation between universities and industries, which provides for stimulation of innovation activity.

With the purpose of effective implementation of reforms in vocational training in Ukraine so as to comply with socio-economic development of the country and study European experience in tackling such issues, the Ministry of education and science of Ukraine initiated such projects: Reforms in vocational training in Ukraine and Entrepreneurship in education and training funded by European Commission in 2001.

Implementation of the projects in vocational training area will enable updating its contents, ensure reforms in accordance with the Law of Ukraine "On vocational

training ", and encourage vocational schools to develop skills that will facilitate self-employment of people and small business, change of traditional thinking and forming of entrepreneurship psychology.

Within the said projects, it is planned to develop vocational skills that would meet the requirements of labour market, relevant documents and study European training approaches. To disseminate results of the projects among other Ukrainian educational establishments, the model centres on the base of the best-practice vocational establishments will be established.

The Ministry of Education and Science of Ukraine co-operates with educational establishments of foreign countries on the basis of bi- and multilateral agreements that stipulate exchange programmes for faculty, research fellows to read lectures, conduct of joint research, exchange programmes for faculty, graduate students, young research fellows and teachers for training, internships and professional development. Swingeing majority of participants in exchange programmes takes part in joint projects, organisation of joint scientific and scientific-methodological forums (conferences, symposia, workshops).

The Ministry of Education and Science of Ukraine takes over integration experience from the candidate countries in the area of education and distributes it in Ukraine. This will enhance effective implementation by the Ministry practical objectives of introduction of the European standards in education, science and technology, make national achievements in education, science and technologies known in European Union and candidate countries, facilitate rising European cultural identity in Ukraine and integration to the European intellectual, educational, and scientific community.

The Ministry of Education and Science of Ukraine continues to implement projects under the Programme of Trans-European co-operation in higher education Tempus (TACIS).

Regional integration and development of co-operation of Ukraine with European Union in particular industries are becoming increasingly significant, in particular, the following projects are being launched:

Establishment of association of technical universities "Russia-Ukraine - European Union", within the scope of which the integrated training system for specialists will be developed with taking into account regional and production needs, practical trend of universities towards technoparks, development of joint standards for Ukraine and Russia;

Establishment of strategic planning centres in technical universities of Ukraine, whose implementation stipulates development of university management systems by means of effective organisation management, resource management and establishment of the strategic planning centres in different regions of Ukraine: Kharkiv, Odessa, Dnipropetrovsk, Ternopil, Kiev;

Reforms in higher economic education in Ukraine in transition to market economy. Under the project training is to be provided to specialists in economics and management. The Ministry of Education and Science of Ukraine requested the European Commission to consider the possibility of its participation in Socrates and Leonardo da Vinci programmes of the EU.

The Ministry of Education and Science of Ukraine proposes such priorities within the scope of the 2004 - 2005 TEMPUS programme for Ukraine:

1. Management of Ukrainian higher educational establishments.

Academic priorities.

- International relations and European studies.
- Law, including the European Law.
- Economics and Banking.
- Introduction of resource - and power effective technologies in higher educational establishments of Ukraine.

2. Human Resource Management (culture, art, education, training, business and public administration, agriculture, tourism, environmental studies, journalism).

Joint European projects on curriculum development will facilitate the development of:

- distance learning and new technologies of teaching;
- modern European languages;
- professional development of administrators and teachers;
- information technologies in education and library management.

3. Institutional changes:

- Professional development of pedagogical and scientific - pedagogical personnel as well as representatives of professional associations at local, regional and national levels;
- Civil education;
- Social work with the purpose of prophylaxis of drug addiction, HIV/AIDS among student youth.

4. Establishment of networks:

Establishment of the National Education Centres:

- inclusion into world network of national informative centres on recognition

of education credentials ENIC/NARIC;

- economics of education;
- organisation of employment of graduating students of higher educational establishments.
- generalization, analysis, systematization and development of databank of curricula, educational courses, practical exercises, innovative training methods developed in Ukrainian higher educational establishments during implementation of the project will promote reforms in Ukrainian higher education.

7.2 Co-operation with the UK

Legal framework of co-operation with the UK is provided by the Agreement between the government of Ukraine and government of the United Kingdom on co-operation in education, science and culture, which was signed on February, 10 1993. The parties are obligated thereby, in particular, to encourage and facilitate development of exchange programmes and conducting research on issues of mutual interest in the area of science and technology, including direct co-operation between research establishments of both countries.

The British Council (culture department of the UK embassy in Ukraine) is the major representative organisation of the United Kingdom in Ukraine that facilitates science and technology co-operation between two countries (www.britishcouncil.org.ua). The British Council headquarters is located in Kiev with regional representative offices in Kharkiv, Donetsk, Odessa and Lviv. The British Council activities in the area of science are as follows:

Excellence and co-operation – disseminates information on the British scientific achievements, presents British science in Ukraine, assists in setting direct scientific contacts and co-operation between British and Ukrainian researchers. Along this direction three bilateral research workshops (N+N workshops) have already been held in different areas of knowledge:

- **Scientific workshop in cryogenics**

Physics is one of the key sciences where the Ukrainian scientists have recognized achievements. The British Council organised first Ukrainian-British science and technology seminar in co-operation with the Committee on Science and Education of the Supreme Council of Ukraine and the Engineering and Physical Sciences Research Council (EPSRC). The workshop was held in the United Kingdom.

- **Scientific workshop on information technologies and computer science**

This workshop became the second in the series of the Ukrainian-British research

workshops held by the British Council in Ukraine in co-operation with the Engineering and Physical Sciences Research Council (EPSRC). Such sub-sections were organised: parallel and innovative architectures, multimedia and their application in computer networks, control and digital signal processing and medical aspects of application of information technologies.

- **Scientific practical workshop in biological sciences and biotechnologies**

Third Ukrainian-British research workshop in biotechnology of plants was held in co-operation with Biotechnology and Biological Sciences Research Council (BBSRC). 26 research fellows from both countries took part in the workshop that was held in John Innes Centre, Norwich - the leading research centre of the United Kingdom in this industry.

Further similar workshop “Biotechnological approaches to plants growth control” for young researchers is scheduled for March 2004, which is to be held in Crimea.

Similar workshops can be organised both in Ukraine and in the UK, with up to 10 participants involved from each country in particular area of science and funded on a competitive basis. Details on participation, registration procedures can be obtained in the British Council.

Innovations and implementation of technologies - promotion of innovation development in Ukraine, advancement of mechanisms of implementation of technologies, commercialisation of science, intellectual property protection, technology development foresight by means of taking over British experience and expertise in the said areas and assistance to Ukrainian-British scientific and engineering co-operation.

Technology development foresight programme is the important initiative in the United Kingdom, aimed at amalgamation of efforts of representatives of science, industry and management to study prospects of development of technologies and market needs in future as well as ways of effective use of science and engineering achievements to improve prosperity and quality of life.

The British Council in Ukraine in co-operation with the Committee on Science and Education of the Supreme Council of Ukraine within the scope of the project of British Know-How Fund provided financial and expert assistance in developing the Foresight programme for technology development in Ukraine which was published in 1998 on the British Council webpage: <http://www.britishcouncil.org.ua/ukraine/science/ukefor.htm>.

Now The British Council co-operates with the United Nations Organisation for Industrial Development (UNIDO), the National technical university the “Kiev Polytechnic Institute”, the Interim Special Commission of the Supreme Council of Ukraine on Future, Manchester University in implementing the national programme of technology development foresight in Ukraine.

Sustainable development of Ukraine: Seeking to support activities to implement resolutions of 5th conference of the Ministers of Environment of the European states “Environment for Europe”, that occurred in Kiev in May 2003, based on achievements of the Programme of support for small environmental projects in Ukraine funded by the Department of International Development of the United Kingdom, the British Council in Ukraine in co-operation with the Department for Environment, Food and Rural Affairs (DEFRA) and Programme of Local Environmental Measures (MEP) of USAID LEAP held the international forum “Sustainable development of Ukraine” in October, 9-10 2003 in Balacava, Crimea. Resolution of the forum can also be obtained from the British Council webpage. Future co-operation in Ukraine will be aimed at assistance in development and implementation of sustainable development strategy in Ukraine in co-operation with the Supreme Council, the Ministry of Environment and Natural resources of Ukraine, other concerned Ukrainian and international partners.

Biological sciences and biotechnologies – the importance of this priority activity is determined by rapid growth of this science in the world where the UK is one of leaders, as well as by extraordinary potential and opportunities that the latest achievements in genetic engineering and biotechnologies to solve numerous problems of health care, environmental protection, quality of food and the like make available. The activities include celebrating 50th anniversary of DNA structure discovery, conference on criminal examination, joint Ukrainian-British scientific workshops on biotechnologies, bio-safety issues and technology transfer.

Other activities of the British Council in the area of science include annual grants for young researchers Chevening, assistance in curbing HIV/AIDS and the like. Additional information can be obtained on the British Council's web page.

Section 8 Prospects for advancing the scientific infrastructure of Ukraine

The official position in this respect is that the strategy of economic and social development of Ukraine for the period 2001-2004 sets forward the imperative of effective application of home science and engineering means for resolving social, economic, cultural and other problems of a community.

Basic directions of reforms in scientific and innovative systems of Ukraine are set forward in the action programme of the Cabinet of Ministers of Ukraine "Openness, Effectiveness, Efficiency" and specified in the relevant action plans of different ministries and departments.

Pursuant to these plans during 2003-2005 the government intends to undertake a number of measures to invigorate substantially science and technology policy. Policy making, adaptation and implementation will provide direct assistance to the transition of economic development of Ukraine onto the innovative way that

complies with the principles of sustainable development. These measures will be undertaken along the following directions:

- 1) Development of organisational and economic mechanisms of R&D planning, funding and implementation, development and implementation of innovations;
- 2) Development of legal framework regulating science and innovation activities, specifically:
 - in the area of reforms in the system of national science and technology priorities and defining state priorities in S&T area;
 - advancement of organisational and legal mechanisms of intellectual property protection and effective use;
- 3) Inspection and adjustment of the national network of research and project organisations, including establishment of innovation structures of different ownership;
- 4) Inventory of organisations funded from the state budget, specification of science objects that represent the national asset;
- 5) Payment rise for scientists and engineering personnel in R&D organisations of private and mixed type of ownership;
- 6) Expansion of international co-operation in science and technology area, ensuring Ukraine's participation in relevant international agreements, participation of Ukraine in progress of single European research area;

In today's economic conditions of Ukraine role of science is to be growing. In particular, it is necessary to augment the role of scientific foresight in all areas of science, social growth and national economy development. Although the foresight is important scientific instrument to make correct selection of social and economic growth, it is neglected so far. In particular, outlines and priorities of economic policy, aimed at long-term economic growth, are to be identified by means of the foresight.

In a contemporary world, the development of science in traditional directions somewhat slowed down. The research at the turn of sciences are developing at accelerated rates (compared with traditional sciences), such as a radiobiology, genetic engineering, cryogen electronics, quantum mechanics, economic cybernetics and the like. The list of such sciences is long enough. The issues of interactions between a man and nature, support of high-tech products, e.g. advanced information, energy saving and nature protection technologies, are becoming topical.

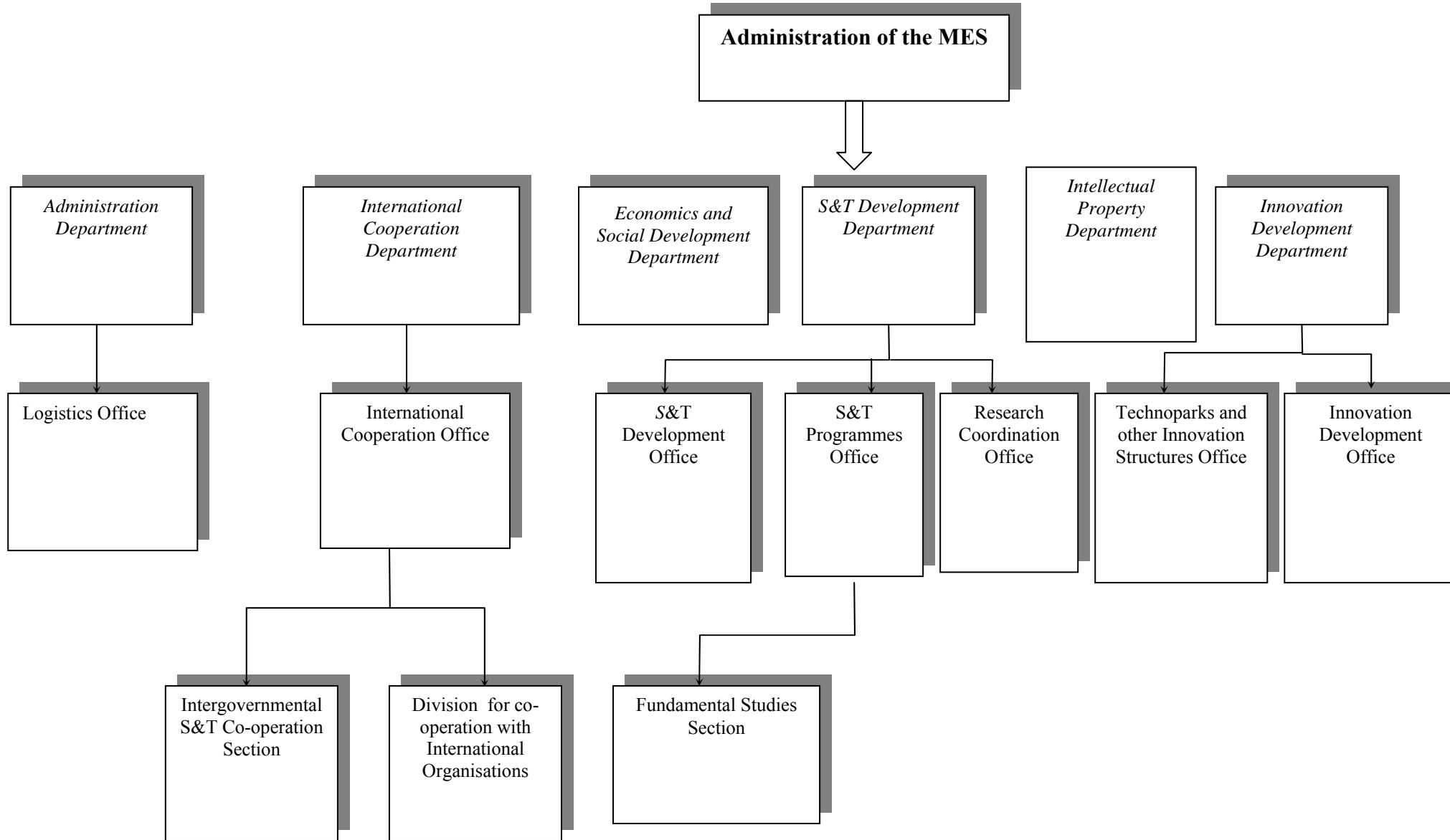
Ways of development connected with the implementation of progressive economic policies is becoming vital for Ukraine in present conditions. The most urgent

objectives at present stage of economy development are as follows:

- development of R&D organisation and management issues, in particular, development of new organisation and economic forms of integration of science in production;
- mastering by Ukrainian experts of advanced management expertise of the developed countries, methods of international business and other innovations with a further dissemination nationwide;
- improvement of industry structure and acceleration of socio-economic development of territories;
- active implementation into industry of progressive science and technology developments and inventions with further transfer of results to be implemented widely in the country's economy.

Redistribution of efforts in various sciences requires the redistribution of efforts in training of specialists. Here three basic factors of civilization affect dynamically the development of education: science and technology factor (science—technology - production), socio-political factor (state), and cultural factor (religion, philosophy, art), which brings in specific features in education and requires relevant approaches to be developed.

Annex 1 the MES



Annex II List of Abbreviations

MES – the Ministry of Education and Sciences of Ukraine

NAS – the National Academy of Sciences of Ukraine

AAS – the Academy of Agrarian Sciences

APS – the Academy of Pedagogical Sciences

Derzhcomstat – the State Committee for Statistics

NSA – the National Space Agency of Ukraine

R&D – research and development

S&T – science and technologies

HAC – the Higher Appraisal Committee

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Institute of cellular biology and genetic engineering	03143, Kyiv 143, Acamician Zabolotny St., 148, t.266-7104, fax (044) 266-7104

	http://biophysics.kiev.ua/indexu.htm
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Institute of Economy of Industry	83048, Donetsk 48, Universitetska St., 77, fax (0622) 55-7844, 55-5312; teletype 615208 "IDEA". E-mail: amosha@lie.dipt.donetsk.ua
Council for Productive Forces of Ukraine Studies	01601, Kyiv-32, T.Shevchenko boul, 60, fax 244-6670. E-mail: labor@cpfs.freenet.kiev.ua
Institute of World Economics and International Relations	01030, Kyiv 30, Leontovycha St., 5, fax 235-7022
Institute of Economic and Legal Studies	83048, Donetsk 48, Universitetska St., 77, fax (0622) 55-7744, teletype 115208, "IDEA"
Institute of Market, Economic and Environmental Studies	65044, Odessa 44, Frantsuzsky boul., 29, fax (0482) 22-6611, teletype 232664 KEY
Institute of Regional Studies	79006, Lviv, 26, Kozelnytska St., 4, fax (0322) 42-7168
Research Institute of Labour and Employment (Ministry of Labour of Ukraine and NAS of Ukraine)	01030, Kyiv 30, I.Franca, St. 15, fax 225-1362
International Institute of Management	01011, Kyiv 11, P.Mirnogo St., 19, fax 290-0495
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Institute of History of Ukraine	01601, Kyiv 1, M.Grushevsky St., 4, t./fax 229-6362
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Institute of Political and Ethnonational Studies	01011, Kyiv 11, Kutuzov St., 8, t.295-7311, fax 296-1526
Institute of East European Studies	252001, Kyiv 1, M.Grushevsky St., 4, t.229-0629
G.S.Skovoroda Institute of Philosophy	01001, Kyiv 1, Tryokhsvyatytska St., 4
Institute of Sociology	01021, Kyiv 21, Shovkovychna St., 12, t.291-5107, fax 291-5696. E-mail: i-soc@mail.kar.net
V.M.Koretsky Institute of Government and Law Studies	252601, Kyiv 1, Tryokhsvyatytska St., 4, t.228-8127, fax 228-5474
V.I.Vernadsky National Library of Ukraine	03039, Kyiv 39, 40-letiya Octobrya prosp., 3, t.267-4850, teletype: 132444 "Rebellion", fax 264-3398. E-mail: nlu@csl.freenet.kiev.ua http://www.nbu.gov.ua/
T.G.Shevchenko Institute of Literature	01601, Kyiv 1, M.Grushevsky St., 4, t.229-1084, fax 228-5281
O.O.Potebnya Institute of Linguistics	01601, Kyiv 1, M.Grushevsky St., 4, t.229-0292
Institute of Ukrainian Linguistics	01601, Kyiv 1, M.Grushevsky St., 4, t.229-1885, fax 228-5327
M.T.Rilsky Institute of Art, Folklore and Ethnology Studies	01601, Kyiv 1, M.Grushevsky St., 4, t.228-3454, fax 229-4522
Institute of Ethnology	79000, Lviv, Peremogy prosp., 15, t.72-7012, fax 72-8007
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International School of Ukrainian Studies	01601, Kyiv 17, T.G.Shevchenko boul., 14

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Kharkiv Medical Institute	310022 Kharkiv, Ukraine Lenin prosp., 4 (0572) 43-07-26
Chernyvtsy Medical Institute	274000 Chernivtsi, Ukraine, Teatralna Sq., 2 tel.: (03700) 2-30-72
Ukrainian State Medical University	252004 Kyiv, Ukraine Shevchenko boul., 13 tel.: (044) 224-4062 fax: (044) 224-4062 email: postmaster@medin.kiev.ua ()
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Odessa Medical Institute	270100 Odessa, Ukraine Narimanova Lane., 2 tel.: (0482) 23-33-24
Lviv State Medical University	290010 Lviv, Ukraine Pekarska St., 69 tel.: (0322) 72-26-60 fax: (0322) 76-79-73
National University "Kyiv-Mohyla Academy"	04070, Kyiv, Skovorody St.,2 tel.: (044) 416-45-15 http://www.ukma.kiev.ua/
National Technical University of Ukraine "Kyiv Polytechnic Institute"	03056, Kyiv, Peremogy prosp.,37 tel.: (044) 441-11-10 http://www.ntu-kpi.kiev.ua/
National Agrarian University	03041, Kyiv, Heroyiv Oborony St.,15 tel.: (044) 267-82-64 http://www.nauu.kiev.ua/
Kyiv National Economic University	03057, Kyiv, Peremogy prosp.,54/1 tel.: (044) 446-50-55 http://www.kneu.kiev.ua/
M. Dragomanov National Pedagogical University	03030, Kyiv, Pyrogov St.,9 e-mail: tig@npu.edu.ua tel.: (044) 221-99-17 http://www.npu.edu.ua/
Odessa State Academy of Cold-related Studies	65100, Odessa, Peter Velyky St.,1/3 tel.: (0482) 23-22-20 http://www.osar.odessa.ua/
Kharkiv State University	310077, Kharkiv, Svobody Sq.,4 tel.: (0572) 45-74-88

	http://www.univer.kharkov.ua/
National Aviation University	03058, Kyiv, Cosmonavt Komarov prosp.,1 tel.: (044) 483-41-05 http://www.nau.edu.ua/