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From Philosophy of Cosmos to Space Policy: Contemporary Issues and Trends

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The paper aims to study the connection between the philosophy of cosmos and space policy. The authors argue that the research of the philosophy of cosmos stipulates the space policy research. Philosophy of cosmos studies the influence of knowledge about the Universe on human ethics. The more humans reveal for themselves the structure of the Universe and understand their place in it, the more the acquired knowledge affects space activities. The article discloses current trends in space policy that determine the perspectives for the exploration of the Universe. The authors substantiate space policy trends with the history and experience of cooperation between NASA and commercial structures. The features of the U.S. space policy development over the past five years are investigated. The results of the analysis lead to the conclusion about the dominant role of governments in modern space policy, even despite the involvement of private companies in space activities. The example of the United States proves the expanding influence of space policy in the national policy of the state due to the perspectives of the space industry, its high technological capacity and the increase in the number of jobs.

Keywords: philosophy of cosmos, space policy, cosmology, space policy perspectives, commercial space policy, NASA

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Introduction

The paper studies the connection between the philosophy of cosmos and space policy. The authors argue that the research of the philosophy of cosmos stipulates the space policy research. The research subject of the philosophy of cosmos is well beyond the narrow limits of cosmology. Philosophy of cosmos studies the influence of knowledge about the Universe on human ethics and discloses new perspectives of human civilization development. The more humans reveal for themselves the structure of the Universe and understand their place in it, the more the acquired knowledge affects their plans of the Universe resources exploration. Space activities are determined and regulated by the state policy. The authors investigate the influence of the philosophy of cosmos on space policy, as well as current trends in space policy that determine the perspectives for the exploration of the Universe.

Issues in the philosophy of cosmos

Contemporary issues and trends in the philosophy of cosmos are presented in the review article of Christopher Smeenk and George Ellis (Smeenk & Ellis, 2017). It is worth attention that the English-language literature makes use of three interchangeable terms to designate the discipline that explores the conceptual foundations of the Universe. They are "philosophical cosmology," "philosophy of cosmology," or "philosophy of cosmos." The most frequent one is the "philosophy of cosmology." The research subject of philosophy of cosmology is "the explanatory scope of cosmology." It involves (Smeenk & Ellis, 2017),

1. Research status of the Standard Model.
2. Research of the general version of underdetermination.
3. Explanation of the nature and purpose of the origin of the Universe.
4. Anthropic reasoning and multiverse.
5. Verification of cosmological models.
6. Opportunities of the human implications of cosmology.

The term "philosophy of cosmology" is promoted by Cambridge University Press, which annually publishes the results of long-term international collaboration between leaders in cosmology and the philosophy of science (The Philosophy of Cosmology, 2017). Cambridge University Press clearly identifies the subject of the research in "philosophy of cosmology." It is limited to physics and astronomy, cosmology, relativity and gravitation, history, philosophy, and foundations of physics (The Philosophy of Cosmology, 2017).

It is worth noting that the term "cosmology" was first coined in 1730. The study of "Cosmologia Generalis" by the German philosopher Christian Wolff has survived to this day. Cosmology developed as a branch of philosophy and is literally translated as "space exploration." Therefore, in its literal meaning, the term "philosophy of cosmology" implies a philosophical understanding of the space exploration results. It is an even narrower discipline than cosmology, based on metaphysics, epistemology, and logic.

For this reason, the equivalence and interchangeability of the terms "philosophy of cosmology" and "philosophy of cosmos" are questionable. In the first case, a narrow aspect of cosmology is considered, namely, the *philosophy* of cosmology. In the second case, the cosmos becomes the subject of philosophy research. Cosmology is just one of the scientific disciplines that explores the cosmos as the Universe. Therefore, the use of the term "philosophy of cosmos" suggests a completely different scale of research into the Universe. Philosophy of cosmos unites scientific knowledge of cosmology, astronomy, physics, etc.,

as well as a purely philosophical reflection based on the methodology of metaphysics, epistemology, logic, etc.

Thus, we argue that the terms "philosophical cosmology" and "philosophy of cosmology" are indeed interchangeable. They emphasize the field of cosmology research and involve the use of philosophical methodology within the boundaries of a specific scientific discipline. However, the term "philosophy of cosmos" has a different semantic meaning.

First, the use of the term "cosmos" frees philosophy from subjection to cosmology, as in the case of using the terms "philosophical cosmology" and "philosophy of cosmology." The cosmos is studied not only by cosmology, but also by many other scientific disciplines. Therefore, the use of the term "philosophy *of cosmos*" emphasizes *that philosophy explores cosmos in order to use the knowledge gained for a better organization of earthly civilization* (Bazaluk & Kharchenko, 2018). Philosophy acts as a platform on the basis of which scientific knowledge about the Universe is combined and systematized. Knowledge about the Universe is transformed into a specific frame of reference and promoted as a special discourse and way of life (Bazaluk & Kharchenko, 2018). For example, consider the course of Philosophy of the Cosmos, which is currently offered by The Australian National University (Canberra) as an undergraduate course (Philosophy of the Cosmos, 2020). This course is taught to students of the Mathematical Sciences Institute. The course assumes that upon successful completion, students will have the knowledge and skills to (Philosophy of the Cosmos, 2020):

a) demonstrate an understanding in the outline of the history of cosmology and contemporary cosmology;
b) demonstrate a conceptual understanding of relativity theory;
c) appreciate that many of the theories underlying modern cosmology are contentious;
d) understand what would be involved in further study in the philosophy of science and cosmology; and
e) make a habit of an educated questioning of scientific orthodoxy.

As it can be seen, the *Philosophy of the Cosmos* course includes the results of cosmological research and gives them a specific practical focus.

Second, the use of the term "philosophy *of cosmos*" conveys the complexity of the relationships between cosmology and history. By history, we mean, first of all, social philosophy. The term "philosophy of cosmos" embraces the scope of social philosophy developed under the influence of continuously updated knowledge about the cosmos. For example, the richness of the relationships that have developed between cosmology and social philosophy is conveyed by "Cosmos and History: The Journal of Natural and Social Philosophy." The subject field between cosmology and social philosophy can be described as follows: "The tension between cosmology, conceiving the cosmos as an immutable, timeless order, and history, concerned with actions, intentions, conflicts and the rise and fall of individuals and communities, has been at the core of virtually all intellectual and political oppositions throughout the history of European civilization. What is required is a combination of natural and social philosophy, transcending all disciplinary boundaries, concerned with the fundamental issues of understanding the cosmos and our place within it as historical agents" (Cosmos and History, 2020). The articles presented in the journal reveal that the real influence of knowledge about the cosmos on the development of the way of human life.

Third, we use the term "philosophy *of cosmos*" for a reason indicated by Alfred Kracher (Kracher, 2020). Kracher pointed out that humans are part of the Universe and the result

of evolutionary processes within it. The acknowledgment of this fact determines human behavior and makes people dependent on the results of space exploration. It is here that the foundations of human behavior and decisions are formed regarding spaceflight and using the cosmos for scientific, commercial, and military purposes.

Thus, the use of the term "philosophy of cosmos" reveals the real connection between knowledge about the Universe and the attitude of humans to the cosmos. Space policy is the main manifestation of this connection in practice.

Space policy perspectives

Philosophy and politics were created and seen by Plato as a whole (Plato, 2020). In fact, space policy is the logical conclusion of the research of philosophy of cosmos in practice.

Space policy was developed in the 1960s as a result of ideological competition between the United States and the Soviet Union. Space exploration was viewed primarily as an image of the state, emphasizing its power and greatness. Outer space was a continuation of foreign policy and underlined the intellectual and technological superiority of the state. Henry Lambright claims that even decades after the collapse of the USSR, ideology and national image remain the basis of the U.S space policy (Space Policy, 2002).

Contemporary issues of space policy are illustrated by the journal with the same name. *Space Policy* draws on the fields of international relations, economics, history, aerospace studies, security studies, development studies, political science and ethics to provide discussion and analysis of space activities in their political, economic, industrial, legal, cultural and social contexts (Space Policy, 2020).

As one can see, space policy covers a wide aspect of interdisciplinary knowledge, the main feature of which is its practical orientation. Space policy is closely related to economic and defense policy and is governed by space law.

Space policy determines and regulates space activities. Over the past several decades, space activities have gone beyond the boundaries of research institutes and ended with the creation of the space industry.

The scale of space activities is growing rapidly, as evidenced by the growing complexity of the main regulatory acts (Drozd, 2019), as well as the Space Foundation Annual Report 2019 (Space, 2019). The document reveals the accents of modern space policy. Pay attention to the following conclusions (Space, 2019):

1. Space policy perspectives. The global space economy grew more than 8% in 2018 that amounted to $414.75.
2. Emphasis on the development of the commercial use of the cosmos. Currently, the cosmos use is more than 79% of the space economy. It is nearly $330 billion.
3. 81 countries are involved in space activities as of 2019. 40 Spaceports are in use, and 10 more are in the final stages of construction.
4. Space Economy employs more than 1 million workers (as of 2017).

In the 21st century, space policy has undergone significant changes (Petronia & Bianchi, 2016). It still remains the hallmark of highly developed countries and occupies an important place in the development of state and regional strategies for sustainable development. However, an increasing number of world countries began considering space policy as a priority direction of their sustainable development. From our point of view, the relevance of space policy is explained by two reasons:

1. The dependence of national security on the degree of space policy development.
2. The increased influence of the space industry on the economic development of the state.

Both reasons can be considered in more detail.

Space policy and national security

In the last decade, the role of the state in space activities has been steadily declining, giving war to commercial activities. However, governments reserve the right to control and regulate. This is done within the framework of national policy, of which the space policy is a part. President Trump highlighted the key role of space policy in government policy as follows: "Our travels beyond the Earth propel scientific discoveries that improve our lives in countless ways here, right here, at home: powering vast new industry, spurring incredible new technology, and providing the space security we need to protect the American people" (President, 2018).

The United States is currently the leading space power. In 2018, the U.S. government space budgets amounted to 11.6% ($48.31 billion) and Non-U.S. government space budgets — 9.1% ($37.58 billion) of the total budget of the space economy (Space, 2019). Therefore, using the example of the National Space Policy of the United States of America, the scale of the influence of the U.S. government on the space policy can be considered.

An analysis of the regulatory acts proves that the U.S. government determines the space policy. Each president of the United States reserves the right to determine the space policy. For example, the decision of President George W. Bush (2001–2009) opened the way for commercial structures in NASA programs (Commercial, 2014). President Barack Obama (2009–2017) expanded the commercial sector's ability to transport crew to and from the Earth orbit. President Donald Trump (2017–2021) in The National Security Strategy clearly defined that "the United States must maintain our leadership and freedom of action in space" (National Security Strategy, 2017).

Consider the sequence of actions by the Trump administration to strengthen the U.S. leadership in space activities. Between January 2017 and December 2020, the Trump administration initiated a series of documents that identified the U.S. space policy. Each document is aimed at consolidating the U.S. leadership in space activities, as well as implementing the stated provisions of The National Security Strategy. Here is a brief review of the adopted documents:

1. Space Policy Directive 1, December 11, 2017. The directive is called "Reinvigorating America's Human Space Exploration Program." The document changes the space policy of the previous President Obama and contains NASA instructions on how to create a base on the lunar surface for the purpose of human exploration of Mars (Reinvigorating, 2017).
2. "National Space Strategy," March 23, 2018. The document unequivocally emphasizes the priority of the United States in space exploration, as well as the direct connection between the space policy and national security policy. "President Trump's National Space Strategy works within his broader national security policy by putting America's interests first" (President, 2018).
3. "Streamlining Regulations on Commercial Use of Space," Space Policy Directive-2, May 24, 2018. The document reforms commercial space regulations and appoints the Department of Commerce in charge of space activities in the

commercial space sector (Streamlining Regulations, 2018).

4. "National Space Traffic Management Policy," Space Policy Directive-3, June 18, 2018. The document clearly states that for decades, the United States benefited from work in space to strengthen national security. The document aims to strengthen the U.S. in space exploration, in particular, "establishes agency roles and responsibilities for space situational awareness and space traffic management" (National, 2018).
5. "Establishing a U.S. Space Force," Space Policy Directive-4, February 19, 2019. The document initiated the creation of the U.S. Space Force as part of the U.S. Air Force. According to the document of the U.S. Space Force must ensure unhindered access and freedom of action of the United States and its allies in space during peacetime and across the entire spectrum of conflicts (Establishing, 2019). The document predetermines the Establishment of United States Space Command as a Unified Combatant Command, thereby establishing that U.S. officials will lead any future space military operations (Establishing, 2019). It is worth noting that the initiative of the Trump administration was supported by the U.S. Congress in 2020.
6. "Executive Order on Encouraging International Support for the Recovery and Use of Space Resources," April 6, 2020 (Executive Order, 2020). The document clearly indicates that the United States does not recognize The Moon Agreement (Agreement, 1979). The USA will be guided by its own policy and internal laws regarding the extraction of resources on the Moon and other places in the solar system, especially concerning commercial exploration, recovery and use of such resources (Executive Order, 2020).
7. "Cybersecurity Principles for Space Systems," Space Policy Directive-5, September 4, 2020. The document focuses on ensuring that all components of space systems are under the full control of the U.S. government. It concerns the space systems that provide "global communications; positioning, navigation, and timing; scientific observation; exploration; weather monitoring; and multiple vital national security applications" (Cybersecurity Principles, 2020).
8. "National Space Policy of the United States of America," December 9, 2020 (National Space Policy, 2020).

Pay attention to the first two tasks that must be performed by The United States Space Force. They emphasize the direct connection between Space policy and national security (Establishing, 2019):

1. "Protecting the Nation's interests in space and the peaceful use of space for all responsible actors, consistent with applicable law, including international law." It is worth mentioning that The United States Space Force is created primarily to protect "the Nation's interests," where "applicable law" ranks first and "international law" — only the second. The document confirms the prerogative of U.S. law over international law. It allows The United States Space Force to be guided in space conflicts mainly by the provisions of its own legislation.
2. "Ensuring unfettered use of space for United States national security purposes, the United States economy, and United States persons, partners, and allies." Pay attention to the phrase "Ensuring unfettered use of space for United States national security purposes." This task initially creates a conflict of interest, especially

taking into account the document "Executive Order on Encouraging International Support for the Recovery and Use of Space Resources," adopted on April 6, 2020 (Executive Order, 2020). A significant part of the 81 states participating in space programs is not partners and allies of the United States. Therefore, for example, the development of the resources of the Moon in the foreseeable future gives a reason for using The United States Space Force.

Commercial space policy

Oleksandr Svetlichnyj and Diana Levchenko revealed the problems of space exploration by individuals and companies that have stepped up space activities. The authors paid attention to the fact that space objects and natural resources should belong to all of humanity and not to individual states or private enterprises. The adoption of the legislation of the United States and Luxembourg on the legalization, production, use, and appropriation of the space resources by private enterprises, on the one hand, fully complies with international obligations. However, upon closer examination, it turns out that they violate the principles governing the activities of states in the exploration and use of the cosmos, space resources, including the Moon and other celestial bodies, "which are not subject to national appropriation, neither by proclaiming sovereignty, nor by uses or occupation, nor by any other means" (Svetlichnyj & Levchenko, 2019).

Over the past decade, the U.S. government has been actively engaging private companies in space activities. It should be noted that most of the regulatory documents that form the basis of the space law are concluded at the state level and provide only interstate regulation. The foundations of space law do not imply the participation of private companies in space activities. Therefore, at present, the participation of private companies and the commercialization of space research is regulated by national laws. The use of private companies in the space policy allows the United States not to formally violate international agreements, on the one hand. However, on the other hand, the U.S. government regulates commercial space activities, effectively monopolizing the future development of the resources of the Moon and Mars.

The U.S. space policy uses the following mechanisms to influence the private sector of the space industry:

1. Public-private partnerships in which the government and the private sector share the risks and rewards of investing in space activities.
2. Influencing government agencies to purchase services from specific private companies.
3. Concluding traditional contracts with the fixed price for services and products of private companies.

Using NASA as an example, consider a relatively short history of public-private partnerships in the space sector. The impetus for the development of the public-private sector of the U.S. space activities was provided by President George W. Bush's decision in 2004 to abandon the space shuttle program. NASA was tasked with solving the problem of delivering cargo and crews to the ISS as soon as possible. It was the first time when private companies have been involved in solving this problem.

The first commercial cargo flights began in 2012. This outstanding success was achieved as a result of competition between two private companies: Space Exploration Technologies (SpaceX) and Rocketplane Kistler (subsequently replaced by Orbital Sciences Corp. (OSC)). In 2016, a third company, Sierra Nevada Corporation (SNC) was recruited to participate in

the transportation of space cargo. The Commercial Orbital Transportation Services report presented the history of the Commercial Crew & Cargo Program Office from 2006 to 2013 (Commercial, 2014). Two main features can be highlighted, which subsequently changed the space policy (Commercial, 2014):

1. It turned out to be beneficial for state corporations to share risks with private companies in the early stages of developing new space projects. The prospect of cooperation with the state encourages private companies to invest heavily in new space projects. On the one hand, there are prospects for obtaining government orders. For example, SpaceX and Orbital Sciences Corp. both invested about $800 million in the development of the COTS program. However, two years later, SpaceX received a government order for $1.6 billion, and Orbital Sciences Corp — for $1.9 billion. On the other hand, the prospects for the technological progress of private companies opened up. For example, in 2006, the number of SpaceX employees was up to 160. In 2020, the number of employees was up to 8000 people despite the fact that SpaceX focuses exclusively on high-tech production that reduces the amount of human labor.
2. It turned out to be profitable for state corporations to lease spaceports and launch sites, as well as to hire private companies to provide space services. For example, NASA concentrated its potential on global projects, while private companies acted as contractors in the maintenance and development of ready-made space projects. The total development cost of SpaceX's Falcon 1 and Falcon 9 rockets is estimated at approximately $ 390 million. In 2011, NASA estimated that it would cost the agency $4 billion to develop a rocket like the Falcon 9 launch vehicle. It is worth noting that SpaceX and Orbital Sciences Corp. experienced certain problems with the execution of NASA contracts. On July 5, 2015, the seventh launch of the SpaceX's Falcon 9 rocket was unsuccessful. The third flight of Orb-3 on October 28, 2014, ended in failure. However, all these failures did not affect the interests of the state and were overcome by the efforts of exclusively private companies.

President Obama had a key influence on Crew Transportation Concepts and Technology Demonstration. In 2010, he made a decision to expand the capabilities of the commercial sector to support transportation of crew to and from the Earth orbit, which was unpopular at NASA. The President's decision forced NASA to conclude contracts with five private companies and involve them in the development of commercial manned space flight capabilities. In February 2010, NASA signed contracts with five private companies for a total of about $50 million. These are (NASA, 2010):

1. Blue Origin will receive $3.7 million.
2. The Boeing Company will receive $18 million.
3. Paragon Space Development Corporation will receive $1.4 million.
4. Sierra Nevada Corporation will receive $20 million.
5. United Launch Alliance will receive $6.7 million.

In April 2011, contracts were signed with four more private companies: Blue Origin, Boeing, Sierra Nevada and SpaceX.

On August 3, 2012, NASA officially announced that Boeing, SpaceX, and the Sierra Nevada were the winners of the Commercial Crew Integrated Capability (CCiCAP) awards. The above companies received funding to develop an integrated crew transportation system.

The system included the creation of spacecraft, launch vehicles, and ground systems. Boeing obtained $460 million, SpaceX — $440 million, and the Sierra Nevada — $212.5 million.

On September 16, 2014, NASA started the last phase of Commercial Crew Transportation Capability (CCtCAP). Contracts were concluded with Boeing ($4.2 billion) and SpaceX ($2.6 billion) to complete the commercial crew development program. The first test launch of astronauts aboard SpaceX's Crew Dragon commercial system took place on May 30, 2020.

Conclusions

The conducted research allows the authors to draw the following conclusions:

1. Philosophy of Cosmos stipulates space policy. Philosophy of Cosmos systematizes the exploration of the Universe and opens up space resources for human exploration. Philosophy of Cosmos makes outer space accessible to humans. Even now, the resources of the Moon and Mars have fallen into the scope of interests of highly developed states, which regard them as a continuation of national policy and economy.
2. Space Policy stipulates space activities. The study justifies the key role of space policy in national policy. Using the example of the United States, the authors proved the expansion of the influence of space policy due to the involvement of private companies in space activities and the creation of the space industry. Currently, the space industry is regarded as the most promising sector of the economy, capable of ensuring sustainable development and prosperity of the state.

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