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STRUCTURAL CHANGES IN HUMAN RESOURCES OF UKRAINIAN SCIENCE

Abstract. *The article analyses the dynamics of human capacity of Ukrainian science during the years of independence, it is shown that save for massive reduction of total quantity of scientists (drop in the number of researchers more than four times), significant structural changes have taken place with sectors and fields of science and also with age structure of scientific personnel. The industrial sector suffered the largest losses, in particular, nearest to manufacturing requirements – the number of R&D performers reduced it to 7.3 times (whereas in the academic sector – 1.8 times). If in the early nineties, the industrial sector had taken the place of about 70% of domestic science, and the academic sector – only about 18%, whereas in 2013 the proportion of academic sector would have been the largest, overbidding 44% due to the reduction of the industrial sector. In the last 20 years in Ukraine, the proportion of natural sciences more than doubled up, but not at the expense of increasing the absolute number of scientists(it is decreased by more than half during this period), but as a consequence, at an even greater loss of personnel potential of industrial science (almost by six times).*

Long-continued regular staff reduction in research institutions negatively affected the age structure of researchers in both NAS of Ukraine and Ukraine all

in all. The author proves that if the determined steps were not taken for consolidation in the science of researchers, to begin with, middle age, which is considered the most productive, then in mid-term the ability to reproduce of personnel resources of scientific potential would be lost in Ukraine.

Keywords: *human capacity, Ukrainian science, academic sector, industrial sector, scientific institutions.*

INTRODUCTION

Preservation, scientific and technical capacity development, creating conditions for its effective use in the enhancement of scientific knowledge, economic development, defence increasement, solution of many other social problems are now a priority of state policy, not only in developed countries but also in many countries of Asia , Africa and Latin America - even those who have recently had their national science. Ukraine undertook a commitment and signed an association agreement with the EU. The agreement refers to cooperation "The parties develop and strengthen scientific and technological cooperation in order to scientific development and to enhance scientific capacity to address national and global challenges ..." and " The parties develop their scientific potential to comply with global responsibilities and commitments in areas such as health, the environment, including climate change and other global challenges. " And in addition, the article 375 is about development of scientific and technological capacity to ensure the competitiveness of the economy and society.

PROBLEM STATEMENT

To begin implementation of the listed commitments, it is important to consider what the scientific potential of Ukraine is today and how it changed over the years of independence. One of the directions of this analysis should be studying the dynamics of scientific personnel as a key component of this potential and the most important factor of its viability.

PRESENTATION OF BASIC MATERIAL

As it was stressed in [1], in the last 25 years, human resources of domestic science decreased more than fourfold. However, the nature and the rate of change were different for the purposes of differentiated consideration in terms of sectors of scientific system.

The aim of the article is the determination of changes of personnel potential and problems that require the urgent response of the state and the scientific community.

In the early nineties of last century, the main body of personnel potential of science worked in the organizations of so-called industry sector (the term appeared in Soviet times to denote the organizations that are responsible for scientific maintenance of sectors of the national economy): 66,8% of workers in primary activity (without including part-time employees) and 65,4% of researchers. The other sector is academic (defines organizations that are under the control of scientific institutions), it was less than one-fifth of the scientific potential of Ukraine (18,5% of workers in primary activity and 17,1% of researchers).

The first years of independence demonstrated exceptionally acrid dynamics: already in 1992-1995 years, the number of realizers of scientific and scientific-technical works in the industrial sector of science, which was previously focused on cooperation within the Soviet Union, was reduced mostly by half. Whereas in the academic sector the reduction was only 23,3%, and in the factory sector (the term is used to denote the scientific departments and organizations in manufacturing plants) – 21,3%. At any later dates, the rate of decline in the level of the scientific system is somewhat slower, and at certain sectors, there were even the variations of growth.

From 1991 to 2013, the rate of total reduction of the number of the realizers was reduced by half and speeded up only in the last 2 years. Until at least 2010, the most significant «castration» in absolute determination was in the industrial sector, which before then had been maintaining a leading position among others. After 2010 the character of the dynamics in the industrial sector has not undergone

essential modifications, but under Azarov and Yatsenyuk's rule, double-quick reduction took place in the academic sector, and also in the factory and educational sectors. The final results of multiannual destruction of human capacity of Ukrainian science may be defined so: the total number of realizers from 1991 to 2015 was reduced by 4,6 times, including the industrial sector – in 7,3 times, in the academic – in 4,5 times, in the factory – in 7,1 times, while in the academic science – only in 1,8 times. The almost coincident rate of adverse changes in the industrial, the academic and the factory sectors of science has been determined the overall dynamics, and the rate has actually neutralized the moderate dynamics in the academic sector. From 2000 to 2005 increase in a number of contractors was happening unlike other sectors, and despite the difficulties in financing it, and from 2006 to 2010 this number has stabilized, but then it began rapidly decrease.

Measure of reduction and the number of employees of main activity was no less breath-taking (this accounting category in addition to the realizers of scientific and technical works involves supporting employees and other scientific organizations): with an overall reduction in their number in 4,4 times, in the industrial sector – in 6,2 times, in the institutional – in 4,9 times, in the academic – in 2,1 times, in the factory – in 6,4 times.

These figures show that the industrial and factory science in Ukraine is closest to the needs and it basically has almost destroyed. Only a small part of organizations, such as DB «Luch», NTC«Antonov», DO «Yuzhnoye» and others, continues to operate, although experiences hard times. In the academic sector of science, the dynamics was slower, but the renovation of human capacity shortly slowed, thereby scientists of a certain age are dominated among researchers of academies, especially in comparison with commercially - oriented structures of the national science. Therefore, a relatively moderate reduction in this sector should not mislead: a large part of the academic institutions are actually teetering on the verge of the prospect of the restoration of the scientific potential may already be lost. Moreover, in NAS of Ukraine, the number of employees at enterprises of experimental – production base (in fact, it was the bridge that provided a direct link

of academic institutions with the academic institutions of technological – production profile) fell by more than 23 times! Thus, there are objective grounds for the conclusion that the Ukrainian science has reached a critical state, which was done in the approved by the Verkhovna Rada of Ukraine on 11 February 2015 recommendations of the parliamentary hearings «the status and legislative support of development of science and scientific – technical sphere of the state»(hearing was held on 2 July 2014).

Besides quantitative changes in the total number of scientific potential of the country, sectoral structure has radically transformed. In the early 90s science industry occupied about 70% and academic sector - only about 18%, but in 2013 due to the reduction of industry sector academic sector exceeded 44%. Considering personnel skill level, the authority of scientific schools, it becomes clear that now academic sector determines Ukrainian science and it is its most powerful component.

However, changes in the academic sector also had different dynamics that can be seen from the table 1 and 2.

Table 1

Number of core activities employees at the National Academies of Sciences of Ukraine, people

	1991	**1995**	**2000**	**2005**	**2010**	**2015**
NAS	63466	46634	34042	38705	37480	30824
NAAS (agrarian science)	19711	18135	14716	14220	12434	7319
NAMS (medical science)		2562	4498	4998	5162	4493
NAPS (pedagogical science)		859	998	1148	1380	1187
NALS (legal science)			79	155	248	262

During the period to 2000 the number of core activities employees of NAS of Ukraine decreased to 1.86 times, and in the Academy of Agrarian Sciences – to 1.34 times, but the number of the Academy of Medical Sciences significantly increased – to 1.76 times. Quite different was the dynamics of science academies

created after 1995 - including educational and legal. Its human potential has been growing until 2013, but still remained too small to affect significantly the negative trend of the sector in general. Especially the National Academy of Arts of Ukraine established in 1996 where the number of employees was only 115 people in 2012. During last two years reduction happened in all academies.

Table 2

The number of participants of scientific and technical work at the National Academy of Sciences, people

	1991	**1995**	**2000**	**2005**	**2010**	**2015**
NAS	41368	28225	22987	25768	25196	20393
NAAS (agrarian science)	13255	12378	10304	9192	8586	5477
NAMS (medical science)		1794	3269	3573	3589	3125
NAPS (pedagogical science)		674	804	871	1066	911
NALS (legal science)			72	102	176	205

Despite efforts to slow down the reduction in the number of scientific and technical workers NAS of Ukraine lost almost half by the 2000. During next five years it was little increased, but further reduction started again and the number of workers was only 49.3% in 2015 of the level in 1991 which is a historical minimum for NAS.

Changes in the number of performers of the work in the Ukrainian National Academy of Agrarian Sciences turned out to be more dramatically: without jumps in the 90s, but with a sharp reduction in 2010-2015 years, as a result the level in 2015 was 41/3% of the value in 1991 yr. The academic staff's dynamic of National Academy of Ukraine (and by extension, assistance measures their development by the state). The supporting of newly formed academies was also different: the most rapid growth in the number of scientists was happening in the National Academy of Legal Sciences – the number of performers of the research and development has increased more than three times in five years. In the second place is the National

Academy of Medical Sciences – in two times, and the National Academy of Educational Sciences has increased the number of researchers in one and a half time. Although, as noted previously, the total number of newly created academies are too small to affect the total reduction of academic science sector in Ukraine.

The changes in the number of main activity employees shows that after 2010 "regime of maximal assistance" for minority academies has already changed to the opposite: the headcount growth for the National Academy of Legal Sciences has stopped, and even the changes for National Academy of Pedagogical Sciences and National Academy of Medical Sciences began to fall. So, an analysis of the academic sector staff evolutions in national science, despite the fact that it has suffered from the "targeted cuts" in scientific potential of the country less than its other sectors, confirms the difficult, sometimes even critical state, in which are academic institutions.

Significant changes were also made in the disciplinary structure of national science. The share of the most powerful sciences – technics has dramatically dropped. Over the last 20 years, the share of natural sciences has doubled, but not by an increase in the total number of scientists (it has dropped more than one and a half times), and as a result of faster workforce capacity fall of technical science (almost six times!).

Meanwhile, the relative share of social and human sciences has increased significantly, although the real increase in the number of researchers has been only in the last, the number of social scientists had been increasing by 2010, but then it started to fall and in 2015 the number of researchers was 20% less than in 1995.

The long-term regular staff reduction in academic institutions took a toll on an age structure of scientists in both the NAS of Ukraine, and Ukraine as a whole.

Local maximum that corresponds to «30-34 years" states: despite falling prestige of the profession of researcher, young people keep going into science. Young people had begun to go actively into science, but after 2012 these indicators began decline. Having acquired professional qualification young researchers left

scientific institutions en masse in search of a decent job compensation to provide for a family. The structure of scientific staff formed a "failure» that corresponds to the age group of 40 to 49 years. And this failure grows every year. However, this is the second maximum in the age structure corresponds to set of age groups from 55 years , and NAS Ukraine is so much more than the first. One of the issues that have caused the greatest argument is how disastrous is such structure for science and whether it possible to build scientific capacity on the basis of cooperation between the youngest and oldest generations of researchers [4; 5]. However, unless we act firmly to consolidate in science researchers primarily middle age, which is considered the most productive, then in the medium term ability to reproduce human resources in Ukraine will be lost (for some scientific groups it has become a fact). Undoubtedly, the present age structure of researchers in NAS of Ukraine cannot be considered as the norm.

The main reason for the reduction of personnel potential of the national science is a funding shortfall. In the 1991, science funding from the state budget of Ukraine was only 11.9% of the total funds spent on scientific and technical work (the rest - the costs of customers and expenditure from the budget of the USSR). As a result of a fall in demand for since in 2015, caused by the restructuring of the national economy (including loss of high-tech sectors), the state's share in financing science after sharp fluctuations tripled nominally (34.5%) But it almost tripled without increasing investment by reducing the funds coming from other sources, while an increase of science funding, were almost entirely declined due to inflation (see., E.g., [1]). So, against the value of 1991 amount of financing of scientific and technical activities in 2015 declined to 6.17 times, and in the past decade it fell by one half (at this time the budget expenditures decreased by almost half, in other words, the state actually did not tried to compensate for the loss of attention to science). Also, the specific level of employee funding in 2015 was the lowest among the observations of the last decade. Despite importance of human capacity of the academic sector for the country, this level has been in the worst conditions since 2006. It applies both to the absolute level of unit costs per

employee, and the rate of its decline compared with other segments of the scientific system. Moreover, in the academic sector, it decreased to 1.45 times, and in industry - in 1.06 times, while reducing of system it decreased to 1.2 times. In addition, unit costs in the special science exceeded the value of the indicator in the academic science more than twice. It turns out that too much is expected from academic science but there are no appropriate material resources to satisfy expectations.

In our view, it is necessary to change the approach to science funding radically. And the only way to “keep” scientists is to higher both wages and funds to replace obsolete equipment and the purchase of materials available to researchers of advanced countries (for example, 66.4% of surveyed young scientists, replied that they lack of equipment for fruitful scientific work. And all other undoubtedly important factors had lower rating). And it cannot be considered a purely social problem (the request to improve welfare of scientists). We must finally realize that the very possibility of scientific, technological and innovative development of Ukraine is problematic today, and the solution of this problem depends on the government .So now it's just a question of whether the government will take drastic course to increase support for science instead of sequential decrease, which has been carried out in the last decade, in 2017? Instead of strengthening the "economy" in science, which is embedded in the draft state budget for 2017, significant increase in state support should be envisaged. Arguments that suggest the sponsors, they say, we have similar requests to several hundred billion, in this case, do not work. However, this is a relatively minor amount, even if increased expenditure on science to double compared to 2015were provided in 2017, it would mean that the state will spend on R & D just 0.4% of GDP, and this amount is not able to significantly influence the balance of income and expenditure. It should be said that the cost of scientific and technical activity are at a rate of 3-5% of state spending, as is the practice and the norm for many European countries.

It is important to ensure the best possible conditions for providing scientific academic sector the opportunity to receive funds for works not only in the form of institutional funding and budget revenues as part of the few international projects, but also through participation in public and private programs and competitions for research grants. It is required by current legislation, but it was eliminated from the national practice of previous governments "without prior arrangement" . The current structure of the Ukrainian economy and its place in the international division of labor largely caused a drop in demand for research and development of producers. Therefore, in the state scientific and technical policy of Ukraine the main issue is to be much better targeted at increasing demand by creating efficient mechanism of stimulation of investment in science.

CONCLUSIONS

In recent decades there have been dramatic quantitative and structural changes of personnel potential of Ukrainian science, which put it in a critical situation, made it problematic to reproduce and development. The very possibility of scientific, technological and innovative development of Ukraine is being questioned. In view of the above, there is a need to radical revision of policy towards science and innovation development of economy. Thus, support for science instead of its consistent reduction (that has been in the recent years) must be radically strengthened.

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