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## **SPACE TECHNOLOGIES TRANSFER AS AN ECONOMIC GROWTH DRIVER**

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*This article deals with the analysis of the main features of the space industry impact on economic development. The basic effects and factors of economic development of space activities are determined. The trends of technological component industry are analyzed.*

**Keywords:** technology transfer, finance, economics of space industry, international cooperation.

**Introduction.** Space economy is the full range of activities and use of resources that create and provide value and benefits to human beings in the course of exploring, understanding and utilizing space. Space activities are focused on improving the efficiency of solving problems of an economic nature, to ensure national security and contributes to the development of national science and technology.

The three major sectors of the space industry are: satellite manufacturing, support ground equipment manufacturing, and the launch industry. Also commercialization of space is the use of equipment sent into or through outer space to provide goods or services of commercial value, either by a corporation or state.

Technological innovation drives competitiveness and growth, while innovations are driven by many factors, but the exploration and exploitation of the space frontier is one of them. The focus of space exploration today is in the economic arena. Rising living standards and technological advancement around the world mean greater competition from places that were never competitors before.

**Analysis of recent researches and publications.** OECD [3; 5; 6], European Space Agency (ESA) [7], International Space Exploration Coordination Group [1] publication which provides findings on the socioeconomic contributions that may be derived from the use of space applications, with an extensive review of existing assessing methodologies.

**Previously unsettled problem constituent.** The task of evaluating the effectiveness of space projects is an important issue. Successful solution of this task depends on the accuracy of the findings of the scientific significance of the results of the social and economic efficiency of planned and completed projects in space industry.

**Main purpose of the article** is to analyze the main economic effects of space economy and consideration of the main tasks of technology management.

**Results and discussions.** The space sector has often been considered one of the main frontrunners of technological development, since the beginning of the space age. Benefiting from advances in related domains (e.g. material sciences), the number of space-related patents has almost quadrupled in 50 years.

The exploration of space is an engine for creation. It sparks high-tech and high-paying jobs. The main source of economic effect of space industry has technological base.

The most common economic measurement for any technology's value is the calculation of benefits and costs. In theory, to calculate the ratio, it is necessary to divide the benefits (e.g. improved productivity, decreased cost of operations, increased revenue and better customer satisfaction rates when applicable) by the costs of deploying the system (e.g. hardware, software, maintenance, training and so forth).

However space systems are by nature multifaceted and rely often on lengthy research and development. The challenge of putting a monetary value on the technologies and services they deliver remains a complex and often subjective exercise. As discussed in OECD (2008), monetary or financial valuation methods fall into three basic types, each with its own repertoire of associated measurement issues and none of them entirely satisfactory on its own. They include:

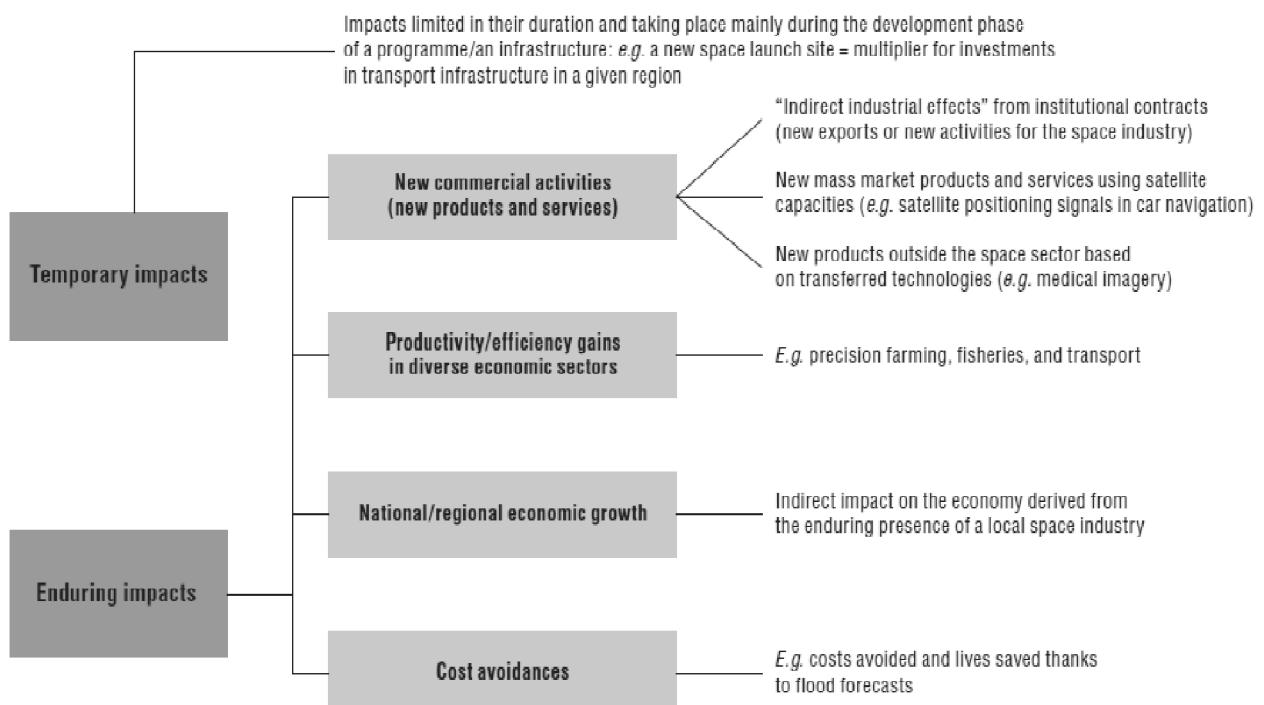
- direct market valuation (e.g. market pricing);
- indirect market valuation (e.g. replacement cost);
- survey-based valuation techniques (i.e. contingent valuation and group valuation).

One option is to use several of these methods in parallel to test assumptions and the resulting impacts of a given space application. Ongoing work in OECD is devoted to conducting case studies on selected space applications, in order to provide a source of comparative national experiences and lessons learned when trying to apply the different methodologies to the study of impacts.

Space investments can also provide socio-economic returns such as increased industrial activity, and bring cost efficiencies and productivity gains in other fields (e.g. weather forecasting, tele-medicine, environmental monitoring and agriculture previsions). Several space applications have reached technical maturity and have become the sources of new commercial downstream activities, sometimes far removed from the initial space research and development. For example, the growth of

positioning, navigation and timing applications, which rely on satellite signals, has spurred new commercial markets (e.g. GPS chipsets in smartphones). But as Einstein wrote: «Not everything that counts, can be counted». This is also true for the diversity of socio-economic impacts derived from space activities.

As shown in Fig. 1, impacts can be categorized in different segments: new commercial products and services (including “indirect industrial effects” from space industry contracts, meaning new exports or new activities outside the space sector), productivity/efficiency gains in diverse economic sectors (e.g. fisheries, airlines), economic growth regionally and nationally, and cost avoidances (e.g. floods). The following sections review some of the impacts that have been detected so far.

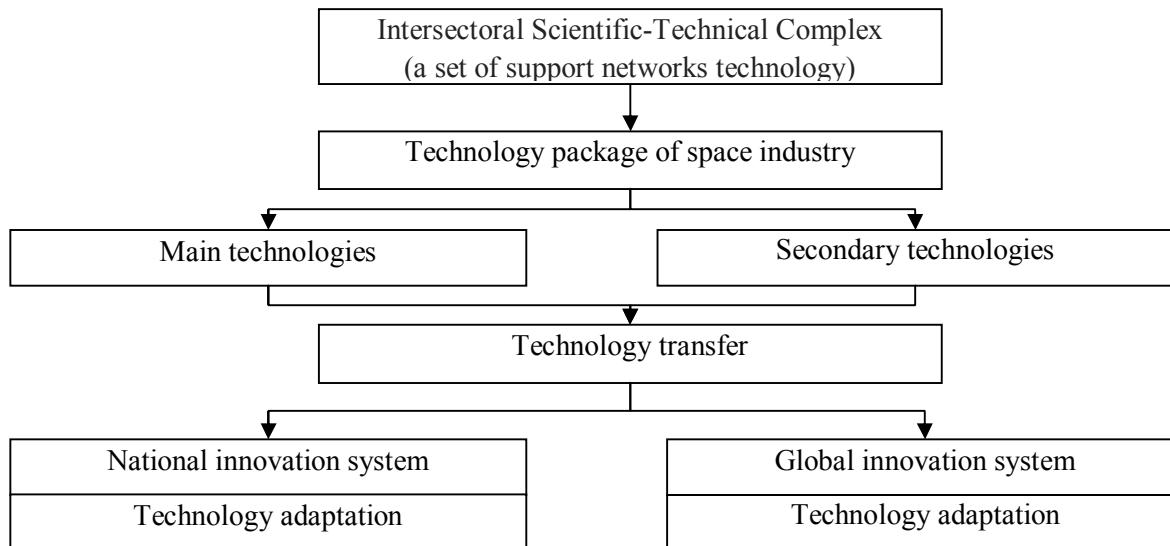


**Fig. 1. Review of possible impacts derived from space programs investment**

The main objective of the industry is the creation of conditions for the integration processes in the space technology and civil industries. the essence of this is to provide enterprises and industries common scientific and technological environment, which would be able to develop and produce a wide range of high-tech products of rocket and space, defense and civil purposes, the establishment on the basis of existing production more efficient and flexible enterprises with different forms of ownership, including joint ventures with significant high-tech industries that are attractive to domestic and foreign investors.

Based on these findings the technology transfer of space industry technologies can be defined as the driving force of economic development (Fig. 2). This approach

is based on analyzing direct and indirect benefits of space tech development.



**Fig. 2. International space technology transfer as a factor in economic growth**

The direct benefits of exploration include the generation of scientific knowledge, the diffusion of innovation and creation of markets, the inspiration of people around the world, and agreements forged between the countries engaged in exploration.

Indirect benefits that result over time include tangible enhancements to the quality of life such as improved economic prosperity, health, environmental quality, safety, and security. They also include intangible philosophical benefits such as a deepened understanding and new perspectives on humankind's individual and collective place in the Universe.

Space exploration thus supports innovation and economic prosperity by stimulating advances in science and technology, as well as motivating the global scientific and technological workforce, thus enlarging the sphere of human economic activity.

**Conclusions and directions of further researches.** Space industry is the engine of innovation development of the economy that contribute to a synergistic effect of the introduction of high-tech products, services, goods in various sectors of the economy. For more than 40 years, the technologies and research derived from space exploration have been successfully applied to a long list of items that enhance our quality of life here on Earth. Space-based systems deliver information and services that protect lives and the environment, enhance security and stimulate industrial and economic development. The next ten years will be essential for building international partnership for exploration. This will offer opportunities to developed and emerging space nations to contribute according to their needs and capabilities.

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## **ТРАНСФЕР ТЕХНОЛОГІЙ КОСМІЧНОЇ ГАЛУЗІ ЯК ФАКТОР ЕКОНОМІЧНОГО ЗРОСТАННЯ**

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*Стаття присвячена аналізу основних особливостей впливу космічної галузі на економічний розвиток. Проаналізовано основні ефекти та фактори розвитку економіки космічної діяльності. Визначено тенденції управління технологічною складовою галузі.*

**Ключові слова:** трансфер технологій, космічна галузь, фінансування, економіка космічної галузі, міжнародне співробітництво.

## **ТРАНСФЕР ТЕХНОЛОГИЙ КОСМИЧЕСКОЙ ОТРАСЛИ КАК ФАКТОР ЭКОНОМИЧЕСКОГО РОСТА**

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*Статья посвящена анализу основных особенностей влияния космической отрасли на экономическое развитие. Проанализированы основные эффекты и факторы развития экономики космической деятельности. Определены тенденции управления технологической составляющей отрасли.*

**Ключевые слова:** трансфер технологий, космическая отрасль, финансирование, экономика космической деятельности, международное сотрудничество.