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HIGH-TECHNOLOGY SECTORS OF ECONOMY: NATIONAL AND INTERNATIONAL DIMENSIONS

Space-rocket industry development has been investigated as a perspective high-technology sector of economy in Ukraine. Based on the global activity tendency in the sphere of space technique and technology development a conclusion has been made regarding the negative influence on the general country's development made by high-technology "outflow" which is not launched within the system; as well as concerning the necessity of commercial segment development of space production and technologies market.

Keywords: high-technology sector of economy, aerospace industry, space-rocket industry, Ukrainian high-technology export.

Нямешчук А. Высокотехнологичные секторы экономики: национальное и международное измерения. Исследовано развитие ракетно-космической промышленности как перспективного высокотехнологичного сектора экономики Украины. На основе тенденций мировой активности в сфере развития космической техники и технологий сделан вывод о негативном влиянии "оттока" высоких технологий, не внедряемых внутри системы, на общее развитие страны, а также о необходимости развития коммерческого сегмента рынка космической продукции и технологий.

Ключевые слова: высокотехнологичный сектор экономики, аэрокосмическая отрасль, ракетно-космическая промышленность, высокотехнологичный экспорт Украины.

Background. An implementation experience of the innovative development pattern within the leading countries national economies confirms the strategic significance of those sectors that are globally competitive. The USA system of scientific and technical programs' fulfillment "budget planning, programming, working out and fulfillment", Finland and Israel innovative systems' high effectiveness, legal norms of stimulating NDDKR in Japan [1], high-technology strategy in Germany, White book "Innovatively-oriented nation" in Britain [2] – each of them is aimed at increasing the effectiveness of sectors which generate innovative high-technology product.

The innovative direction of development has been chosen in Ukraine as well. Among the principal normative legal instruments the following should be pointed out: "The innovative development strategy of Ukraine for 2010–2020

in conditions of global challenges", the Program of economic reforms for 2010–2014 "Prosperous society, competitive economy, effective state", State program of economy development activation 2013–2014 [3].

Analysis of the latest research and publications. The problem of effective implementation of innovative development pattern and further increasing of the national economy competitiveness is being studied by the leading scientist-economists, particularly, Antoniuk L. [4], Filipenko A. [5], Fedulova L. [6], Makohon Yu., Cherep A. and Androsova O. [7] and many others. The works of such scientists and experts as Horbulin V., Alekseiev M., Dzhur Ye. and Dzhur O. [8], Dehtiarev O. [9], Kisterskyi L., Koniukhov S. and others are devoted to the search of ways to increase the economy effectiveness of the Ukrainian space-rocket industry, being a potential high-technology sector. It should be mentioned that space-rocket industry is becoming more often an object of scientific investigation conducted by promising scientists.

The further study is needed for the process of the national economy's high-technology sectors development that defines their perspectives on high technologies global markets.

Taking into account the experience of countries – innovative leaders, the available scientific work by researchers and experts, the article's **objective** is to assess the Ukrainian space-rocket industry potential and its relation with the global activity in the sphere of space technique and technologies development.

Materials and methods. Information resources of the scientific research are statistics data of Organization of economic collaboration and development, State service of Ukraine's statistics, current documents about the global activity in the sphere of space technique and technologies development Spacefoundation, Annual reports of Ukraine's State space agency, information provided by the official media. The investigation's methodological instruments are represented by general scientific methods of research: dialectical, cognition, scientific induction and deduction, systematic, comparison and synthesis.

Results. In 2010–2012 the Ukrainian space industry enterprises manufactured and sold goods for more than 9.5 billion UAH. At the same time space-rocket production constitutes 62 % of the general volume of manufacturing. The goods exported for 6 billion UAH constitute more than 60 % of the general volume of manufacturing [3]. The state policy's tasks for 2013–2014 are the implementation ensuring of programs and projects in space activities sphere, including the creation of space rocket complex "Tsyklon-4" and National system of satellite communication. As a result of program fulfillment it is anticipated an increase at least by 1.5 times of production volume of rocket-space equipment and export of goods and

service by 2.3 % in 2013 and by 10.8 % in 2014. Optimistic forecast of Ukrainian rocket-space industry development reflects the global activity tendencies in this sector.

The data analysis [10–14] shows, that in the period of 2000–2011 among the countries – leaders in the sphere of space investigation and employment there were France, Germany, Japan, Great Britain and the USA that were demonstrating systematic, stable accumulation of gross expenses volume for research and development: for the period of 12 years the value indices increase was from 42.25 % for Great Britain up to 77.77 % for Germany (by equality of purchasing power). This group of countries is characterized by a systematic increase of expenses volume of private sector: in France and Japan the indices increase in 2011 even exceeded the gross expenses volume increase in relation to 2000.

During this period China and Russia have demonstrated a considerable increase of gross expenses volume and private sector expenditure for research and development. An increase by 664.77 % of the gross expenses indicator and by 866.05 % of the private sector expenditure indicator in China is caused by implementing the aggressive strategy of country's investment-innovative development. To support this fact there is a data closure regarding the aerospace industry in China. A significant increase of expenses on research and development in Russia (respectively by 234.13 % and 187.48 %) is a result of transformational processes, the reformation of economic management system and other factors.

In Japan and Russia a considerable reduction of private sector expenditure and an increase of financing the research and development in aerospace industry by state funds are still lasting. In France and Germany the sources of private sector as well as budget resources are equally involved to develop space activities. The USA encourage the activity to raise private funds for partnership relations in astronautics, showing in 2011 against 2000 the increase of private sector expenditure for research and development in aerospace industry by 189.31 %. The national aerospace industry financing by state budget establishes a significant segment of economic activity on the space technique and technology world market (*figure 1*).

Just the volume, forms and directions tendencies in financing define the development tendencies of both the world astronautics and Ukrainian space industry. This factor is becoming the most important one during transformational processes of the world activity in space technology and technique development area, as it sets up new promising opportunities for the industry's national enterprises.

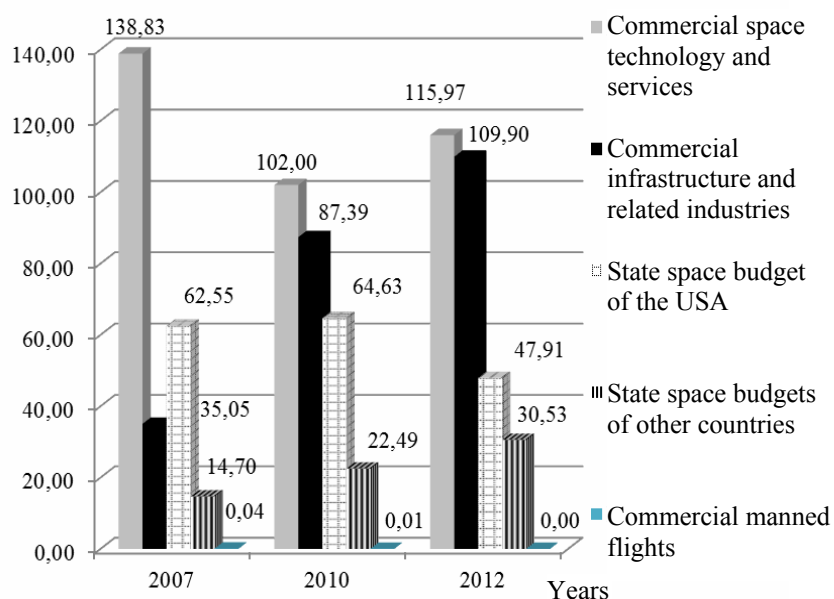


Figure 1. World activity financing in the sphere of space technique and technology development in 2007–2012, billion USD*

* Made by the author according to the data [15–17].

The principal factor of Ukrainian space industry development is a predomination of state ownership in the property structure of the majority of enterprises and the state exclusive right to distribute the manufactured goods. Production manufacturing at the industry's enterprises is made according to the state order or the contracts (projects) concluded between foreign partners and governmental bodies of Ukraine (the State space agency of Ukraine, the Cabinet of Ministers of Ukraine, the Ministry of Defense of Ukraine). Under such conditions an analysis of space industry financing by state budget of Ukraine is becoming topical (*table 1*).

The figures in *table 1* are visual evidence of the tendency to reduce the volume of budget programs financing of the Ukrainian space industry enterprises: by comparison with an indicator in 2008 the total sum of financing in 2011 was reduced by 38.85 %. The tendency of reducing is a typical one for almost all state financing programs, where the activity of industry's enterprises has been undertaken. The greatest volume reduction was observed under the Nationwide space program of Ukraine (by 73.30 % in 2011 against 2008).

The tendencies analysis of budget programs financing in 2008–2011 witnesses that the activities' restructuring and diversifying processes are still lasting at the Ukrainian space-rocket industry's enterprises: in 2010 the following programs "Administration and management in the sphere of space activities" and "Loans service for international projects" were accepted to be

financed. These programs' implementation caused an increase in the general structure of financing the area "Other budget programs" (by 71.34 % in 2011 against 2008) and, it is possible, initiated the programs of construction (purchase) of accommodation for servicemen as well as the restructuring, developing of the industry's key enterprises – executives of international projects and contracts. At the same time the main volumes of funds are directed to the international project "Tsyklon-4" implementation, which loans servicing in 2011 constituted 30.79 % in the financing programs general structure.

Table 1

Ukrainian space industry budget programs financing in 2008-2011 *

Programs of financing	2008		2009		2010		2011	
	%	mil UAH	%	mil UAH	%	mil UAH	%	mil UAH
Nationwide space program	30.37	222.97	20.16	82.39	17.7	60.06	13.26	59.53
Applied scientific and scientific and technological products	0.09	0.66	0.15	0.61	0.17	0.58	0.14	0.63
Space instruments running and trial	17.63	129.43	29.36	119.99	40.19	136.37	26.07	117.03
Propellant and ammunition utilization	36.18	265.62	22.51	91.99	23.9	81.10	23.16	103.97
Wind power plants' construction	2.25	16.52	–	–	–	–	–	–
Providing young people with aerospace education	0.44	3.23	0.8	3.27	1.06	3.60	0.83	3.73
Other budget programs, including	13.04	95.74	27.02	110.42	16.98	57.61	36.54	164.04
Administration and management in the sphere of space activities	–	–	–	–	4.22	14.32	3.68	16.52
Loans service for international projects (including "Tsyklon – 4")	–	–	–	–	12.76	43.30	30.79	138.22
construction (purchase) of accommodation for servicemen	–	–	–	–	–	–	1.78	7.99
Restructuring and development of CB "Pivdenne", "Pivdenmash"	–	–	–	–	–	–	0.29	1.30
Total	100.00	734.17	100.00	408.67	100.0	339.31	100.00	448.92

* Made by the author according to the data [11–13].

The results of structure analysis of products sold by types are rather interesting (*figure 2*). The Ukrainian space industry's enterprises demonstrate an increase of overall volumes of goods sold: an increase in sales in 2011 against the 2008 indices was 47.02 %. Such an increase was ensured by raising the space-rocket equipment sales volumes (by 44.27 % in 2011 against 2008) and by special purpose products sales volumes growth. In 2008 these two types of production were combined within the heading "Space-rocket production". The special purpose production, which was placed into a separate type, in 2011, demonstrated an increase of sales volumes by 81.41 %.

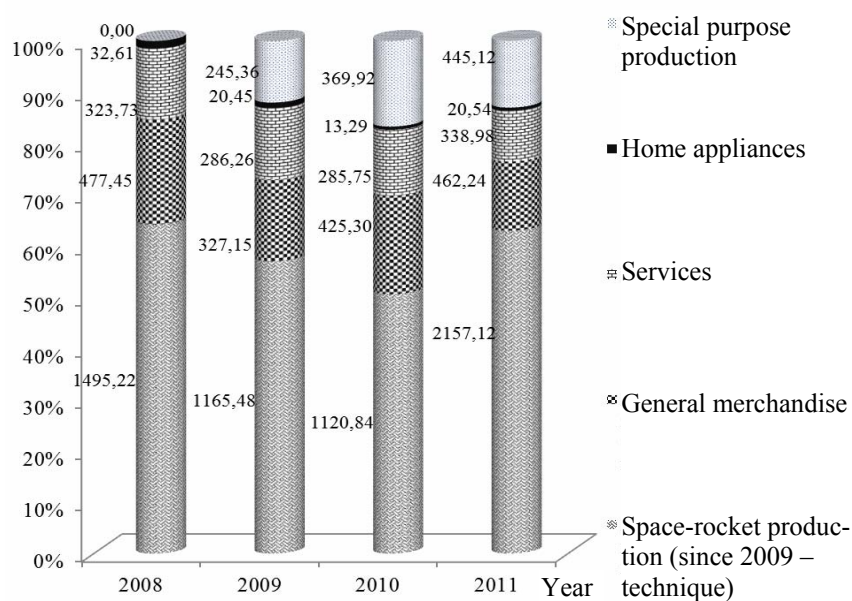


Figure 2. Sales of production by space industry's enterprises of Ukraine in 2008–2011 according to their types, mil. UAH*

* Made by the author according to the data [11–13].

Comparing with the dynamics of industry's budget programs financing (see table 1), it should be pointed out, that along with a production new type selling in 2009 there was an obvious increase of financing "Other budget programs" resulted in considerable growth of the share of this sphere within the programs' general structure. It has to be noted that since 2009, the budget institutions and scientific organizations of dual-purpose have not been included into the index of the overall sales volume of the industry's production.

The space industry production is systematically a component of high technology export of Ukraine that is characterized by the tendency to increasing (figure 3). According to the press service's reports of the State space agency of Ukraine [18], the production sales volumes of the Ukrainian space industry's enterprises in 2012 rose by 17.7 % against 2011 (respectively they were in terms of value indices near 4006.08 mil. UAH).

Thus, in the period of 2008–2012 the industry's sales volumes rose by 72.01 %, mainly at the expense of the space-rocket technique manufacturing and work fulfillment according to the Program of solid propellant utilization and drilling-and-blasting operations. The production announced share to the export in the overall sales volume constitutes 61.7 % or nearly 2471.75 mil. UAH. As Figure 3 shows, the industry enterprises' activity is characterized by the tendency to increasing the production sales volumes to the export (in 2012 there was a growth by 124.37% against the 2008 indices). Such a tendency is well-grounded for relative ratio as well as for value indicators: syste-

matically the production share to the export in the overall sales volume is increasing (61.7 % in 2012 p. against 47.3 % in 2008), more than double increase of the sales value volumes is observed (2471.75 mil. UAH in 2012 against 1101.62 mil. UAH in 2008). In 2009 the principal export products were carrier-rockets for the international space projects "Sea launch", "Ground launch", "Dnipro", control systems for the carrier-rockets "Soiuz", "Proton", docking systems "Course". In 2012 the principal export products also were rocket-space technique that is confirmed by the correspondent growth of this production type in overall sales volumes.

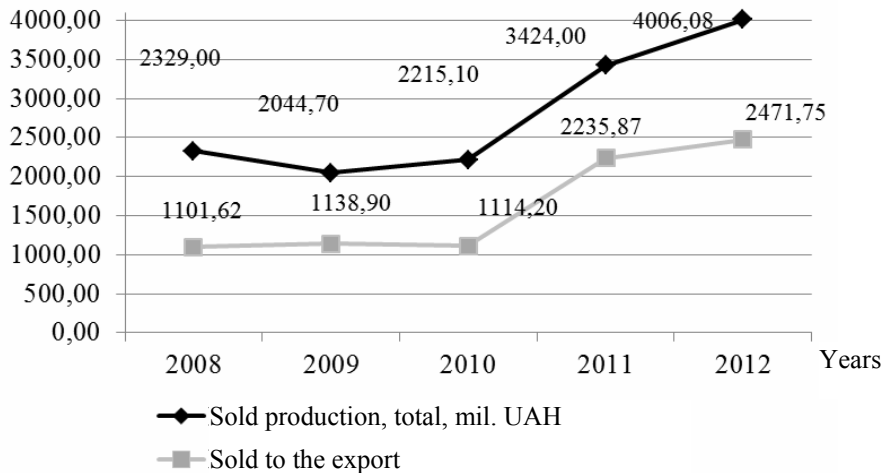


Figure 3. The Ukrainian space industry's production selling to the export in 2008–2012, mil. UAH*

* Made by the author according to the data [11–13; 18].

The investigation results have proved the intellectual-personnel potential's significant impact on the character and effectiveness of the Ukrainian space industry enterprises' activities (*table 2*).

The analysis of *table 2* shows, that the industry's enterprises suffer a reduction of overall amount of employees (reduction was in 2011 by 11.85 % against 2008). At the same time there is an increase of the young people under 35 (by 40.42 % in 2011 against 2008). A considerable rejuvenation of human resources, working at the industry's enterprises, is accompanied by gradual reduction of employees, who have general secondary and higher education, as well as those who have an academic degree. At the same time it should be highlighted that there is a significant increase of quality indices: in the period of 2008–2011 the index of products sold per one employee was grown by 66.77 %, and the index of export products sold per one employee – by 130.24 %.

Table 2

**The effectiveness' description of the intellectual-personnel potential's
employing by the Ukrainian space industry enterprises in 2008–2011 ***

Indices	2008	2009	2010	2011	Increase (2011 to 2008), %
Total number of employees, thous. pers., including those who	32.50	31.00	30.20	28.65	-11.85
have general secondary and higher education, thous. pers.	16.25	20.00	14.00	13.70	(15.69)
have academic degree, thous. pers.	0.195	0.190	0.190	0.184	(5.64)
at the age under 35, mil. pers.	4.55	4.81	6.64	6.39	40.42
Products sold per 1 employee, thous. UAH	71.66	65.96	73.35	119.51	66.77
Export products sold per 1 employee, thous. UAH	33.90	36.74	36.89	78.04	130.24

* Calculated by the author according to the data [11–13].

Conclusion. The assessment results of the rocket-space industry's national enterprises' potential in relation to the world activity in the space technique and technology sphere have allowed to make conclusions concerning the development prospects of this high technology sector in the economy.

Firstly, the increase of overall sales volumes of both the production and the export products of the Ukrainian rocket-space industry's enterprises witnesses the presence of demand for the national high-technology core production on the space technologies' world market. But opposite side of this fact is the lack of domestic market due to the state monopoly on the national space production. Technologies, which "are flowing out" from the country without being launched within the national system, reduce an overall effect produced by the high-technology sector's development.

Secondary, the accumulation of private investment volumes into aerospace industry in the leading countries is accompanied by dynamic development of commercial space technology and services segments as well as of commercial structure and related industries that show the greatest growth rates and, therefore, the biggest profit. The necessity to allow the private funds to enter into the national rocket-space industry is caused by the discovered tendencies of reduction and insufficiency of financing the space programs by the state budget of Ukraine.

Thirdly, the reduction of the employees' total number, the quantity of employees who have general secondary, higher education and academic degree at the Ukrainian rocket-space industry's enterprises can be viewed as a demonstration of the set of the economy system domestic problems.

The relationships of high technology sectors with the national and international universities regarding the personnel recruitment and scientific studies require the further investigation.

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Нямышук Г. Високотехнологічні сектори економіки: національний і міжнародний виміри.

Постановка проблеми. Досвід реалізації інноваційної моделі розвитку в рамках національних економік провідних країн світу підтверджує стратегічне значення секторів, що є конкурентоспроможними у світовому масштабі. **Метою** статті є оцінка потенціалу ракетно-космічної промисловості України у взаємозв'язку із світовою активністю в сфері розвитку космічної техніки і технологій.

Матеріали і методи. Інформаційними матеріалами є статистичні дані Організації економічного співробітництва і розвитку, Державної служби статистики України, звітні документи про світову активність у сфері розвитку космічної техніки і технологій Spacefoundation, Річні звіти Державного космічного агентства України, повідомлення з офіційних засобів масової інформації.

Методичний апарат дослідження становлять такі методи: загальнонаукові, визначення прямих та зворотних зв'язків між економічними явищами та процесами, творчо-критичний та описово-аналітичний.

Результати дослідження. Зворотним боком попиту на українську високотехнологічну профільну продукцію на світовому ринку космічних технологій є відсутність внутрішнього ринку. Технології, що "витікають" з країни, не маючи впровадження всередині національної системи, зменшують сумарний ефект від розвитку високотехнологічного сектора.

Висновки. Нарощення обсягів приватних інвестицій в аерокосмічну галузь у країнах-лідерах супроводжується активним розвитком комерційних сегментів, що демонструють найбільші прибутки. Це потребує допущення приватного капіталу в національну ракетно-космічну промисловість, а також подальшого вивчення зв'язків високотехнологічних секторів із національними і світовими університетами щодо кадрового забезпечення та наукових розробок.

Ключові слова: високотехнологічний сектор економіки, аерокосмічна галузь, ракетно-космічна промисловість, високотехнологічний експорт України.