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MANAGING THE INTERNATIONAL SPACE – THE BIG CHALLENGE AHEAD

Abstract: This paper deliberates on the kind of challenges the international space business might have and what actions should the states undertake to help operators to access to space. This is a qualitative research paper. The entire material included in this article comes from dedicated conferences and seminars about space business and policy organized, legal documentation, and literature review, which refer to business security or safety in this subject. The analysis conducted by authors shows that states are forced to take internal actions, to monitor and control private activities of entrepreneurs. Interaction of international and national legislation is necessary for the face of privatization of space activities (in the domain, such as liability and jurisdiction). States have the legislative mechanisms needed to establish a licensing and monitoring regime and a sanctioning system. States should also be aware that economic and security challenges show the importance of peaceful cooperation between states according to the United Nations treaties. In such an environment, operators can be competitive and cooperative in the international space market. The constant process of commercialization of space requires adapting the existing legislation to current needs and challenges. The economic challenges show the importance of peaceful cooperation between states. As technology progresses and small satellites emerge, access to space becomes easier and cheaper. It favours small countries and their private entities. Free and undistorted competition, in line with the basic principles of operation of democratic states, should be supported by new space programs and strategies and national regulations, so as to make this space available to all. The subject of the article is innovative and new. As there is limited literature available on

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this subject, therefore, there is a clear need to fill this gap. The authors keep the reader informed about the latest updates and information in respect to management, policies and law regulation in the space.

Keywords: space commercialization, space liberalization, space management, space technology dissemination (civil and military), space assets export limitations, space technologies dual-use

INTRODUCTION

As early as the early 1980s, private sector interest in space activities was observed in some Western countries, mainly in the US[1]. The rapid development of commercial activity in space began with the change in the international political situation in the early 1990s when the Soviet Union ceased to be one of the two most powerful nations (the Russian Federation was established over most of its territory). Now, democratic states, mainly the United States, have decided to allow private entities to operate in space, which private entities were flashier and more efficient than state entities. Soon another step in this process took place in space, with government and private companies acquiring private sector services. It is a new business model and a new kind of partnership. Thanks to this, many new technologies and projects were created, and the space industry has become a significant source of GDP growth in some countries.[2]

Government budget allocations for research and development (GBARD) is one of the indicators which provides information about the long-term directions and volume of government-funded R&D (Research and Development) projects. This kind of data is available on OECD (Organisation for Economic Cooperation and Development) and gather economic indicators since the early 1980s. And such, in 2019, civil space R&D (Research and Development) accounted for 0.05% of GDP and almost 13% of total government allocations to civil GBARD (see Figure 1). In the UK, these allocations are 0.006% and 1.36% or for Australia 0.03% and 0.81%, respectively.

The subject of the article is innovative. As there is limited literature available on this subject, there is a clear need to fill this gap. One of the authors has experience in diplomacy work for International Civil Aviation Organization as Polish Council Representative and is a member of the ICAO subgroup of Suborbital Flights. Prior to that, she worked as an expert for the national carrier and national regulator. Her participation in the international organization of the air

[1] R. Skaar, Commercialization of space and its evolution, will new ways to share risks and benefits open up a much larger space market, European space Policy Institute. Report no 4, 2004, p. 5

[2] G.S. Robinson, space jurisdiction and the need for a trans global cybernation: the underlying biological dictates of Humankind dispersal, migration and settlement in near and deep space, "Annals of Air and space Law AASL" 2014, p. 325.

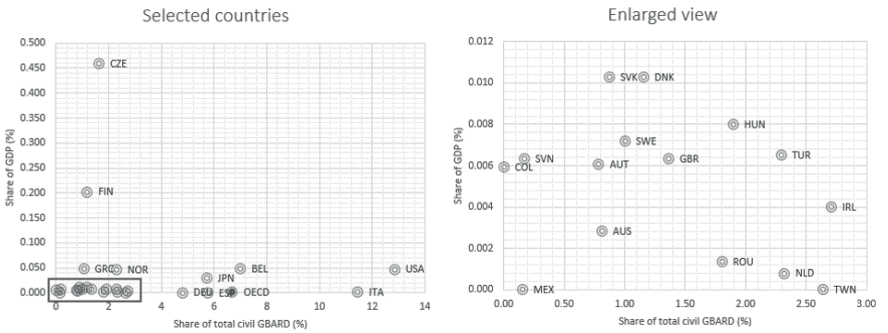

Figure 1. Civil GBARD space programs as a share of GDP and government RD allocations (2019)
Source: OECD (2020), "Main Science and Technology Indicators", OECD Science, Technology and RD Statistics (database), https://doi.org/10.1787/data-00182-en

and space conferences and seminars related to the topic have helped to make this article more relevant.

The subject of this article is new, and the authors keep the reader informed about the latest updates and information in respect to management, policies and law regulation in the space. The entire material included in this article comes from dedicated conferences and seminars about space business and policy organized, in particular, by COSPAR (Committee on space Research) and European space Policy Institute ESPI. Some legal documentation, such as the United Nations treaties or other EU regulations, also were used. In addition, the authors reviewed several articles, which refer to business security or safety published in international journals and own publications in this subject. Below Figure 2 summarizes the current, top published space literature in the global context. The most significant number of papers came from the US, UK and Germany.

This article is divided into the following sections: section 1 considers business and the legal environment, section 2 highlights increases in the activities of private space companies, section 3 treats about the growing importance of small satellites,

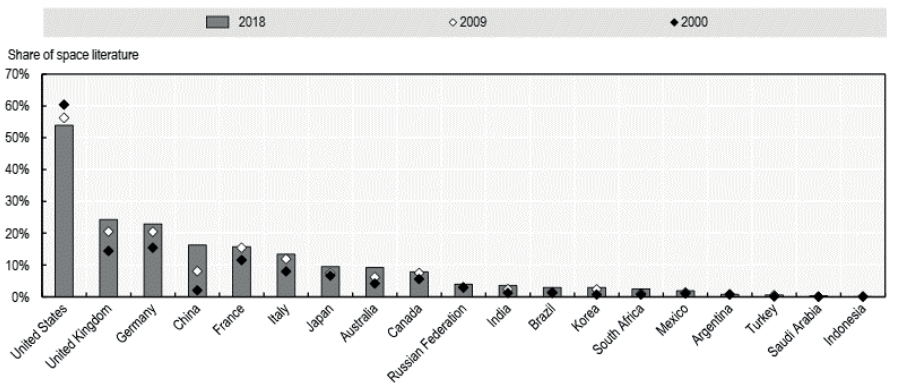

Figure 2. Share of the top published papers in the space literature, per country
Source: Measuring the Economic Impact of the space Sector, OECD, 2020

section 4 discuss commercialization of space in the US, section 5 focus on export control of space equipment, section 6 summarizes activities related to space resources. At the end of the article, final remarks and conclusions are presented.

LITERATURE REVIEW AND THEORY DEVELOPMENT

SPACE BUSINESS AND THE LEGAL ENVIRONMENT

Due to the increasing involvement of private capital and the development of technology, there is a need to explain many issues, such as the differences in interpretations of the concepts of use[3] and exploration, related to space. In the existing space law, treaties and common law, the principle of non-appropriation and freedom of use are strictly established. The analysis of these principles shows that in some cases, they may be contradictory. The possible conflict between use and appropriation challenges the new space law.

There is no definition of the word "use" in space law. The Treaty on the Moon 1979 gives some hints, but it was not adopted by most countries. Some of the rules are contained in the 1967 space system. The most important indication is that the use of space resources, including celestial bodies, is allowed (for example, mining or extracting space resource)[4]. In the absence of international regulations, some states regulate private entities through internal legislation[5]. Thanks to this, the idea of global cooperation between the state and private entities was born[6]. A good example is the regulations governing the activities of the International Space Station (ISS). [7]However, there is still a lack of sufficient legal solutions to regulate, for example, satellite operations. Facilitating satellite lifting should be international standards, independent of political conditions and equal for all, including private entities[8].

In space tourism by space shuttle (RLV), crew, passengers and cargo must be safely returned. The system must be operational and checked for quality; on the other hand, it must bring certain economic benefits. To run such a business,

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3 R. Jakhu, Introduction into the conference 3rd Manfred Lachs International Conference on New space commercialization and the law, 16-17 March 2015, Montreal, ICAO

4 K-H, Böckstiegel, Introductory remarks[in:] Research and Invention in outer space. Liability and Intellectual Property Rights, A. Mosteshar [ed.], Dodrecht, The Netherland 1995, pp. 1-6

5 R. Skaar, op. cit. p. 5

6 J. Monserrat Filho, Why and how to define "global public interest", Proceeding of the forty-third colloquium on the law of outer space, International Institute of space Law of Outer space of the International Astronautical Federation, 2–6 X 2000, Rio de Janeiro, Brazil, pp. 22-32

7 A. Farand, A. Commercialization of International space Station Utilization: The European partner's Viewpoint, "Air and space Law, ASL" 2003, Vol. XXVIII, no 2, pp. 83-88

8 V. Leister, M.C. Frazier, The role of national and international law in the regulation of space activities. Proceeding of the forty-third colloquium on the law of outer space, International Institute of space Law of the International Astronautical Federation, 2–6 X 2000, Rio de Janeiro, Brazil, pp. 164-167

however, numerous procedures are required, in particular related to transportation (ship equipment, types of routes, insurance for the crew and passengers, emergency procedures, spaceport infrastructure and the like).[9]

Commercialization of space activities is a natural result of the continuous development of space technology. However, commercialization causes numerous legal problems, including in connection with civil liability[10]. Some argue that this responsibility should be left to the market alone[11]. space transportation services and telecommunications may require separate and specific international rules. Other authors believe that space flight can take advantage of the fourth and third freedoms (combined), established by the Chicago Convention in 1944 about air transport, are still used in civil aviation today. Transporting a satellite to Earth can be compared to cabotage (a satellite is considered a quasi-state territory)[12].

At present, in some countries, private companies only need to obtain authorization from the state of registration to conduct their activities in space; from a legal point of view, technical and operational access to space is also free[13]. However, not all lawyers are supporters of excessive liberalization of activities in space[14]. According to them, the "international regulator" should take into account the differences of opinion and requirements of states; hence the transport laws and expansion of space activities cannot be the same for all states[15]. Some authors point out the need to create a new branch of space law, that is, the law dealing with commercial activities in space[16].

As already mentioned, back in the 1980s, the United States announced a space technology commercialization program, which included, among others, postulates to ensure favorable conditions for the development of private companies, a continuation of exploration and discoveries, limiting the risk and restrictions

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9 W.A. Gaubatz, International Certification for Commercial Reusable space Transportation, [in:] space law – General Principles, R.S. Jakhu (ed.), Institute of Air and space Law, University McGill, Montreal 2007, Vol. II, pp. 51-57

10 H. Qizhi, Certain legal aspects of commercialization of space activities, "Annals of Air and space Law" AASL, 1990, Vol. XV, pp. 333-342

11 P.D. Bostwick, Liability of aerospace manufacturers: MacPherson v. Buick Sputters into the space age, "Journal of space Law" JSL, 1994, Vol. 22, no 1-2, pp.75-96

12 L. Ravillon, Droits des contrasts spatiaux: quelques thèmes récurrents, "Revue Française de Droit Aérien" RFDAS, 1998, no 2, pp. 61-62

13 H. Wassenbergh, The art of regulating international air and space transportation, an exercise in regulatory approaches to analyzing air and space transportation, "Annals of Air and Space Law" AASL 1998, Vol. XXIII, pp.201-229

14 A. Kerrest, Launching spacecrafts from the sea and the Outer Space Treaty. [in:] Le droit de l'espace et la privatization des activites spatiales, A. Kerrest [ed.], Paris 2003, pp.16-21

15 H. Wassenbergh, Access of private entities to airspace and outer space, "Annals of Air and space Law" AASL, 1999, Vol. XXIV, pp. 311-331

16 P.A. Salin, Orbites, fréquences et asteroïdes a l'heure de la commercialization des activités spatiales (vers une appropriation graduelle du patrimoine de l'espace?), "Annals of Air and Space Law" AASL 2001, Vol. XXVI, pp. 179-195

imposed on space technologies. Many American researchers even believe that US space companies should be allowed to circumvent some regulations until they themselves create the appropriate regulations for space operations.[17]

For the time being, however, jurisdictional issues remain a serious concern for private parties. The concept of responsibility for activities inconsistent with the principles of international law, including the activities of private entities, and the responsibility of the state for damages caused by space objects, including private operators, is becoming a fundamental problem in international space law. States are therefore forced to take internal measures, to monitor and control the activities of private entrepreneurs. Therefore, cooperation between international and national legislation is necessary.

States controlling private enterprises should have the legislative mechanisms needed to establish a licensing and monitoring regime and a system of sanctions. It seems that international law should be left to define the parameters and the scope within which such control of private enterprises should take place. States should be able to decide in which categories private companies should operate[18]. Many countries have introduced laws favoring commercialization in their national law. They include European Union countries and others, such as Australia, which in the Act of 1998 provided protection for the activities of the private space sector[19] or the US, which in the Act of 1984, amended in 1988, introduced certain powers for the private sector[20].

In the commercialization process, apart from ensuring safety and the correctness of operational procedures, what matters is the economic factor (i.e. profitability). Likewise, it is crucial for an appropriate government authority to be authorized to issue commercial spaceports and commercial operating licenses based on an assessment of the operators' ability to ensure public safety and to protect property and the environment. A spaceport is not defined by international law or by US domestic law. In the Oxford dictionary, the term denotes the place from which spacecraft are disembarked, take-off and land. Each spaceport must be adequately equipped and have appropriate facilities. The interests of all parties involved must be protected. Below Figure 3 presents the global map of active, inactive and orbital human launch spaceports.

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17 P.S. Dempsey, Overview of the United State Space Policy and Law [in:] National Regulations on Space Activities. R.S. Jakhu (ed.), Dordrecht, Heidelberg, London, New York, 2010, pp. 374-403

18 F.G. von der Dunk, Public space law and private enterprise, [in:] Space Law – General Principles, R.S. Jakhu (ed.), Institute of Air and Space Law, University McGill, Montreal, 2007, Vol. II, pp.47–471

19 R.J. Lee, The liability convention and private space launch services- domestic regulatory responses. "Annals of Air and Space Law" AASL 2004, Vol. XXXI p.57-87

20 Ch. W. Stotler, International and US national laws affecting commercial space tourism: how ITAR tips the balance struck between international law and the CSLAA (Commercial Space Launch Amendment Act), "Journal of Space Law" JSL, 2007, Vol. 33, no 1, p.268

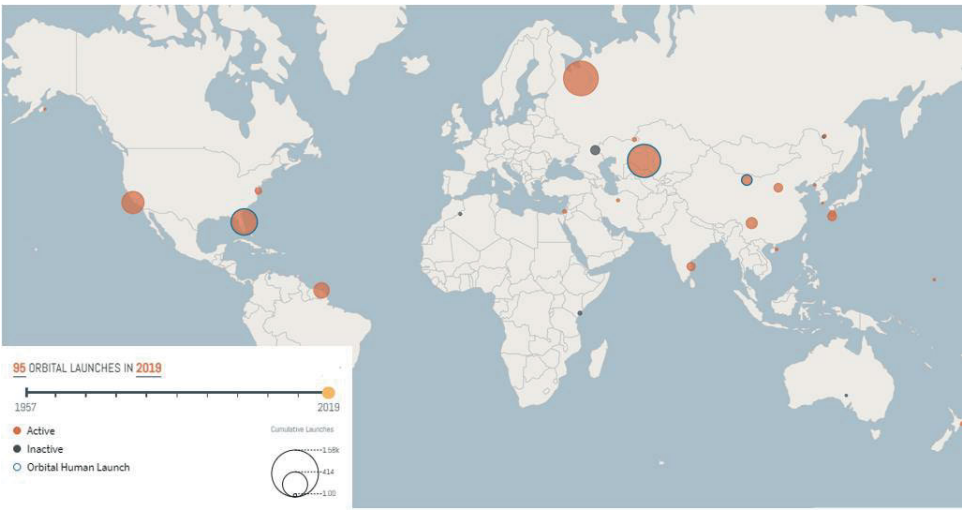

Figure 3. Currently operating spaceports, 2020
Source: Thomasa G. Roberysa World Spaceports (2020), https://aerospace.csis.org/data/spaceports-of-the-world/

In the US, spaceports were initially used only for military purposes, but with time, they also came into private hands. Government spaceports that undertake commercial activities must comply with registration and licensing requirements, as do commercial spaceports (government ports performing government functions are not subject to these regulations). spaceports can be classified as terrestrial or off-Earth[21].

INCREASE IN THE ACTIVITIES OF PRIVATE SPACE COMPANIES

Thanks to the favorable position of some countries, many private companies developed rapidly. Good examples of newly established companies are Nanoracks, Skybox or Made In Space. These new companies were operating with older capital of Bigelow Aerospace, Blue Origin, SpaceX or Virgin Galactic, and older companies using new technologies, such as Orbital Sciences, Boeing or Lockheed Martin. In addition, there are alliances between newer and older market players such as Stratolaunch & Blue Origin in partnership with United Launch Alliance or entrepreneurs who do not deal with space on a daily basis[22].

The below Figure 4 provides information about selected economic state sectors that benefit from space programs (GBARD), including transport, defense and security or energy and more; whereas Figure 5 highlights types of effects

21 M.C. Mineiro, Law and regulation governing US commercial spaceports: licensing, liability, and legal challenges. "Journal of Air Law and Commerce" JALC, 2008, Vol. 73, no 4, p. 760

22 R. Jakhu, Introduction into the conference 3rd Manfred Lachs International Conference on New Space commercialization and the law, 16-17 March 2015, Montreal, ICAO

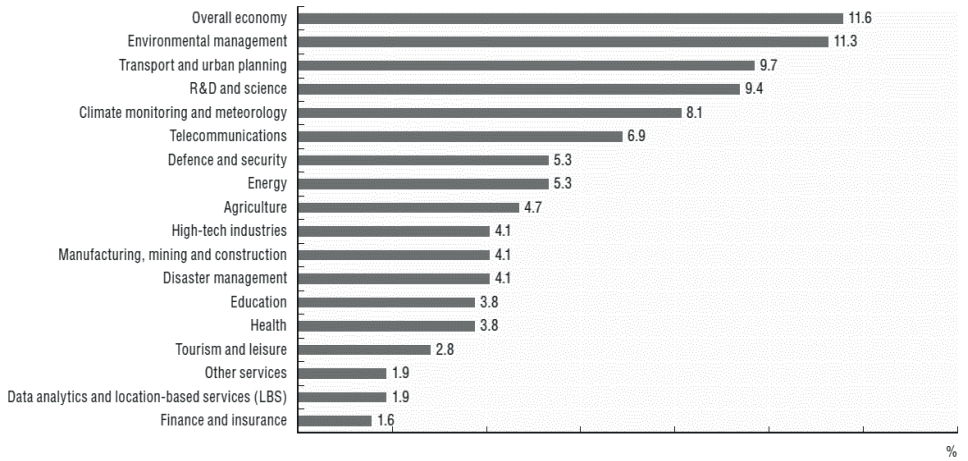

Figure 4. Selected economic sectors that benefit from socio-economic effects derived from space investments (share of total occurrences identified in the literature, 1972-2018)
Source: Measuring the Economic Impact of the Space Sector, OECD, 2020

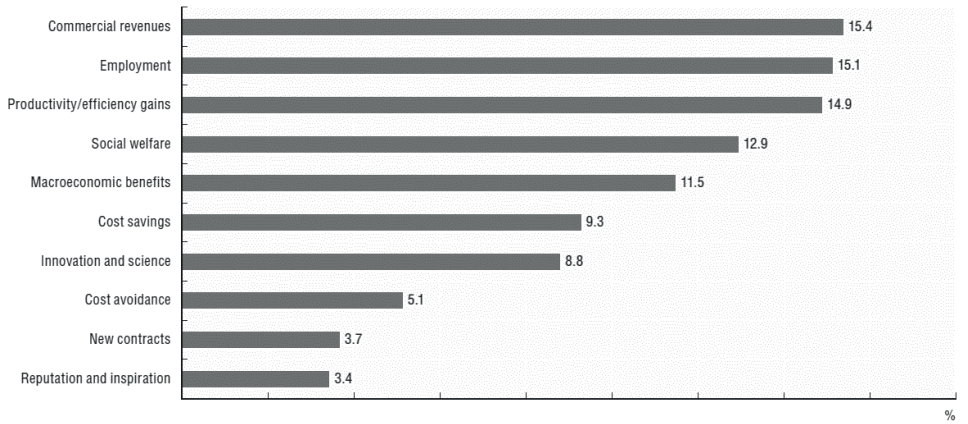

Figure 5. Types of positive effects derived from space investments (share of total occurrences identified in the literature, 1972-2018)
Source: Measuring the Economic Impact of the Space Sector, OECD, 2020

derived from space investments in the world, and this refers to commercial revenues, employment, or social welfare.

Not all activities are already regulated by national law. Even in the United States, not all entrepreneurs know which authority is responsible for issuing appropriate permits for the operation of certain "space companies" and which for overseeing them[23]. The intensification of activities in space (civil and military) requires, first of all, the allocation of more and more funds by states. The pu-

[23] M.C. Mineiro, Regulatory uncertainty for non-traditional commercial space activities 3rd Manfred Lachs International Conference on New Space commercialization and the law, 16-17 March 2015, Montreal, ICAO

blic has relatively the best information on the funds allocated by states for civil space activities. The United States planned the largest budget for civil and defence activities in space in 2019 ($74.48 billion). Japan and Chinese budgets were smaller and constituted only 4.78% and 1.34%, respectively, of the US budget. Among other countries, significant budgets have been adopted by the European Union countries: Germany, the UK and Italy – in total 7.53 billion USD (which constituted approximately 10% of the US budget)[24].

To represents the estimated measures for government space budget spending, the ratio of space budget to the national GDP (Figure 6) has been created. In 2019, the US budget accounted for 0.35% of national GDP, followed by Germany (0.08%), China (0.08$), turkey (0.07%) and Japan (0.07%).

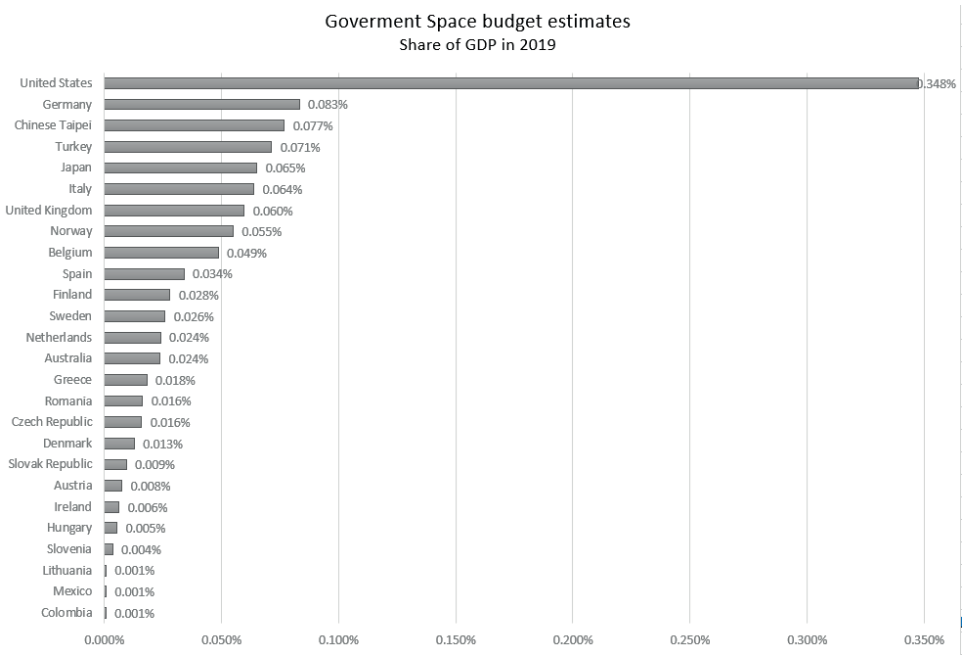

Figure 6. Government space Budget estimates for 2019
Source: OECD (2020), "Main Science and Technology Indicators", OECD Science, Technology and RD Statistics (database), https://doi.org/10.1787/data-00182-en

This US financial advantage over the rest of the world resulted not only from the increased tax burden on its citizens but above all from the innovation of the US space industry.

US space expenditure is accounted for 0.224% of the national income, which is almost twice as much as in France, and more than twice as much as in the

24 OECD (2020), "Main Science and Technology Indicators", OECD Science, Technology and RD Statistics (database), https://doi.org/10.1787/data-00182-en

Russian Federation. Relatively low expenditure for this purpose was anticipated by Great Britain – more than twice less than for India. It can be seen that the US economy allocates (in percentage) less than twice as much from its national product as France. Still, thanks to the leading technology and organization of work, it obtains more than sixteen times more funds than this country. Even worse results are obtained by the Russian Federation, which allocates more than two times less national income to the space economy than the United States but obtains almost 28 times fewer funds from these investments than the United States. In 2017, the largest expenditure on space activities per capita was to be: 133.20 USD in the USA, almost 41USD in France (i.e. over three times less than in the USA), in the Russian Federation 10.21 USD, and China – 5.76USD.

The increase in financial outlays for space purposes has resulted, among others, to a rise in the number of satellites launched and other space devices (refer to Figure 7). In 2017, the largest number of satellites was launched by the USA (154), followed by India and Russia. The largest number of this type of devices was launched by private companies 289 fires (i.e. 61.3%), while state--owned companies recorded 80 fires, (i.e. 27.7%). State-owned companies seem to have launched more satellites, and private companies have launched fewer satellites, and the number of military satellites appears to be understated[25]. As of March 31, 2019, the number of operational satellites was 2,062, of which the United States accounts approximately for 47.3% of all satellites, ahead of European countries (14.9%) and China (14.5%). Other entities own about 19.5% of these devices. Most of the satellites are in the orbits, such as LEO (approx. 65%) and GEO (approx. 27%); while the largest number of satellites is used in communication (approx. 37.5%) and Earth observation (approx. 37.2%).

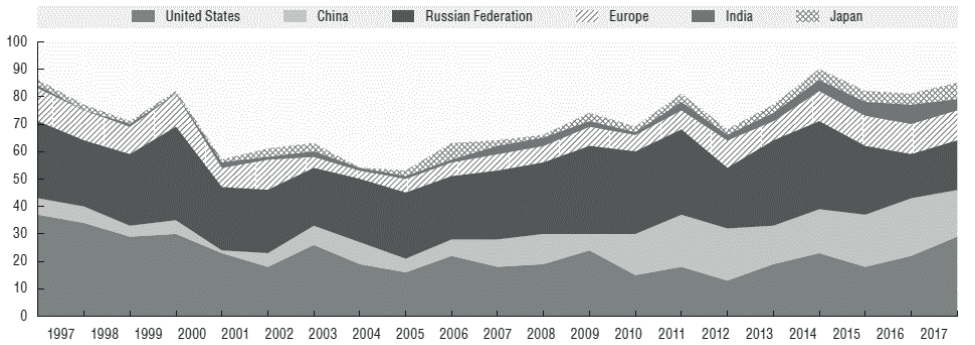

Figure 7. Satellites launched between 1957 and 2018
Source: Measuring the Economic Impact of the space Sector, OECD, 2020

25 E. Burger, G. Bordaccini, Yearbook on Space Policy 2017. Security in Outer Space: Rising Stakes for Civilian Space Programmes. Edited by the European Space Policy Institute, Cham, Switzerland, 2019

Currently, a characteristic feature of large space projects is not only the cooperation of many companies and people from many countries but also the longtime of their implementation. Nevertheless, their results are very favorable, for example, from an economic point of view. For example, the European GALILEO (Copernicus) program for monitoring earth disasters (land, sea and air) offers the potential to create up to 85,000 new jobs. Other projects also contribute to faster development. enterprises engaged in activities in space[26].

THE GROWING IMPORTANCE OF SMALL SATELLITES

In recent years, small satellites have played an increasing role; According to the calculations of the international consulting company Euroconsult, about 500 small satellites worth about USD 7.4 billion are planned to be launched in the next 5 years. The mini-satellites weigh less than 1000 kg, micro – less than 100 kg, nano -10 kg and pico -1 kg (refer to Table 1). There are also satellites called cube sats in the shape of cubes with the parameters of 10x10x10x10 cm and weighing from 10 to 100 grams. These satellites land mainly in lower orbits, usually without fuel. However, they have different applications and structures, are more or less complex, have different radio frequencies, and use different types of frequency technology. They are used by a number of entities (private companies, governments and their agencies, armed forces, universities, research centers, and even private individuals). Small satellites are used in both rich and developing countries. They can be launched even by small devices from the surface of the Earth, sea, air or space[27].

Source; E. Burger, G. Bordaccini, Yearbook on Space Policy 2017. Security in Outer space: Rising Stakes for Civilian Space Programs

Small satellites offer many possibilities to use space for various purposes. They are the main tool in the development of space commercialization and at the same time, a challenge to the existing international treaties and national regulations. In addition, some authors believe that new space regulations are needed for the safe conduct of private economic activities, but not the so-called soft law because it is not strong enough. The importance of cooperation between states in areas such as space management or environmental protection is also underlined[28]. Table 2 provides some information in reference to the number of satellites produced and launched by selected companies, such as CAST, Airbus or Lockheed Martin.

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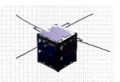
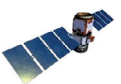
26 European Space Policy Institute "ESPI", Report 71, Towards a European Approach to space Traffic Management- Full Report. Published January 2019, [ed.]European Policy Institute (ESPI), Vienna, Austria, p. 15

27 A. Cazenave, Monitoring Sea Level Change from Space, "Space Research Today", 2019, August, no 205, p.49

28 K. Uwe Schrogl, Regulations for future space traffic control and management, [in:] J. Pelton and R. S. Jakhu, Introduction to space safety regulations and standards, Nidjihof, the Netherland 2010, pp. 303-308

Table 1. Types of satellites launched in 2017

type of satellite		number of satellites launched	Percentage	average satellite weight in kilograms	Total mass of satellites in kilograms
Nano		288	61.1%	4.3	1,238
Micro		30	6.4%	43.3	1,300
Mini		29	6.2%	266.6	7,732
Large		124	26.3%	3149.1	390,483
Total		471	100%	850.9	400,754

Source; E. Burger, G. Bordaccini, Yearbook on Space Policy 2017. Security in Outer space: Rising Stakes for Civilian Space Programs

The production and operation of small satellites are cheaper; therefore, private entities have undertaken to manufacture and launch them. The problem, however, is that manufacturers of small satellites are not very experienced and government regulators are used to large facilities. Hence the need to introduce into national law provisions relating to small satellites, including their insurance, development of registration rules[29], environmental protection (including the disposal of residues)[30]. These principles should be balanced[31]. Financial issues or risk minimization would be less flexible[32]. It is also related to the problem of the end-of-life predictability of the satellites. Large satellites can operate for several years (and the modernized technologies will be able to reach even several dozen

29 N. Palkovitz, Small satellites and developments in space law; International Air and space Law Conference, Gdańsk, Poland. November 15 2013

30 I. Marboe, K. Trunmuller, Small satellites and small states: new incentives for national space legislation, "Journal of Space Law", JSL, 2012, Vol. 38, no 2, p.318

31 S. Freeland, New space, small satellites and law: finding a balance between innovation, a changing space Paradigm and Regulatory Control, 3rd Manfred Lachs International Conference on New space commercialization and the law, 16-17 March 2015, Montreal, ICAO

32 M. Othman, A. Matas, 3rd Manfred Lachs International Conference, 16-17 March 2015, Montreal, ICAO

Table 2. Number of satellites produced by selected companies and launched in 2017

Company name, country, region	Number of satellites produced and launched		Military purpose only	Civil-government missions	civil-military missions	Commercial purposes
	Number	Percent				
CAST, China	10	9.6	-	6	2	2
Airbus, Europe	7	6.7	-	3	-	4
Thales Alenia space, Europe	45	43.3	-	-	-	45
ISRO, India	8	7.7	-	7	1	-
Mitsubishi Electric, Japan	5	4.8	-	4	1	-
ISS Resztniew, Russia	1	0.1	-	1	-	-
Boenig, USA	10	9.6	4	1	-	5
Lokheed Martin, USA	3	2.9	3	-	-	-
Orbital ATK, USA	2	1.9	-	2	-	-
space Systems Loral	13	12.5	-	-	-	13
Total	104	99.1	7	24	4	69

Dash: No data of production has been accounted for; Source: E, Burger, G. Bordacchini, op. Cit. p.93

years), smaller ones – they only operate for a few years. A new challenge is also to regulate, in the case of small satellites, the issue of freight transport, which is of interest to an increasing number of private companies[33].

Small satellites are cheap and can be built even by students or non-governmental organizations with a lower budget. Over the 4 years (2010-2014), the number of nano- and micro-satellites increased by 37.2% per year. In recent years, more and more companies, mainly in North America and Europe, declare their interest in such launches. Small satellites can pose a threat to existing technologies as they serve a new market segment and are cheaper to operate. Large companies must take into account the new challenges and threats posed by new players and incorporate these innovations into their programs. It is possible that new technologies, due to their low cost, will threaten banks, insurers and investment funds[34].

For the time being, however, insurance matters for commercial companies (launching large or small satellites) have not been included in the space law. As the 1972 Liability Convention in principle applies only to space activities of states and international intergovernmental organizations; it is also imprecise and

[33] M. Buzdugan, Satellite financing through hosted payloads: benefits and challenges, "Air and space Law" ASL. 2011 Vol 36, no 2, pp.139-160

[34] L. Rapp, V.D. Santos, A. Martin, Entering a New Space era; what might be expected from Satellite Miniaturisation? 3rd Manfred Lachs International Conference on New Space commercialization and the law, 16-17 March 2015, ICAO, Montreal

unclear. In this situation, many private space companies insure their activities in well-known companies with great traditions. For example, Lloyd's has been insuring all communication risks for several hundred years and has been operating in the space field for the last 30 years. During this period, the company raised $4.2 billion in contributions from various entities and paid out $3.4 billion to customers. In recent years, an increase in the number of insured entities and a decline in insurance rates have been noticeable. The average cost of insurance (start-up and annual stay in orbit) is about 10% of the value of the insured cargo; the orbital satellite's insurance premium is approximately 0.5% of the insurance value[35].

Small satellites are usually used to test new products, reducing the risk of mission failure. They are treated as "space objects" in accordance with international rules; however, in practice, they are excluded from the scope of these rules. Nanosatellites will be more and more popular in the future (they can also be used in commercial missions). The most significant risk for them is the possibility of a collision, as they cannot be maneuvered and may be left as space debris. The satellite operator receives the data from him and can send it to a certain level but cannot change the orbit. This raises questions about possible collisions with other objects in lower orbit, but so far nothing has happened. Nanosatellites usually burn when they enter the Earth's atmosphere.

Moreover, the cost reduction factor is crucial at the current times. The below Figure 8 clearly showing the decreasing costs of satellite or space vehicle production and successfully launched. Each circle represents the estimated cost per kilogram in the spread of the past sixty years.

For now, the issue of nanosatellites is treated differently in different countries; in many cases, national legislation has legal loopholes and divergences. For example, under Dutch law, small satellites are exempt from space activities, while under Belgian law they are covered by national law. Under Dutch law, a license is not required to launch such satellites, so the state is not responsible for them. This issue is currently being discussed in parliament – the problem of the blame for collisions is being raised – it is necessary to determine which country will be responsible (if the collision involved a maneuverable object and one that is not a space object). Austria (according to national law 2011) requires their owners to have a license. It also provides for the introduction of other insurance regulations, if the activity is commercial or even scientific and educational[36]. Obtaining such insurance will be difficult because no companies are offering cheap space insurance on the market[37].

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35 M. Polkowska, Prawo bezpieczeństwa w Kosmosie, Warszawa 2018, Instytut Wydawniczy Euro Prawo, pp.220-221

36 N. Palkovitz, T.M. Zwaan, T.M Orbiting under the radar: nano-satellites, international obligations and national space law 55th colloquium on space law s. 578, 2012, Naples

37 J. N. Pelton, R. Jakhu, R.S Small satellites and their regulation, New York 2014, p.1

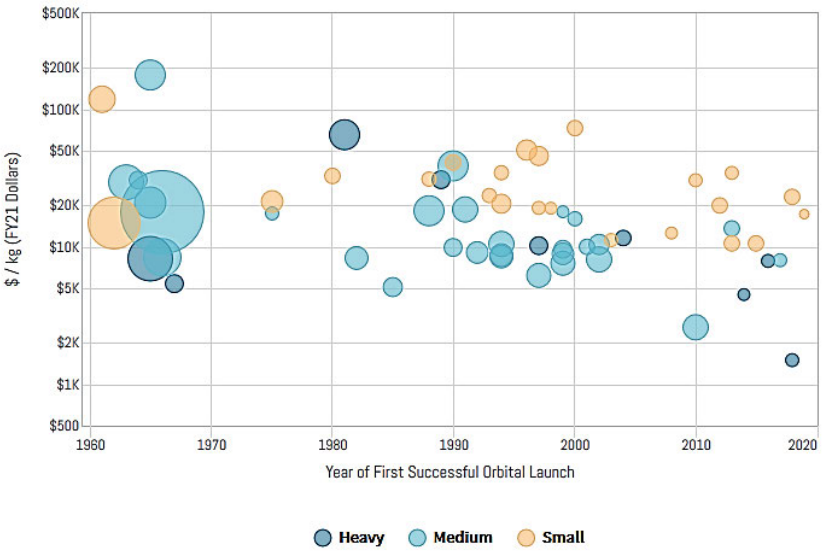

Figure 8. Cost comparison for space launch satellites
Source: Thomasa G. Roberysa World spaceports (2020), https://aerospace.csis.org/data/spaceports-of-the-world/

The increasing availability of low-cost launching equipment provides an opportunity to reduce overall operating costs for enterprises. Moreover, new technologies and computational methods are changing the way data is obtained, managed and processed. The big data created by small satellites will require new rules of analysis. In a 2019 report prepared by the international group of experts within the Space Research Committee, COSPAR, the term "small satellite" is somewhat arbitrarily defined as a spacecraft with an upper mass limit in the range of several hundred kilograms[38]. Yet the mass limit is less important than the processes used to build and launch these satellites[39].The roadmap in this report aims to encourage the space research community to stimulate the development of small-scale satellite industries in order to increase flight frequency and to change the way small scientific satellites are built and managed. Five recommendations were made; one each for the scientific community, the space industry, space agencies, policymakers and finally COSPAR itself.[40]

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38 R. von Steiger, Small satellites for Sustainable Science and Development. Small satellites for space Science (4S), a COSPAR Scientific Roadmap, presentation at Israel, Herzilija CO-SPAR meeting 4-8 November 2019

39 Small satellites for space science, a COSPAR scientific roadmap. Advances in Space Re-search. Robyn M. Millan, Rudolf von Steiger, Meir Ariel, Sergey Bartalev, Maurice Borgeaud, Stefano Campagnola, Julie C. Castillo-Rogez, Rene' Fle'ron, Volker Gass, Anna Gregorio, David M. Klumpar Bhavya Lal, Malcolm Macdonald, Jong Uk Park, V. Sambasiva Rao, Klaus Schilling, Graeme Stephens, Alan M. Title, Ji Wu, 64 (2019) p. 1

40 https://council.science/what-we-do/research-programmes/thematic-organizations/committee-on-space-research-cospar/ (access 21/08/2020)

In 2017, 36 small Cube Sats were launched to study the upper atmosphere in the EU-organized QB50 constellation. Participating in this program were: Australia, the United States, Canada, China, Taiwan, South Korea, Israel, South Africa, Turkey and Ukraine. Other entities have also collaborated in this field; for example, several new private companies are building rockets for small satellites (e.g. Rocket Labs and Virgin Orbit). It seems that the commercial sector is already developing new ways to build and test small satellites. Significant technological advances open up new opportunities for small satellites[41].

COMMERCIALIZATION OF SPACE IN THE US

Countries, including the US, are increasingly limiting their government budgets due to insufficient funds. Research and Science Prof. Dempsey draws attention to the dynamic pace of development of the private sector in space, especially in the period of decline in government activity. The global cost of government and private space operations increased to $ 314 billion in 2013, but commercial product and service revenues increased to 7%, and state-owned revenues fell[42].

Already in the program of the US government for 2010, it was stated that its task is, inter alia, supporting and facilitating the development of the commercial space sector, thanks to which the US will become a world leader in space. At the same time, an increase in the number of people delegated from private companies was recorded in the American offices and institutions involved in the implementation of the American space program. As a result, there has been an increase in the activity of private companies, including, e.g. Virgin Galactic, Bigelow, Microsoft, Amazon, and the stagnation of some government agencies.

The US government counts on close cooperation between government agencies and experienced private agencies whose operating costs are relatively low, and the results are encouraging. In the near future, the United States anticipates, inter alia, three types of missions: freight and manned transport to the ISS Platform, space flights in the sub-orbital space and reconnaissance missions to Mars. In the case of flights with passengers on board, NASA cooperates with three American airlines. There are currently 8 licensed spaceports in the US, but the number of US spaceports will grow; getting ready for this investment are, among others states, Texas, Hawaii and Colorado. Also, in other parts of the world, new ideas are emerging about the location of attractive spaceports attracting sub-orbital operations (Curacao, Japan, Sweden, Spain, Singapore, UK and

41 A. Freeman, SmallSat Constellations for Earth Science-it's about timing, presentation at the COSPAR meeting, Israel, Herzilya 4-8 November 2019

42 P.S. Dempsey, National legislation governing commercial space activities, Aerospace symposium ICAO. Montreal, March 2015

the United Arab Emirates)[43]. The activity of private entrepreneurs is constantly developing; it concerns not only the transport of passengers but also of satellites (Virgin Galactic). It is even said that there is a new concept of sub-orbital tourism in space. In the US, some entrepreneurs and NASA are also interested in transporting expeditions or building modern asteroid observing telescopes.

Commercial space activities also take place in Europe. Companies such as EADS, Astrium, Swiss space System, Booster, Reaction Engines operate here. Among others, balloon designs that can carry tourists to high altitudes[44].

EXPORT CONTROL OF SPACE EQUIPMENT

The control of the export of space devices (or their components) plays a significant role in the space business; it contributes both to protect national security and the interests of private companies. Entrepreneurs who export or import this type of goods must take into account the diversity of domestic and foreign regulations. Nowadays, export control regulations have become more complex and extensive. US export control laws have had a strong impact on other countries, as the US also applies its domestic regulations to export procedures outside its territory. Therefore, a non-US importer of US goods must comply with applicable US regulations, especially in cases of further re-export of such goods.

Any company or individual in the US can be placed on the so-called blacklisted or subjected to criminal prosecution by authorities in cases of non--compliance with the law. The US regulations also apply to situations where American technologies or information systems are used or are a component of a product outside the US. In the space industry, it is often impossible to do without American components. In this case, the foreign space enterprise is forced to comply not only with domestic regulations but also with American regulations.

In addition, more and more countries are beginning to adopt appropriate legislation to avoid the export of certain goods and equipment to hostile or unstable countries. The exporter needs to know what rules will apply to his export (hardware, software or technology). When controlling exports, goods are sometimes divided into two groups: the "dual-use" category (goods used for civil and military purposes) and the "military" category, for which export regulations are more burdensome.

Certain rules and legal regimes have been established to harmonize export controls at the international level. Also, restrictive national regulations are based on these international rules (including lists of controlled goods). The US export regulations are quite complex as there is no single set of regulations and no single

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43 G.C Nield, A new way to look at things [in:] R. Jakhu, K. W Chen, Regulation of emerging modes of aerospace transportation, McGill, Montreal 2014, p. 21

44 M.E. Dirkx, High hopes and low estimates: new space's rocky contractual road, "Journal of Space Law", JSL, 2010, Vol. 36, no 1, p. 55

licensing authority. There are several departments involved in export control, each with its own regulations[45].

In 1999, the US Congress decided to transfer control of the export of commercial satellites to the Department of State. The reason for this was a dozen incidents involving the export of satellites and modern technology to China. This transfer was deemed to endanger US security. On the one hand, this change had an impact on the US industry, which experienced stagnation in exports due to restrictive and lengthy licensing procedures, and on the other hand, contributed to the strengthening of the space industry in Europe[46].

In order to ensure compliance with international agreements and responsibilities of the European Union Member States, in 1994 the European Commission decided to strengthen the control system of goods that could serve both civilian and military purposes (dual-use) exported to third countries. Pursuant to the EU Regulation No. 428/2009 of 5 May 2009, unified control rules were introduced to ensure international security and allow EU exporters to complete formalities faster.

For the transport of weapons, the European Code of Conduct applies, to the export of weapons and other transfers of defense-related goods – the EU Common Military List, as well as Directive No. 2009/43 / EC of 6 May 2009. Embargoes are managed on the basis of regulations of the European Council. Council Regulation No. 428/2009 for dual-use goods sets the regime for the control of exports, transfers, brokerage and transit services. These rules establish common EU export authorizations. National regulations and decisions regarding dual-use exports must be taken into account in the common trade policy. EU members may adopt their own additional licensing requirements for dual-use as deemed necessary for national security or human rights reasons.

For exports requiring authorization, such documents will be issued by the appropriate authorities of each Member State in which the exporter is established. There are several types of authorization: individual, global, or general. When deciding whether to grant or refuse an authorization, the list of dual-use regulations is taken into account, taking into account: a) obligations and arrangements derived from international treaties, b) sanctions imposed by the European Council, OSCE (Organization for Security and Cooperation in Europe) or by the UN Security Council, c) comments on the national and foreign security policy, d) comments on the intended end-of-life of the goods and the risk of change in use.

The terms and conditions of Directive 2009/43/EC of the European Parliament and of the Council as regards transfers within the Community of defence-

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45 P.J. Blount, The ITAR Treaty and its implications for US Space Exploration Policy and the Commercial Space Industry, "Journal of Air Law and Commerce" (JALC), 2008, Vol.73, p. 705 and next

46 P.S. Dempsey, The evolution of US Space Policy, "Annals of Air and Space Law, AASL 2008, Vol. XXXIII, p. 325

-related goods, according to the authors of the directive, should be simplified. Moreover, when necessary, the list of defence-related products should be updated by the European Commission to align with the EU's common list closely. The member states should determine penalties for breaching the provisions of the directive. The directive does not automatically become part of national law; it still has to be transposed by the law of each Member State. Hence, Member States have to create appropriate national provisions for this[47].

The basic regulations for export control in Germany are the Foreign Trade and Payments Act (Aussenwirtschaftsgesetz – AWG) and the Foreign Trade and Payments Regulation (Aussenwirtschaftsverordnung – AWY) together with the German export list (Ausfuhrliste – AL). The AWG contains the rules of German law for export control, and AWY has specific prohibitions and licensing requirements. The central licensing body for the export is BAFA (translated into English – Federal Office of Economics and Export Control). In some cases, BAFA will decide whether to grant or deny exports. The legal basis for exports is the principles of checking the reliability of the company ("Principles of the Federal Governmental checking the reliability of exporters" of 2001). The authorization is issued only after political consultation with the Federal Minister for Economics and Technology. A unique German requirement for export transactions is the appointment of a person responsible for the export. Such a person must be, for example, a member of the company's board of directors and is personally responsible for compliance transactions with German export regulations. There are the following types of export authorizations: individual, collective (for the export of goods to a dozen or so recipients) and general (the latter are published in the federal newspaper and exclude the issue of individual licenses). All licenses may be provided with specific export restrictions and requirements[48].

In France, the export control system is different from that in Germany; there is no licensing agency. In France, the licenses are issued by the Minister of Defence. However, the French exporter needs his formal approval even to sign an agreement with the importer. Satellites and other space equipment are classified as warfare products. The licensing process can take place in two phases. Firstly, before the proposal is sent, and the contract is signed, a preliminary agreement (Agreement Préalable) must be obtained. Secondly, after it was obtained and restricted by the Secretariat of National Defence (SGDN) on behalf of the French Prime Minister, the Minister of Defence, following a positive recommendation of the inter-ministerial commission for the export of war materials (Commission

47 M. Gerhard, M. Creydt, Safeguarding National Security and Foreign Policy Interest- Aspects of Export Control of space Material and Technology and Remote Sensing Activities in Outer Space [in:] National Space Legislation in Europe: Issues of Authorization of Private Space Activities in the Light of Developments in European Space Cooperation. FG der Dunk (ed). Leiden, the Netherland 2011, pp. 196-219 (www.bafa.de access 20/08/2020)

48 S. Hobe, J. Neumann, Regulation in Space Activity in Germany, [in:] National Regulation of Space, R. S. Jakhu (ed.), Dordrecht, the Netherland, 2010, p. 150

Interministérielle pour l'Etude des Exportations de Matériels de Guerre), admits preliminary consent. There are various scopes and levels that may be authorized by pre-approval. The contract can only be negotiated after obtaining the preliminary consent (sales or negotiation). Then the contract must be compatible with the scope of the preliminary agreement and signed during the validity period of the preliminary contract. Ultimately, the exporting producer has to respect the clauses and restrictions of the draft approval. In the second phase, the manufacturer can obtain a valid export authorization, i.e. AEMG (Autorisation d'Exportation des Matériels de Guerre). However, the export authorization is valid only after obtaining the consent of the Minister of Foreign Affairs and SGDN (on behalf of the prime minister). There are two types of AEMG license: a temporary export license (valid for one year and authorizing the export of items mentioned in the initial approval, and a permanent export license (valid for 2 years and authorizing the permanent export of goods). Products that are not classified as materials used for and associated with warfare may still be considered dual-use[49].

In the UK, important export control regulations are those contained in the Control Act of 2002, along with implementing legislation in various forms (orders). Released in July 2009, Export Control Order 2008 consolidated and updated the 2002 Act, along with legislation on the export of items, technology transfer and technical assistance regulations. The British licensing authority for strategic export control is ECO (Export Control Organization) and BIS (Department for Business, Innovation and Skills). ECO processes all military, nuclear and dual-use export licenses. Licenses are issued (or denied) after receiving opinions from other authorities, such as the Ministry of Defence, DESO (Defence Export Services Organization) or FCO (Foreign and Commonwealth Office). Under UK law, there are the following types of export authorizations: Standard Individual Export License (SIEL), Open Individual Export License (SIEL).

Individual Export License (OIEL), which is specific to an individual exporter and an Open General Export License (OGEL) that allows the export of specific goods controlled by each exporter, provided that the conditions match, and the shipments and runs are elective[50].

The export control system in Russia has much in common with the German system, which was the model for the government of the Russian Federation. Regulations concerning the export control and licensing process are administered by the FSTEK (translated into English – Federal Service for the Technical and Export Control) belonging to the Minister of Defence. The most important export control regulations are contained in the government ordinance No. 691 of 2008. Depending on how sensitive the exports are, the FSTEK may also involve

[49] P. Achilleas, Regulation of Space Activities in France, (in:) National Regulation of Space Activities, R. S. Jakhu (ed.), Dordrecht, the Netherland 2010, p. 121

[50] https://www.pmddtc.state.gov/ddtc_public?id=ddtc_kb_article_pagesys_id=%2024d528fddbfc930044f9ff621f961987 (access 28/08.2020)

an Inter-ministerial Council in the licensing process. Two types of the license can be applied for: (a) single, which allows a certain amount of goods to be exported, and (b) general, which allows export to certain countries without the need to provide an end username[51].

Overall, it can be said that most of the existing national export control laws are based on the international regime. The national rules have the same characteristics; they all distinguish between the categories of export – dual-use and military-use. Some national regimes have only one license (e.g. Germany, UK), while others, e.g. the US and France, have more than one, with different jurisdictions. Unique here is the extraterritorial application in US regulations, which cannot be found in other legislation. In France, too, there is a special rule stating that a preliminary contract is needed to sign a contract consent. Pursuant to European Regulation No. 428/2009, no license is required for du-al-use exports within the EU. National dual-use regulations still exist but must refer to the Council Regulation that prevails in a conflict situation.

ACTIVITIES RELATED TO SPACE RESOURCES

Economic exploration of space is also of great interest; there is even a new concept of "lunar economy". In 2015, the United States adopted a draft law on the commercial use of space (Commercial space Launch Competitiveness Act)[52]. The president orders this draft, acting through appropriate Federal agencies, to facilitate the commercial exploration and commercial sourcing of space resources by US citizens.

Luxembourg, which is not a space power, has adopted similar legislation. The Luxembourg government is very active, organizing symposia and conferences to which it brings experts and business representatives. It also cooperates with other countries and international organizations (e.g. UNOOSA- United Nations Office of Outer Space Affairs) on various space initiatives and projects. It created good economic conditions for companies in the space industry and a useful legal framework for them. The Space Resource Research Center was established. There is also an act that opens the market for external companies to space research (the 2017 Act on the Search and Use of Space Resources). Article 1 of the Act states that: "*space resources may be owned. The search is allowed. The authorization shall be granted to an operator for a mission to explore and use space resources for commercial purposes upon a written request to the ministers*" (Article 3)[53]

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[51] S.P. Malkov, C. Doldrina, Regulation of Space Activities in the Russian Federation (in:) National Regulation of Space Activities.R. S. Jakhu (ed.), Dordrecht, the Netherland 2010, p. 315

[52] Public Law no 114-90: www.congress.gov/bill/114th-congress/house-bill/2262 – (access 11/25/2015).

[53] https://spaceagency.public.lu/en/agency/legalframework/l (access 21/01/2020) law_space_resources_.hml

During the last symposium on this issue, organized by the Luxembourg space Agency (November 13-14, 2019) – the Hague international working group on space management adopted the "Building Blocks for the Development of an International Framework on space Resource Activities ". A working group was set up to promote international cooperation and dialogue with a wide range of stakeholders to identify ways of economic exploitation of space resources[54].

CONCLUSIONS

The constant process of commercialization of space requires adapting the existing legislation to current needs and challenges. The economic challenges show the importance of peaceful cooperation between states. As technology progresses and small satellites emerge, access to space becomes easier and cheaper. It favors small countries and their private entities. Free and undistorted competition, in line with the basic principles of operation of democratic states, should be supported by new space programs and strategies and national regulations, so as to make this space available to all.

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[54] https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group (access 22/08/2020)

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