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UNDERSTANDING SPACE SECURITY CULTURE AS A NEW EXPLORED HUMAN ENVIRONMENT

This article focuses on systematizing the artificial environments that humans produce in the course of conscious activity. With dynamic technological progress, these, in turn, evolve and become separate entities. Here, the authors attempt to "extend" the artificial human environment to include the space environment. Whether it should be treated as a separate entity from well-known environments such as the rural, urban, industrial, military, and cyberspace will be the subject of the authors' interest and scientific inquiry. As human activity in space increases, including satellite launches, exploration missions, and potential economic ventures, the creation of a robust space security culture becomes a necessity. Anthropocene man (Sommer, Zakrzewski 2017b) expands on the planet Earth, which is why he looks so eagerly towards Space. The kind of safety culture that will be brought to the newly explored environment will be the subject of piecemeal research. The central problem is formulated as follows: *Should humanity learn about and explore Space?* Undoubtedly, the decision to explore space is complex and requires consideration of the potential benefits against the associated costs and ethical considerations.

Keywords: Space, ecosystem, security culture.

1. INSTEAD OF AN INTRODUCTION

Since the dawn of mankind, primitive man has always looked at the sky and asked himself what secrets the universe holds[3]. Today, due to its exploration, the word "Space" is used more often. These terms mean the same thing – that is, everything that is outside the Earth and it is:

> the arrangement of all astronomical objects, scattered matter and physical fields together with the space-time they fill". It is space together with the matter in it

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[3] Latin "universum" was created almost 14 billion years ago as a result of the Big Bang. Throughout this time, it constantly spread and changed to achieve it's current size and appearance [Access: 21.09.2023]. Access on the internet: https://zpe.gov.pl/a/jak-urzadzony-jest-wszechswiat/D14tUpAYP.

(stars, planets and other even smaller celestial bodies, their clusters – galaxies, clusters of galaxies, intergalactic matter and other objects), which in any way can affect us (or we affect it) in the past, present or future (See more: *PWN Encyclopedia*).

Until the Middle Ages, through ancient times and regardless of the type of religion practised, the axiom was that the Universe was created in the act of creation and the Earth occupies a central place in it, as the habitat of man. The mechanics of the sky were not understood by man and often threatening (lunar eclipse); they were interpreted as the works of the gods, which is why mythologies were created. Space is, after all, an element of any theogony. The work of Nicolaus Copernicus[4],published in Nuremberg in 1543, changed the understanding of the Universe. Mankind was unable to come to terms with this revolutionary theory and, for historical justice, it should be said that the work was put on the index of banned books, from where it was only withdrawn in 1757[5]. As a result of the development of science, the theory of N. Copernicus was modified, among others, by scholars: Johannes Kepler discovered that the motion of the Earth and planets follows an elliptical trajectory with the Sun at one of the foci in the early 17th century and a few decades later Isaac Newton formulated the law of universal gravitation and in the 1920s Albert Einstein, Nobel Prize winner, created the special and general theory of relativity. Even as late as the fourth quarter of the twentieth century, the Cosmos, in the average mass audience culture, was perceived as the space that hosts science fiction and fantasy novels and films. Almost simultaneously, intensive research on the military and economic use of Cosmos was carried out in scientific centers.

2. EXTENSION OF THE HUMAN ENVIRONMENT

Homo Sapiens, since he began to make the Earth subject to himself, began to create artificial environments one by one (Sommer, Zakrzewski, 2023b). The division supplemented by the space environment is shown in Figure 2. H. Sommer, G. Zakrzewski in their article *Determining the level of awareness of the use of selected components of the artificial environment (Określenie poziomu świadomości korzystania z wybranych składowych sztucznego środowiska naturalnego)* (Sommer, Zakrzewski, 2017a), signaled the need to place the space environment and placed it within the artificial military environment.

On the basis of the analysed literature on the subject, the authors propose to supplement the artificial environment with the space environment in a basic division. Compared to its predecessors, it is the most technicalised and closest to the cyber environment.

[4] Nicholas Copernicus, born on 19 II 1473, Toruń, died 24 V 1543, Frombork, Polish astronomer, mathematician, physician, lawyer and economist; creator of the heliocentric theory.

[5] In 1999, the manuscript of the work was entered on the UNESCO Memory of the World list. [Access: 22.09.2023]. Access on the internet: https://encyklopedia.pwn.pl/haslo/kopernik-mikolaj; 3925575.html.

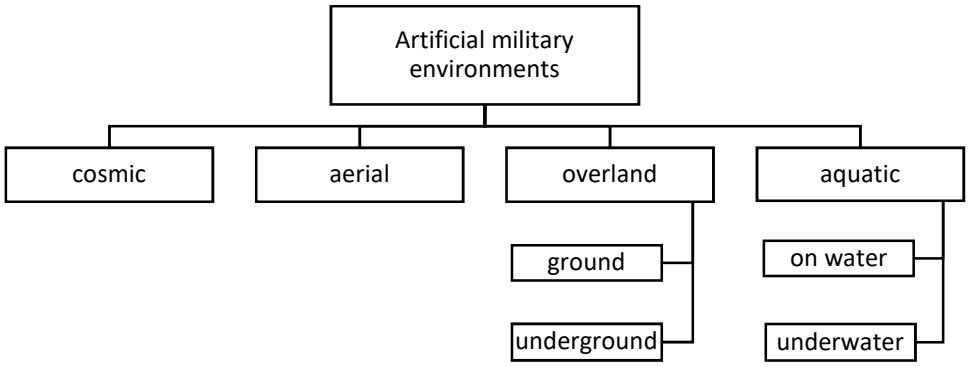

Figure 1. Division of artificial military environment

Source: (Sommer, Zakrzewski, 2017a).

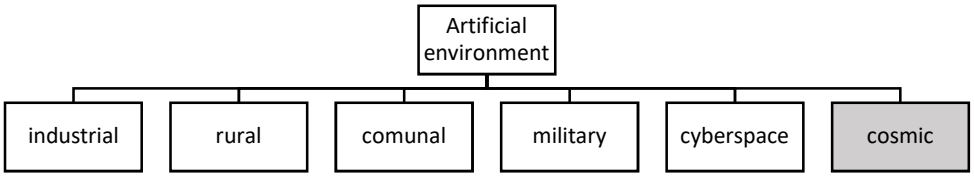

Figure 2. Division of artificial environment

Based on own research: (Sommer, Zakrzewski, 2023b).

In the remaining artificial environments (rural, industrial, communal and military), human presence is obligatory. In the cyberspace and space environment, humans are not 'present' all the time. The criteria used to characterize the natural human environment can be used to describe the space of the new artificial environments, where the essential bonding element is the relationship between the biocenosis and the habitat, which is part of the flow of energy and matter. H. Sommer, G. Zakrzewski state:

> An ecosystem is an area of relatively homogeneous abiotic conditions (biotope), occupied by a corresponding set of species linked by trophic and paratrophic relationships, through which a stream of energy and matter flows. According to this definition, an ecosystem consists of two closely related components:
> – inanimate (biotope, also called habitat), which consists of soil, water and air with their physicochemical properties and climate that exists independently of biocenosis;
> – animated (biocenosis), composed of a combination of species specific to a given biotope under given geographical conditions (Sommer, Zakrzewski, 2023a). From the classical definition of a habitat, one can easily derive the definition of a technicised habitat, i.e. one that is the product of human thought and engineering achievements, which is inhabited by humans.
>
> Extreme cases of a technically developed ecosystem include an orbital station or a nuclear-powered submarine (Sommer H., Sommer H., Zakrzewski, 2018b).

The latest two artificial environments will be of the greatest interest to the scientific world as well as to decision-makers as an important attribute of the social life of the earth's inhabitants in this century.

3. THE MEANING OF SPACE

The development of space exploration and the technical means to explore it after the Second World War was significantly influenced by German scientists who built the space powers: USA's Wernher von Braun[6], and his right hand Helmut Gröttrup[7] the might of the USSR. The last decade, after years of downtime, the "new" exploration of space is once again gaining momentum. One of the factors of this specific acceleration is the inclusion of the private business sector in the implementation of extraterrestrial exploration. New states and the EU are striving for sustainable space exploration in order to accept not only the huge costs of the project, but also the public acceptance of space projects. A new policy is emerging before our eyes – the space policy to support the development of modern and secure satellite systems used to improve life on Earth. As assured by those in power, the systems being exploited and designed are civilian in nature, including those on the civil-military frontier such as humanitarian overseas operations and crisis management, with military circles looking on with the greatest interest from the outset. It is no secret that before any new invention sees the light of day it is first given a close look by the military (Sommer, Zakrzewski, 2017a).

4. METHODOLOGY AND RESULTS OF THE RESEARCH

Research methods are a certain general system of rules that deal with the organization of a given research activity, namely, various cognitive and practical operations, the order of their application, and activities oriented towards the established research goal. In this study, the research will be conducted centred around the following question:

Should humankind learn about and explore outer space?

An effectively conducted study, in addition to formulating a research question, requires the formulation of a hypothesis. The following hypothesis can be formulated in response to the main question:

It can be assumed that the responders' level of knowledge of outer space depends on the acquired and learned behaviour.

The research was carried out in July 2023 in the city most closely associated with the aerospace industry in Poland (See more: Aviation Valley.PL). A total of 159 people took part in the study. The research was conducted using a survey with 9 questions. Random individuals who agreed to participate were surveyed. The only criterium for participants was living in one of the areas marked in Figure 3. They were not involved in the research issues. The respondents came from different counties of the Subcarpathian Voivodeship (33% from each area marked in Figure 3). Figure 3, for the purpose of the article, divides the Subcarpathian Voivodeship into three zones. The first zone (A) covers an area with a developed technical culture. It was in this area, among others, that the Central Industrial District, which was the largest economic investment of interwar Poland, developed

[6] Operation Paperclip (Allies / USA) – the Allies imported thousands of Hitler's scientists from Germany.

[7] Operation Osoawiachim (USSR) – a Soviet operation that had analogies with Allied operations.

intensively. This is where not only the economic strength of the Second Polish Republic was created, but also technologies that were modern at the time were implemented and what is nowadays referred to as innovations were created. The Central Industrial District permanently changed the face of these areas**.** The second zone (B) is well developed agriculturally. Fertile soils and a favourable climate are conducive to its development. On the other hand, the third zone (C) has no potential for dynamic development due to the terrain. This is an area from which a large percentage of residents have emigrated (See more: Sommer, H., Sommer, H., Zakrzewski 2018a) due to poor transportation system or the lack of well-paid jobs. Educated young people are leaving to larger cities. These are serious problems for the region. This is an area in need of strategic investment due to low socio-economic development.

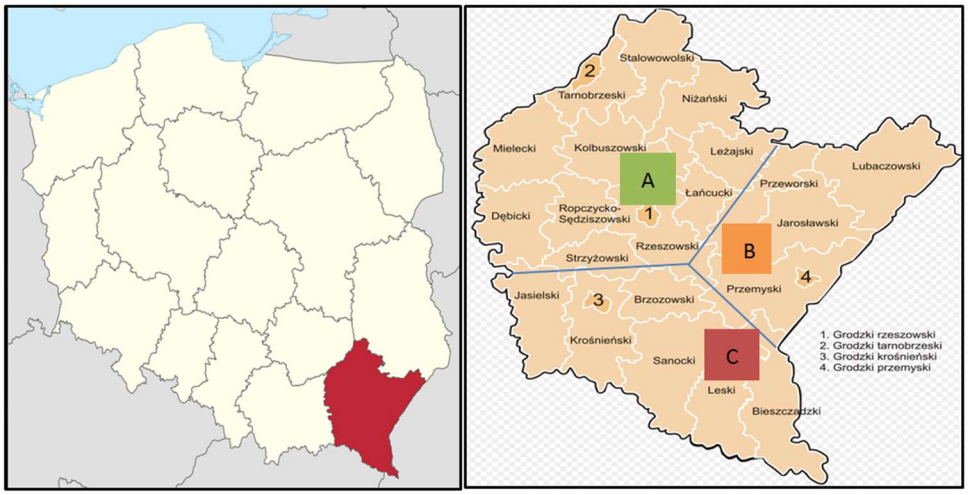

Figure 3. Scientific research area by zone

Source: based on own research: https://pl.wikivoyage.org/wiki/Wojew%C3%B3dztwo_podkarpackie#.

The results of the conducted research are illustrated with 9 graphs.

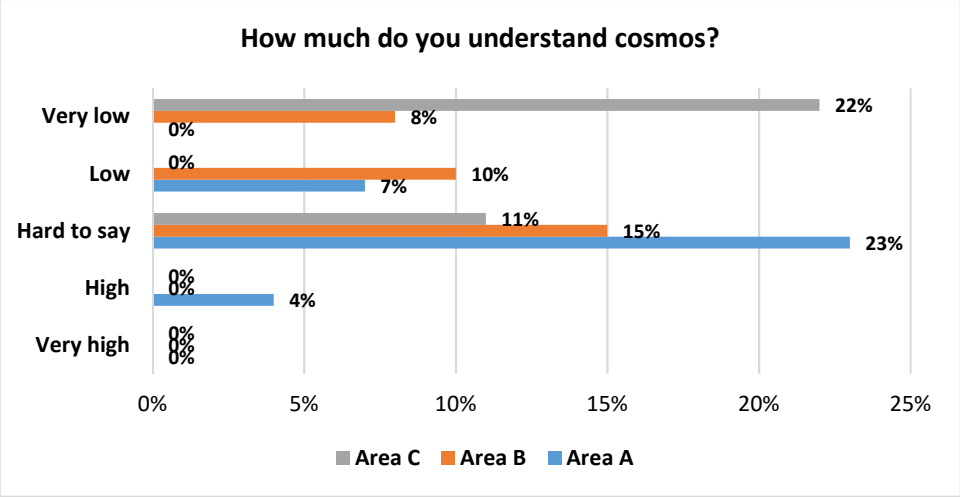

Chart 1. Level of cosmos understanding

Source: authors' own research.

Understanding the universe is a vast and complex endeavor. The results of the conducted research confirm this. The most common answer chosen by respondents – difficult to say, was chosen by as many as 23% from zone A, 15% from zone B and 11% from zone C. Their knowledge of outer space was rated as limited or very limited by respondents living in zone A (7%, 0%), B (10%, 8%), and C (0%, 22%), respectively. Only 4% of respondents from zone A felt that they had a high level of knowledge of this subject. However, no one indicated a very high level of understanding of the space environment. Scientists from various fields are constantly collaborating to find answers to complex questions and gain a more comprehensive understanding of outer space.

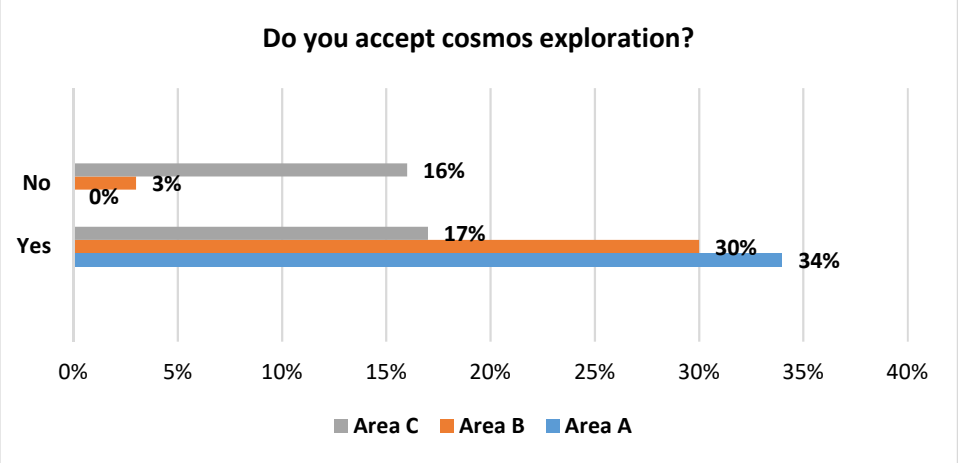

Chart 2. Acceptation of cosmos exploration

Source: authors' own research.

Space exploration often stimulates the human imagination and inspires dreams of possibilities beyond Earth. Many people see space exploration as a driving force behind scientific and technological progress. This is reflected in the survey results. The vast majority of respondents (81%) from all areas of research are in favour of space exploration, A (34%), B (30%), and C (17%), respectively. Only 3% of respondents from zone B and 16% from zone C do not approve of space exploration. Although there is a generally positive attitude towards exploring outer space, public opinions can vary and depend on several factors (e.g. education, individual perspectives). In the research presented, it can be seen that the residents of the socioeconomically least developed area are reluctant when it comes to these efforts.

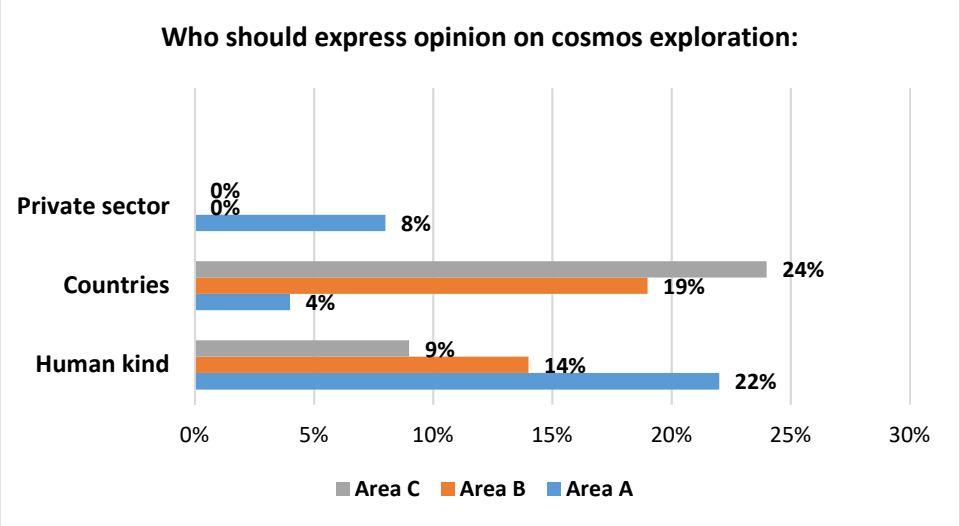

Chart 3. Who should express opinion on cosmos exploration?

Source: authors' own research.

The discussion on space exploration involves different parties, each with their own perspective and interests. The respondents of the survey do not have a definitive opinion. 45% of respondents support the human species, respectively A (22%), B (14%) and C (9%). Entrusting this decision to the states was approved by 47% of respondents, A (4%), B (19%), and C (24%), respectively. Only 8% of respondents from a well-developed technical culture believed that the assessment of space exploration should be left to commercial entities.

The concept of space security culture recognises the interconnectedness of space activities and the need for collective commitment to responsible behaviour in order to maintain the security and sustainability of outer space. This concept refers to the development and promotion of practices, standards and behaviours aimed at the responsible use of space. More than half of the respondents (58%) said that they were not familiar with the concept of a space security culture, A (6%), B (22%), and C (30%), respectively. A rather large percentage of them (36%) are not sure whether they know this

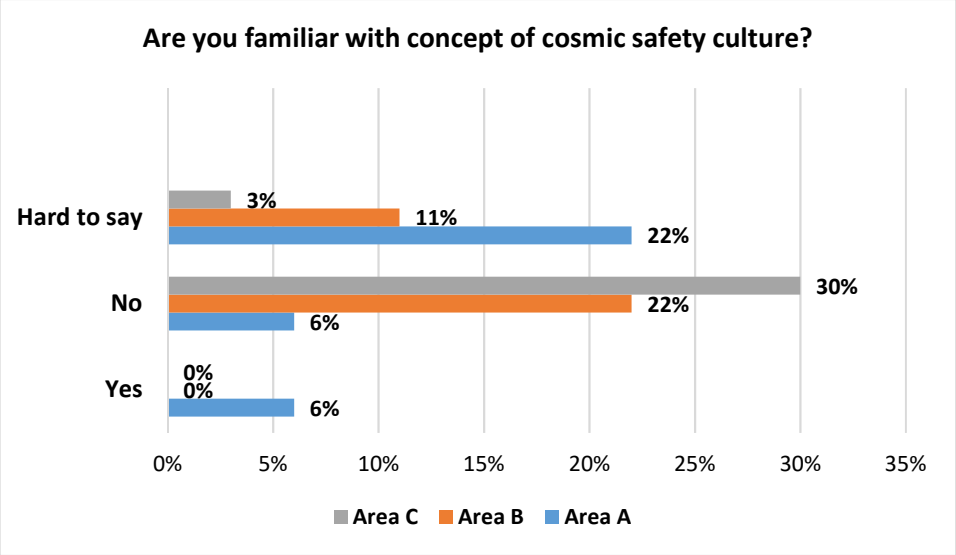

Chart 4. Knowledge of cosmic safety culture

Source: authors' own research.

concept, respectively A (22%), B (11%), and C (3%). Only 6% of respondents from the highly developed zone believe that they know what the concept of a space security culture is, and that its application should be beneficial for all humanity.

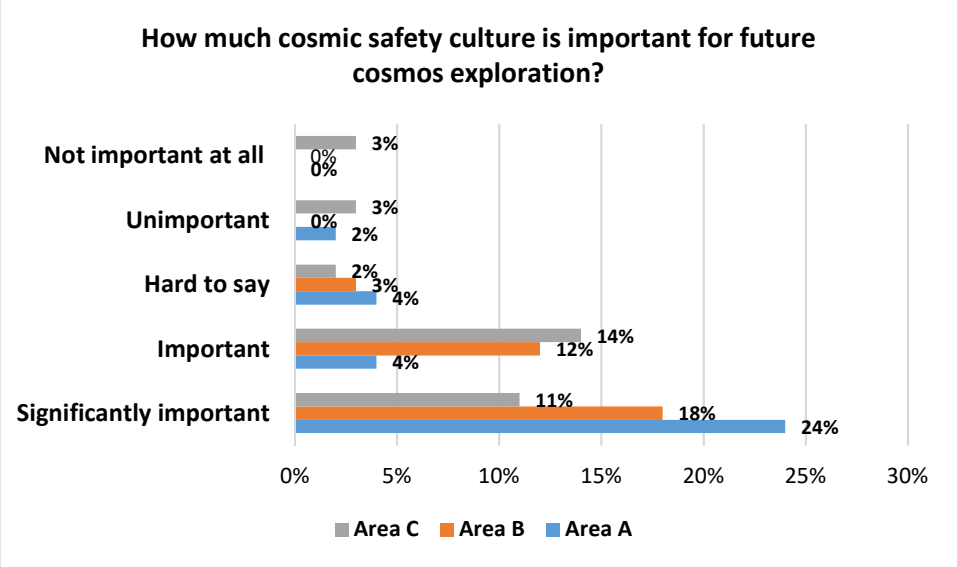

Chart 5. Importance of cosmic safety culture for future cosmos exploration

Source: authors' own research.

Despite the fact that in question 4 such a large percentage of respondents did not know or were not sure that they knew the concept of a space security culture, after learning about this concept, the results regarding its rating are interesting. As many as 53% considered it to be extremely important – A (24%), B (18%), C (11%); 30% thought it was important – A (4%), B (12%), C (14%); 9% could not rate it – A (4%), B (3%), C (2%); 5% rated it as not very important – A (2%), C (3%) and 3% of respondents from the area with less developed technical culture considered it to be not important at all.

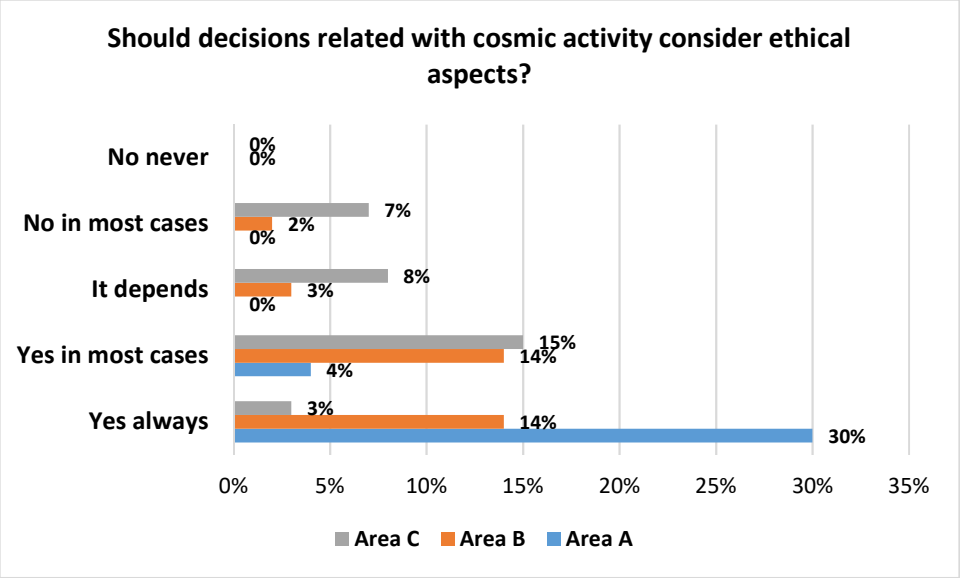

Chart 6. Ethical aspects in decisions related with cosmic activity

Source: authors' own research.

When making decisions about the use of space resources and the environmental effects, the interests of future generations must be taken into account. Including ethical considerations in decision-making processes can contribute to the responsible and sustainable development of space activities, in accordance with principles that prioritize the best interest of individuals, communities and the environment, both on Earth and in outer space. This approach is supported by as many as 47% of respondents – A (30%), B (14%), C (3%). A large percentage (33%) believe it to be true in most cases – A (4%), B (14%), C (15%). There are also those (11%) from less economically developed areas who make it dependent on various issues – B (3%), C (7%). However, all respondents disagree that ethical aspects are never important.

It can be said that there is unanimity among the respondents on minimising space debris. As many as 41% (A – 26%; B – 12%; C – 3%) strongly support actions to do so, and 50% (A – 8%; B – 19%; C – 23%) agree with this approach. Only 4% (B – 2%; C – 2%) of respondents are unable to take a position on this issue, and 5% (C) considered that there was no need to take any action in this area.

Solving the problem of orbital debris is crucial to the sustainability of space activities and ensuring the long-term viability of space exploration. Continued efforts in research,

technology development and international cooperation are indispensable to effectively manage the challenges posed by space debris.

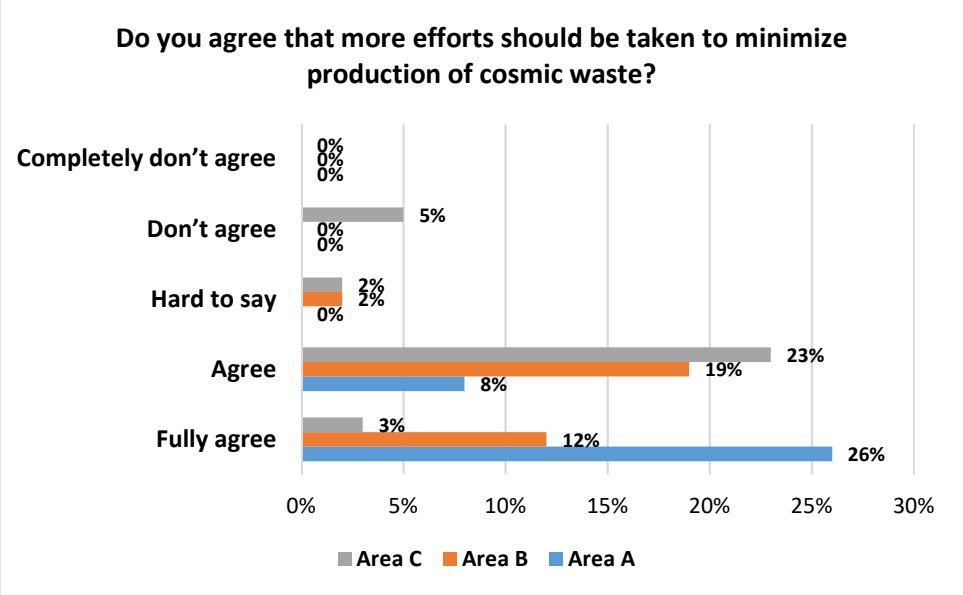

Chart 7. Can taking more effort help minimize production of cosmic waste?

Source: authors' own research.

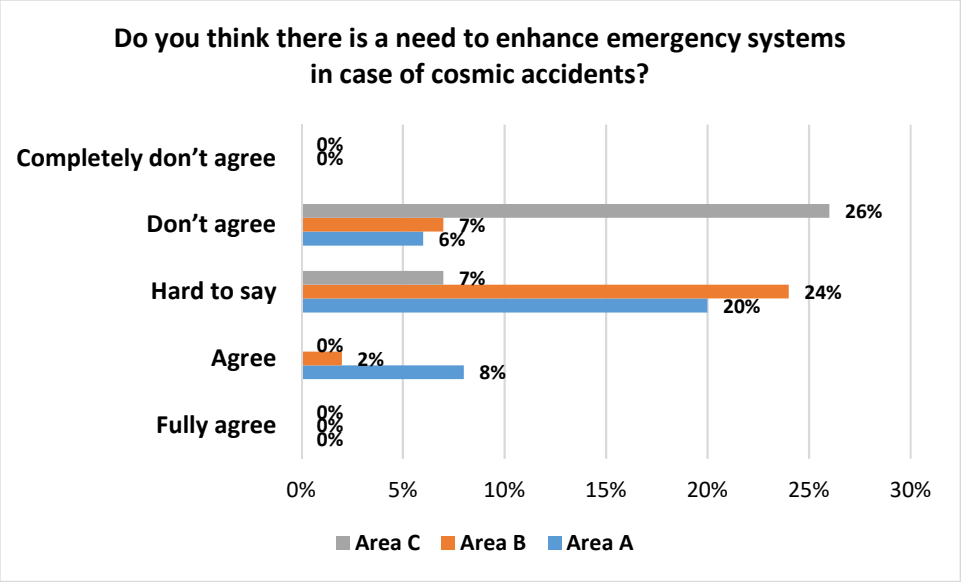

Chart 8. A need to enhance emergency systems in case of cosmic accidents.

Source: authors' own research.

Regarding the improvement of crisis response mechanisms in the area of space events, the answers have been narrowed down to three categories, I agree or disagree and it is difficult to say. Most often, 51% (A – 20%; B – 24%; C – 7%) did not take a position on this issue. A slightly smaller percentage do not see the need for such actions 39% (A – 6%; B – 7%; C – 26%). However, only 10% believe that efforts should be made to ameliorate crisis response mechanisms in space events.

Although space activity has become an integral part of various aspects of modern life, emergency situations in or related to space can have significant consequences. It seems that the respondents did not fully understand the question posed. Their answers may indicate this.

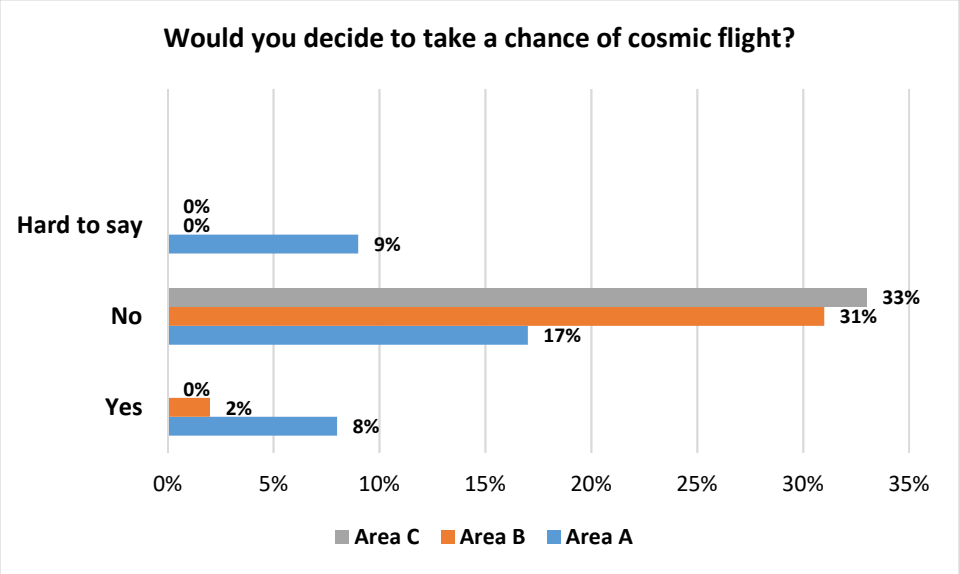

Chart 9. Declaration of cosmic flight.

Source: authors' own research.

Graph 9 presents the results regarding the flight into space. It is astonish that as many as 81% (A – 17%; B – 31%; C – 33%) of the respondents do not want to go to space. Only 10% (A – 8%; B – 2%) of the respondents are of the opposite opinion. On the other hand, 9% of highly developed areas were unable to take a position on the analyzed issue.

For some people, the lack of control over their surroundings and the reliance on technology and systems that they may not fully understand can be anxiety-inducing. As space technology evolves and becomes more commonplace, it's possible that these fears may diminish for some individuals.

However, it is observed that in recent years there has been a significant development of the commercial space industry, driven by technological progress, increased private investment and growing interest in space tourism.

Our understanding of the Universe is constantly evolving as we make new observations and refine or replace theories. However, summarizing the results of the conducted research, it should be stated that a significant part of the respondents could not determine their degree

of knowledge of the Space. The largest percentage of them comes from a separate, highly developed area. Others assessed this knowledge at a low level, and the largest percentage came from areas with a low level of socio-economic development. The respondents are generally in favor of space exploration, but a large percentage of area C is opposed to such activities. Countries or human species should speak out about the subject of space exploration. Only a few from area A indicated commercial entities. The vast majority of participants from all areas surveyed are unfamiliar with the concept of space safety culture or cannot identify themselves. Only single people from areas with a high degree of development recognized that they knew this concept. However, after familiarizing the respondents with the issue of space security culture, the vast majority of respondents, coming from all areas, considered it necessary for the future of space exploration. Ethical considerations in making decisions related to space activities are of great importance due to the potential impact of these activities on various stakeholders and the long-term sustainability of space exploration. This is also the position of the vast majority of respondents. Over 90% of respondents supported the fight against space debris. Proactive approach to space debris mitigation shows responsibility and care for our planet. More than half of the respondents did not take a position on the need to improve crisis response mechanisms in the event of space events, and the others most often did not see such a need. Only a few in area A are in favour of improving crisis response mechanisms that help to minimise the economic impact and facilitate faster recovery from setbacks. Surprising results concern the declaration of a desire to fly into Space, where over 80% of respondents do not want to experience such an adventure. The commercial space industry faces challenges such as regulatory hurdles, safety concerns, and sustainability issues, including the management of space debris. As the industry continues to evolve, regulatory frameworks, safety standards and international cooperation will be essential. The research goal has been achieved. However, it requires further research to precisely describe the need of space exploration and perceive it as an exciting boundary of humanity's progress.

5. INSTEAD OF A CONCLUSION

By the end of the 18th century, many scientists argued about the quantitative issues of elements on Earth. During the formation of the industrial environment, the exploiters wondered whether intensive exploitation of resources would eventually determine the end of their activities. Their doubts were dispelled, independently of each other, by the Russian Mikhail Lomonosov and the Frenchman Antoine Lavoisier, who in 1756 and 1785, respectively, based on the mass preservation during chemical reactions, stated and formulated the law of mass preservation in chemistry. According to this law, in a closed system (where the products of the reaction do not leave the system), the total weight of the substrates is equal to the total weight of the chemical reaction products. It means that an equal mass of products is produced from the mass of substrates used in the reaction. Thus, during the chemical transformation, the total mass of the substances involved does not change.

"Nothing in nature is lost" – this saying refers to the basic principle governing changes in our world. The precursor of this statement can be considered the ancient Greek scholar Empedocles of Akragas, the creator of the concept of the four elements, who stated: "Nothing arises in nature that can die; there is no complete annihilation; nothing happens except changes and disintegration of what is connected". As humanity, we are aware of

two basic things – in order to change the existing system, we must export or import something from Earth, speaking economic language.

That is why there is so much interest in Space. Not everyone is aware that a cosmic environment is being created before our eyes, into which Homo sapiens is already entering, often not yet defining the rules of living there. The conducted fragmentary research showed that we want to have a monopoly on the exploitation of space, but we have not established the rules that we want to "follow" there. Will the people of the old continent repeat the mistakes similar to those made during the period of discovering the continent of the new world? The fragmentary research undertaken is to draw attention to the importance of a safety culture in the space environment, so that the alien civilization does not think of us as barbarians.

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