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**Old Space vs New Space: New Players between Space
Economy and Space Warfare**

Master's Thesis

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Declaration

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2. I hereby declare that my thesis has not been used to gain any other academic title.
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In Prague on
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References

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Abstract

As NATO (North Atlantic Treaty Organisation) stated in 2019, a dramatic growth in the use of space's destructive and constructive potential has attracted attention to space as an operational domain (Doboš, 2022). Due to the wide range of services that satellites in orbit provide, it is possible that in the unusual case of war, the destruction of one of a nation's satellites may have a severe impact on the state's performance generally, not just during that particular situation. Unfortunately, geopolitical processes did not sufficiently support the establishment of an international and national framework appropriate for the developing field of space, particularly in terms of security. The inflow of various new private players, whose importance is rapidly growing, is what brought this dissertation to light.

There are more prospects for collaboration and commerce as more parties enter the global space market, but this expansion also raises worries, particularly when it comes to the introduction of new technologies that are frequently employed not only for civil purposes but military as well. This thesis will examine the role of private space enterprises in the context of the War in Ukraine, which highlighted the growing strategic relevance of private players, particularly during times of war, taking into account the United States (USA) and the European Union (EU), which having democratic regimes, include a more commercialised future vision, and moreover they are the main supporters for Ukraine.

Abstrakt

Jak prohlásilo NATO (Organizace Severoatlantické Smlouvy) v roce 2019, dramatický nárůst využívání destruktivního a konstruktivního potenciálu vesmíru přitáhl pozornost k vesmíru jako operační doméně (Doboš, 2022). S ohledem na široké spektrum služeb, které satelity na oběžné dráze poskytují, existuje možnost, že v neobvyklém případě války by zničení jednoho z národních satelitů mohlo mít vážný dopad na celkovou výkonnost státu nejen v průběhu dané situace. Bohužel geopolitické procesy nedostatečně podpořily vytvoření mezinárodního a národního rámce pro rozvíjející se oblast vesmíru, zejména pokud jde o bezpečnost. Příliv různých nových soukromých hráčů, jejichž význam rychle roste, je to, co přineslo tuto disertační práci na světlo.

Existuje více možností spolupráce a obchodu, protože více stran vstupuje na globální vesmírný trh, ale tato expanze také vyvolává obavy, zejména pokud jde o zavádění nových technologií, které se často používají nejen pro civilní, ale také pro vojenské účely. Tato práce bude zkoumat roli soukromých vesmírných společností v kontextu války na Ukrajině, která zdůraznila rostoucí strategický význam soukromých hráčů, zejména v době války, s přihlédnutím k USA a EU, které mají demokratické režimy, včetně komercializovanější vize budoucnosti, a navíc jsou hlavními podporovateli Ukrajiny.

Keywords

Military, Commercialisation, Private Space Capabilities, Ukraine, European Union, United States of America, Starlink, Space Policies

Klíčová slova

Armáda, Komercializace, Soukromé Vesmírné Schopnosti, Ukrajina, Evropská Unie, Spojené Státy Americké, Starlink, Vesmírná Politika

Název práce

Old Space vs New Space: Noví Hráči mezi Vesmírnou Ekonomikou a Vesmírnou Válkou

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List of Abbreviations

ASI	Agenzia Spaziale Italiana (Italian Space Agency)
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
COPUOS	The United Nations Committee on the Peaceful Uses of Outer Space
DG-DEFIS	Directorate-General for Defence Industry and Space
DoD	US Department of Defence
ESA	European Space Agency
EU	European Union
FAR	Federal Acquisition Regulations
GDP	Gross Domestic Product
GPS	Global Positioning System
IR	International Relations
ISR	Intelligence, Surveillance and Reconnaissance
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
MoD	UK Ministry of Defence
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NRO	National Reconnaissance Office
NSP	National Space Policy
OPIR	Overhead Persistent Infrared
OST	Outer Space Treaty
P3	Public-Private Partnership
PNT	Positioning, Navigation and Timing

PRS	Public Regulated Services
PSSI	Prague Security Studies Institute
R&D	Research and Development
SAR	Synthetic Aperture Radar
SME	Small and Medium-Sized Businesses
SSA	Space Situational Awareness
ULA	United Launch Alliance
USA/US	United States of America
USML	US Munitions List
USSF	United States Space Force
USSR	Union of Soviet Socialist Republics

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1. Introduction

The conquest of space embarked on with the launch of the first artificial satellite, Sputnik 1, by the Soviet Union in 1957 from the Baikonur Cosmodrome in Kazakhstan, and briefly after, the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) was instituted (1958), the first man was shipped to space (1961), and the first man landed on the Moon (1969) (Ziemblicki & Oralova, 2021). The Cold War has been characterised by the two superpowers, USSR (Union of Soviet Socialist Republics) and US, in a challenge to show power and prestige, and the desire of affirming its own technological and military superiority. The end of the Cold War era, which demonstrated the strategy of space, resulted in a significant economic reorganisation, with a huge number of businesses and procedures entering the market to meet the demands of heightened global competitiveness (Rosanelli, 2011). Never before today has there been such a flurry of activities in the space industry, with satellites in orbit registered in over 80 nations and ever-increasing public and commercial investments (OECD, 2019).

Thirty years after the end of the Cold War, space still represents a field of competition and conflict, especially for its military potential, and ultimately constitutes a new stage in relations between States and non-state actors. Used as a diplomatic and political lever, the development of space programmes has become an integral part of the strategic positioning of countries. Yet, even though the entry of an expanding number of actors into the international space theatre fosters more potential for partnership and trade, it also raises challenges (Rosanelli, 2011). The 21st century marked the start of a new era for commercial space enterprise, resulting in the coining of a new epoch, the New Space Age (Isnardi, 2019). New Space – *“a movement of commercial space companies seeking to redefine the relationship between the public and the private sides of the space sector as*

well as assert a greater role for the private sector in the use and development of space more generally” (Weinzler & Acocella, 2017, p.2). The "privatisation" of space activities is the vital novelty of the past few years, in which enterprises have taken control of telecommunications and Earth observation industries, and even the administration of launch bases (Rosanelli, 2011, p.178). The international space scene is, indeed, becoming much more complex every day. The programmes are often carried out in cooperation, not only between States like it was during the Cold War, but also between a number of private companies from different nationalities. The explanation for this shift is because private enterprises work considerably more effectively and can take greater risks than government organisations, also allowing them to accomplish duties at a lower cost (Ziemblicki & Oralova, 2021). In addition, it is important to highlight the 'dual-use' capabilities of space systems, since many players employ a non-military programme to test technologies of possible military use, further blurring the distinction between civilian and military activities (DIA, 2022).

Despite the fact that the law recognises outer space to be a peaceful environment, space has become critical for contemporary warfare, and nations with superior space capabilities undoubtedly have a geostrategic edge over their opponents. In fact, the US Department of Defence (DoD) identified the space environment as "congested, contested, and competitive," highlighting the difficulties of growing players and increasing numbers of objects competing for precious funds, operationally advantageous orbits, and space-based capabilities (King & Blank, 2019, p.125). The importance of space assets for military, economic, social, and scientific goals is evident, and it is projected to keep growing in the near future (Doboš & Pražák, 2022). The military apparatus, international banking, and every key organisational infrastructure all depend on space. Space resources are vital to any modern command, control, communications, computers, intelligence, surveillance, and

reconnaissance (C4ISR) architecture (DIA, 2022). Being actively engaged in space assures both direct and indirect gains, including military advantage, national and international prestige, economic competitiveness, and scientific independence (Rosanelli, 2011). For this reason, a rising number of governments are developing space capabilities, such as missile warning, geolocation, weather monitoring, finance, navigation services, for their population and military forces (DIA, 2022). Space, given its multidimensionality, is a strategic resource capable of providing a precise grasp of reality and directing efforts towards the fulfilment of national policy objectives (Rosanelli, 2011).

This dissertation will attempt to address the research topic of how military applications of space are being impacted by the rising commercialisation of space. It will investigate the influence of privatisation on military applications of space in the peculiar context of the War in Ukraine. It will specifically examine the role of private firms in supporting military tactics and Ukrainian forces, with a major focus on the “Starlink case”. Furthermore, the links between the dominance of public actors limit the analysis to the United States and the European Union (Frankowski, 2017). The US and the EU, additionally, are currently considerably more involved in support to Ukraine, as well as being democratic regimes, their liberal policies allow easier deal and relation with private business. Ideologies and regimes, indeed, can make a difference. Effectively, the hypothesis that drives this thesis is - because of their inventive and cost-effective solutions, private space-provided services are expected to progressively supplement nations' military capabilities.

2. Literature Review and Theory

2.1 Literature Review

Over the past few decades, the application of space has changed substantially, moving from a nation-state-dominated field (Old Space) to one where private organisations are increasingly playing a key role (New Space). Satellite technology and space-based services have rapidly advanced thanks to an extraordinary inflow of money, inventiveness, and insight brought by the emerging commercial space industry. These businesses have shown an unequalled capacity to create, launch, and run satellites efficiently, upending established business practices and posing a threat to major participants in the space industry (Caselli, 2011). As they move ahead with audacious ambitions and ground-breaking technology, commercial space businesses are previewed to enhance nation-state space capabilities, including their military endeavours. The literature review seeks to delve into this progressive trend.

The objectives of this review are threefold: first, to examine security issues and the potential contributions that private companies might bring to military applications; second, to explore governance challenges in space and the public-private relationships, as well as the complex collaboration between commercial space enterprises and state military organisations; third, to analyse the phenomenon of space democratisation brought on by the influx of numerous new players in the market. It will compare various academic papers, journal articles, political reports, and political approaches in order to understand each outcome, context, and process from multiple angles. Its purpose is to present an analytical overview of existing research papers the most pertinent to the topic in question. It will be mainly focused on the analysis and

developments of international theories applicable to space. It will identify gaps, conceptions, and beliefs in existing theoretical concepts.

The literature review will be a foundation of the subsequent theoretical framework section that will present an eclectic approach and will analyse three grand paradigms of International Relations (IR). The notions retrieved from the documentary analysis will put the basis to understand the changes occurred between Old and New Space, and the transforming intriguing development of the military space capabilities realm. For this reason, it will mainly focus on the advent of commercialisation in all its aspects. And it will try to overcome the legal, social and security challenges posed by the military utilisation of space services.

2.1.1 Space Warfare

In a way somewhat similar to what occurred in the 60s, being present and active in space enables us to impress other nations with our possession of technologically superior capabilities, which indicate an independent ability, leadership, but also interdependence (Rosanelli, 2011). Around the turn of the millennium, Everett Dolman (2002) recognised that space had become a brand-new and strategic battlefield where each characteristic and players must be examined and refined because every decision affects international politics and tactics (Doboš & Pražák, 2022). Although space is not yet a battleground in and of itself, it is nonetheless useful for armed conflicts due to the services that it may provide for the terrestrial soil. By focusing on cardinal systems like navigation, early warning, or communication, space systems offer a significant advantage, especially in the early stages of a conflict (Doboš & Pražák, 2022). However, in line with Tobin & Borak (2022) and Wakefield (2022), these cardinal systems have a “dark side” when it comes to potential military, alongside civilian targets.

From a civilian standpoint, space systems support our daily life, through environmental monitoring, communications services, Internet, as well as transportation, precision farming, autonomous vehicle guidance, banking transactions, “*emergency medical, fire and police services, as well as navigation services for rail, road, air, and ocean cargo operations*” (DIA, 2022, p.2). But space operations are becoming a crucial component of military operations. We refer to these programmes as “force multipliers” because despite the civilian uses, from a military standpoint, they serve to increase the impact of more traditional forces that provide logistical support to the troops in the operating spots (Rosanelli, 2011, p.49). What is more, purchasing commercial companies and so commercial data allows the governments to view more places on Earth with a major frequency, and in some circumstances, data is now accessible rapidly enough to allow for decision-making in real-time on the battle ground (Borowitz, 2022). Detsch & Gramer (2023), in fact, emphasises the importance of commercial data, in particular taking the current war in Ukraina into example, underlining commercial data benefits essential for public and military connectivity in the country. That is why pressure is being put on private space organisations to contribute data that provides valuable insight on this present-day context (Wakefield, 2022). In line with this statement, Erwin (2023) and O’Sullivan (2023) underscores the efficiency of commercial capabilities, and a need for regulations, especially, in relation to private companies’ commitments, liability, economy and autonomy.

According to Johnson-Freese (2016), space warfare and its inevitability, especially in the last decades, started to be a more and more investigated topic. Since under space law there are only specific restrictions regarding weapons of mass destruction, and since space cannot be owned, there is clearly no "Leviathan" to placate space players, contributing to see patterns in the case of outer space that would lead to a move

towards the weaponization of outer space (Pražák, 2021, p.493). Johnson-Freese (2016) observes the rising tendency towards the integration of military space assets into defence plans as a result of the space environment being defined as "congested, contested, and competitive". Space security, in fact, is regarded in three dimensions as *"outer space for security, security in outer space, and security from outer space"*, therefore *"private companies active in outer space could apart of providing security with space assets can generate threats in outer space, from outer space, and also through outer space"* (Frankowski, 2017, p.135-136). Further, because of their potential to have a detrimental effect on public utilities, cyberattacks, jamming, or as an example the outage that occurred to ViaSat's satellite communication service in February 2022 ought to be taken as well into assessment (Boschetti, 2022). A path ahead towards accomplishing the overcoming challenges of space security and space development can only be discovered by taking a holistic approach to tackling the complexity of dealing with space challenges and the multitude of actors involved in those concerns, both public and private (Johnson-Freese, 2016).

2.1.2 Space Governance and the Military-Industrial Complex

Military has always worked with business to identify easier and faster solutions and mitigate difficulties without the bureaucracy of the governments. According to Denis (2017, p.428), the rapid commercialisation of space can lead to the so-called "hype effect threat" with the collapse of new initiatives due to lack of funding or a viable business model. As a consequence, it is fundamental to consider the military–industrial complex. In conformity with Johnson-Freese (2016), the military-industrial complex's expanding cast of players plays an imperative role in the politics that determines how security policy in general and space policy in particular are decided. In addition, elite power theorists in the C. Wright Mills tradition have long argued that the military-

industrial complex's concoction of interests and players has assisted in “*determine, shape, and refine the definition of "national interest" in order to maximise profits and protect access to resources*” (Johnson-Freese, 2016, p.104). It is also important to note that significant strategic and national interests, referring to Salin (2001)’s statements, are increasingly being sponsored by non-national customers all around the world, and one of the main motivations for liberalising space initiatives was a reduction in governmental funds. In accordance with Caselli (2021), indeed, the competitive pressure that the private sector puts into the space environment is without precedents but at the same time risky. Due to the contradictory and interpretative character of international and national space laws, private actors, for example, may be encouraged to pick a state to launch their spacecraft from depending on the enforcement practices that will benefit them the most (Isnardi, 2019). Since States are held responsible by international law for their non-governmental actions, when private companies pursue commercial space operations, the legal responsibilities and risk of exposure of the parties are not always clear (Dempsey, 2016). Nasu (2022), indeed, points out the limits of “the law of war” and its controversies applications in relation to claim of liability and third-party rights.

In furtherance of globalisation and the growing commercialization of actions and space actions, the issue of exporting and importing sensitive technologies and ensuring that they are compatible with national security aims, along with the transfer of the technology, raises problems of sovereignty (Rosanelli, 2011). However, we do not refer to the classical notion of sovereignty per se. For this reason, the concept of sovereignty is examined as part of research to find a balance between economic concerns and security needs. We refer to Rosanelli (2011, p.9), who uses the term "technological sovereignty" for appealing to the capacity to develop technological and

scientific knowledge on one's own or to utilise technological capabilities created elsewhere through the implementation of partnerships that are deemed trustworthy. In relation to this notion, governments must grant authority and ongoing oversight for their space operations, including private commercial ventures. Therefore, space governance must be investigated from several viewpoints. Space governance, in line with Frankowski (2017) includes laws, guidelines, standards, and frameworks that organise interactions in space, as well as the procedures that are employed to develop and enforce such norms. However, one facet of space governance is particularly perplexing about the expanding role of private administrations, when public players voluntarily and actively withdraw from space security standards (Frankowski, 2017).

Commercial players are emerging as a significant new element of space governance, despite there is a clear gap between liberal and illiberal regimes in this process. The private corporations that have emerged in the West over the past two decades are a combination of start-up businesses that typically look for solutions to problems and companies formed by billionaires who operate in accordance with their personal objectives and ideas for space activities, though, this further reduces the traditionally strong position of states in the area that previously governed private operations (Doboš, 2022). What is distinguishing the two types of government's approaches are their political and economic goals (Sallai & Schnyder, 2021) In fact, governments such as China or Russia, on the other hand, choose more direct geoeconomic instruments that are connected to governmental policies, following the state-capitalism model, which is based on the state's direct engagement in the economy (Doboš, 2022).

2.1.3 Democratisation of Space

Today, privately held companies, non-profit organisations, and other public bodies are quickly creating and deploying images satellites due to increasing accessibility

provided by energy-efficient computing and cost-effective launch strategies (Kim, 2019). It is common to refer to this tendency as "the democratisation of space", which Kim (2019, p.35) argues to be "*a change in the status quo that has made outer space accessible to not only the global superpowers and large multinationals, but to developing countries, start-ups, universities, and even high schools.*" In accordance with Iyengar (2022), services and competencies that were previously predominantly in the hands of only governments are now commercially available to everyone thanks to the private sector. This is what characterised the main distinction between Old and New Space, because in the first-place, space was managed only by governments (Interview Falvella, 2023). Consequently, the New Space Era is described by Weinzler & Acocella (2017) as a progressive action which sees private companies gaining a much greater role. And this change can be attributed to the fact that private businesses can face bigger risks since they may receive backings from various entities, have a freer administration, possess a bigger margin of error, and complete tasks more cheaply (Ziemblicki & Oralova, 2021). Yet the government is in a position to substantially affect the space industry due to the dependability of privates to public funding and, popular and institutional audience (Yonekura, 2022). Public-private partnerships (P3), which have gained popularity recently, are a partial solution that can be used to control the agreements and connections between public and private sectors (Jones, 2018). Although P3s have become a prominent research issue for the field of IR, many researchers are still studying the connections between the global environment and non-state entities.

The current war in Ukraine and the New Space Age also underlined the democratisation of information, which has extensively been used to shape public opinion (Kolovos, 2023). Space is providing transparency around the world in a way

that is no longer totally controlled by the government (Stopher Interview, 2023). Even if there have been complaints about the harm to privacy or national security, satellite imagery is one of the most popular sectors, and it is becoming much more important in light of globalisation, commercialization and propaganda (Denis, 2017). Space-based photography keeps on retaining the ability to not only affect foreign policy, in ways that were virtually unimaginable a few decades ago, but also open the door for public exposure (Kim, 2019). What is truly in jeopardy here, and what should be the subject of a broad and open democratic debate, is the concept of public interest, and if the so-called "national public interest" or "global public interest" should prevail (Salin, 2001). Understanding the manner in which space-based technologies matter is momentous to appreciate the resurgence of interest in space, in particular in the 21st century (Robinson, 2018). Even if we might not be aware of it on a daily basis, space plays a significant role in our lives.

Because of the private sector's involvement, it is pivotal to underline the significance of security, stability, responsibility, and sustainability in space operations and activities. The fact that Starlink was directly involved in the preparation of an armed attack against the Russian military during the Russia-Ukraine conflict, which resulted in casualties and damage to military hardware, illustrates the potential dangers of this democratisation process (Ray & Selvamurthy, 2023). The presence of private actors in space is notably quickly expanding. This rapid proliferation, according to Ireland-Piper (2023) has consequences for numerous facets of human life, including human rights, access to data and scientific progress, environmental stability and safety, and unfortunately existing space treaties do not provide exhaustive details on the presence of private entities in space activities.

2.2 Theoretical Framework

Gaining authority in your country's environment is decisive for private space firms' marketing operations since it safeguards their licences to operate. A broad variety of enforcement levels across states has been made possible by granting governments total flexibility over how they approve and manage the launch of space operations. For example, one licence may be provided by certain jurisdictions for all space operations and another by other states for only particular space activities (Isnardi, 2019). Moreover, while some nations claim jurisdiction over the country of origin of the private actor that launched the space object, others claim jurisdiction over the location of the launch (Isnardi, 2019). Due to the analogy that can be gleaned between human behaviour on Earth and in space, war has seen "*as a political, emotional, and chaotic activity*", and we can assume that space warfare and outer space policies, in general, are the continuation of earthbound politics by additional means (Bowen, 2016). Ideas and debates from throughout history as recorded glance at the bigger notions of power, security, and politics, and offer fresh perspectives on situations and places directly applicable even outside the Earth's atmosphere (Bowen, 2016).

Constructivism accords the proper weight, not only to states, but also to all the other actors involved in the world system, that are crucial elements of change because of their norms, practises, ideas, presumptions, social structures, and connections, that are capable of easily influencing the global order (Pfaltzgraff, 2011). It is evident how non-states actors are shaping the space environment in a way that has never been seen before. That makes the constructivist approach suitable for what is its understanding of reality, a reality created by individual ideas and perceptions, which impact the development and arguments on which judgements and decisions are made (Wendt, 1995). Constructivism offers the advantage of considering the power of ideas as change

agents in international politics, where every player may influence the outcome, as we can see in the conflict in Ukraine, where every single actor can generate big transformations. That is the idea of New Space, where multiple actors are able to influence norms, practices and logics. Constructivists indeed focus on how results are affected by how procedures are seen as legitimate (Pfaltzgraff, 2011).

However, the constructivist approach alone would be not enough for the analysis. Therefore, a conceptual approach namely eclecticism will best support the research. Eclecticism makes use of more than one theory adaptable in different situations, and so it draws a variety of theories, methods, or concepts to get complementary insights into a topic. As a result, two other basic grand theories of IR, liberalism and realism will be taken into account.

2.2.1 Liberalism

Liberal thought provides recognisable notions when it comes to space policy through its understanding of individuals, sovereignty, and to a degree standards. It is essential to understand the liberal worldview, in which governments and their members participate in comparative advantage and mutually beneficial interactions. The development of both cooperative and competitive space policies has been heavily influenced by the commercial value of space. Cooperation can lead to the development of advanced technologies for space surveillance and monitoring, ensuring the safety and security of space assets and activities (Moronese Interview, 2023). While there are standards and legislation that may be attributed to the European and American space regimes, Eastern spacefaring governments tend to reflect them less in their policies and practices. Albeit there are agreements on the need for collective problem-solving approaches and the use of legal remedies for both the public and private sectors within Western space institutions, China and its neighbours are mostly sealed off from one

another, do not share information, and exhibit an extensive degree of control over the private sector (Doboš, 2022).

According to the neoliberalist Axelrod & Keohane (1985), even if states pursue personal interests, and the international actors play in an anarchic system which is a constant, the expansion of the global economy and more common interests create incentives for collaboration, and more an economic interdependence will prevail, more chances for a long-term cooperation will succeed, while also maintaining the important role of States and institutions feasible. Moreover, considering the liberal view it is possible to improve the measurement of economic liberalisation, along with the vantages of the spread of democracy. Along with liberalist authors such as John Locke, Immanuel Kant or Adam Smith (Andreatta, 2012), liberalism and its importance is related to the value of cooperation, justice and ethics, and institutions, such as ESA (European Space Agency) or NASA (National Aeronautics and Space Administration), or NATO in favour of common rules, interest and market, but at the same time that recognise the self-government, self-sufficiency and self-determination of every state. Space has always been distinguished by ideational and prestige-based incitement, interwoven with commercial, intergovernmental, and transnational policy and practise in low Earth orbit and beyond (Rosanelli, 2011). Liberalism focuses itself on the concept of interdependence, and in this case the discussion that wants to be developed refers to the characteristics of liberal cooperation in activities and projects in space. This entails encouraging governments to collaborate in developing norms, legislation, and agreements that encourage peaceful use of space and prevent militarization of space. Liberal governments may advocate for space-related weapons control and disarmament treaties, counting the influence of private firms, and they may lobby for transparency measures to increase trust among space actors. However, liberalism

cannot be taken as the only theory to consider, due to its strong optimism that cannot completely embrace the heterogeneity of the international context.

2.2.2 Realism

It is perilous to remember the realist premise of anarchy in the international arena, which is critical for recognizing nations' concerns and mistrust, and thus, their intentions and perspectives, which are frequently in line with the parameters for a classic security dilemma. On the basis of John Herz (1950)'s theory, the security dilemma is a metaphor of the realist thought and it stated that the conflict does not stem from aggressive intentions, but from insecurity due to uncertainties about the intentions of others - the state will therefore tend to accumulate power to promote its own security and reduce its uncertainty but this will generate a menace to other states triggering a chain reaction where other states will also try to increase their security and therefore also power, causing an increase in general instability as the prospects of a confrontation become progressively real and threatening, as in the case of the Ukrainian invasion. The notion that proficiency in technology is a major indicator of national power in a fiercely competitive world, with applicability to space and the actual world, is a key concept (Johnson-Freese, 2016).

According to Thomas Schelling (1958), the concept of strategy does not need to be far from the conception of realism, and it implies an idea of action and reaction based on the expectations that one has about the counterparty. This means that the behaviour of a state responds to the expectation that that state has about the behaviour of the opponent. As follows, increasing the uncertainty of interactions, especially with regard to the information that a state can circulate about its future actions, which may not correspond to what it will actually do, generates a problem of information asymmetry that in conjunction with the space environment spawns greater rivalry (Schelling,

1958). The realistic conception and therefore an objective vision of reality allow us to consider the various approaches of the various states towards the growth of the private sector, in relation to national power and reputation.

“The prestige effects may also turn out to be a major consequence of outer space activities in the international system” (Knorr, 1960, p.579). As evidenced by the work of theorists like Morgenthau (2006), the accommodation for prestige within the traditional realist view of power allows us to see the space race as a contest to enhance a state's fame for strength and performance. Considering the glory and wide range of benefits associated with space capabilities and profits, it is accurate in characterising all the actors involved as prominently selfish, as well as unequal. Even while egotists have a natural tendency to distrust others, given the right circumstances, they will take actions that are in their own best interests meanwhile interaction is a must for chances to advance shared interests (Johnson-Freese, 2016). Institutions, for their part, try to generate dynamics in favour or compensate for the disequilibrium. Realism recognises that space is becoming increasingly congested, competitive, and contested, and acknowledges the limitations of existing space treaties (Johnson-Freese, 2016). As more nations and commercial organisations explore into space, the potential of accidental collisions, intended attacks, electronic warfare vulnerability, and dual-use proliferation escalates. Stakeholders may build better strategies for minimising risks and improving space situational awareness (SSA) by using a realistic approach to threat assessment. Nevertheless, the reason why realism is not the only theory to be considered is because sometimes it has a too deterministic vision and poses not enough attention to non-state actors.

2.2.3 Constructivism

As early as the 1970s, NASA began considering strategies for using the private sector to supplement public funding for space missions (Johnson-Freese, 2016). Over the past few decades, private sector investments have expanded, but with the privatisation of satellite telecommunications services, the first wave of commercialization of space systems occurred during the 1980s and 1990s (OECD, 2022). The end of the Cold War contributed to the legitimacy of constructivist views because realism and liberalism both missed to foresee the end of a bipolar world and had some difficulty explaining it (Walt, 1998). After the dissolution of the USSR, several states were born from its ashes, creating a pivotal change in the international environment and relations. Constructivism, in fact, is a more recent approach and developed itself in a context that is mutating, and it also measures the events of international politics expanding a strong interest for the growing number of parties, despite their prominence. In a constructivist reality, the behaviour of a state depends on how that state is perceived, which can range from friendly to hostile, and how the players' identities, values, and ideas are interpreted (Filipec, 2019).

Given the range of actors that interact with space and their capacity to determine the agenda and goals of government action, there is value in thinking about players in a way that is not primarily defined by only national interest. Private actors have an impact and a disproportionate control over the space sector (OECD, 2019). In truth, the interactions among and within each of these entities and agencies are what determine whether space is turning into competitive or collaborative. It is necessary in this to keep reliance on constructivist logic, which according to Alexander Wendt (1995) gives much more credence to the power of ideas. Understanding the goals - or lack thereof - of international space players requires recognising ideas and rhetoric in

shaping space policy. Wendt's logic, additionally, provides the basis for comprehending space warfare, particularly its civilian component in light of deception and propaganda. Propaganda and misinformation may be used to boost mobilisation of the population, as well as, in line with Russian endeavours, to create “information sovereignty” (Filipec, 2019, p.65). “*Public opinion can affect all your kind of instruments of power, military as well*” (Interview Stopher, 2023). In terms of security, public-private partnerships’ data diffusion in real time can enhance SSA and information sharing between government entities and private firms (Interview Moronese, 2023). Identifying behavioural and ideological values within a constructivist perspective concerning foreign policy, as well as critically taking into consideration economic and military drivers, are the way international interactions in space can be best examined.

Given that, what is to be expected is that the role of privates will be less and less marginal in the next years, and commercial data showed how much space is vital for every type of normal daily function, and on the combat field too. The autonomy and position taken by private actors has brought them to be an essential part for Ukraine survival. Especially with the greater development of dual-use space technologies the perceptions and rivalries between states are evolving and the constructivist’s view of change is important to understand this evolution. Constructivist principles can impact the development and adoption of standards governing responsible space behaviour and consumption of resources. Constructivism emphasises the significance of actor interactions and perspectives in affecting their behaviour, which might translate into enhanced confidence-building measures between spacefaring states and commercial entities. When commercial firms join the space domain, they bring their organisational societies, protocols, and values. Constructivism can help offer light on how the

identities and motives of these private players differ from those of conventional state actors, possibly impacting the overall behaviour and governance of New Space programmes.

The three theories of liberalism, realism and constructivism should not be seen as mutually incompatible but rather as complementary, since this will enable the development of an analytical framework for various aspects related to the space industry. As a result, the eclectic approach is the most suitable one because it does not concentrate itself only on one ideology of thinking, but it believes that IR should incorporate various schools of thoughts and not be constricted to only one theory (Makinda, 2000). The future should be aware of realism's insistence on the unavoidable role of power and anarchy, liberalism's consideration of domestic and institutional dynamics and possibility of cooperation, and at the same time consider constructivism's vision of evolution and ideas, and all the potential actors involved (Walt, 1998).

3. Methodology

The methodological technique adopted for this analysis employs the use of a qualitative research methodology, using a case study approach to analyse the involvement of private space enterprises in the current crisis in Ukraine. The case study will concentrate on the conflict in Ukraine, which sees the involvement of both commercial and institutional organisations, such as the United States and the European Union, most particularly. As a result, the study will focus on democratic, and non-authoritarian regimes. Indeed, the governments that do not avail themselves to the support of the private sector are nations, such as Russia, or China, or North Korea, with a more protectionist and statal vision (Falvella Interview, 2023). Furthermore, the concentration of the research wants to pay

attention on liberal-capitalist geoeconomic theories rather than state-capitalist ones. The legislation, incentives, and ownership that are employed, as well as their intended use, are what set these two methods apart (Sallai & Schnyder, 2021). Thus, a liberal order creating a stronger geoeconomic approach is slower but, based on logical presumptions, more sustainable (Doboš, 2022).

More precisely, using primary and secondary resources, such as interviews, academic and newspapers, the thesis seeks to investigate how private space companies, particularly those in the US and the EU, are influencing the war dynamics and space policies as well, specifically in terms of security and foreign affairs, and if they will or are already complementing the military state's capabilities. For this reason, the research question (RQ) elaborated is - *how military applications of space are being impacted by the rising commercialisation of space?* -. Additionally, the partnerships and the various ways of collaborating between private and public space industries will be investigated likewise to better analyse the research hypothesis – *due to their innovative and cost-effective solutions, commercial space-provided services will increasingly complement states' military space capabilities* -.

The study is directed by the RQ previously stated, and it seeks to determine how and to what degree private space enterprises supplement states' military capabilities. Chapter 4 will, in fact, centre on the case study. One sub-chapter will be exposed to assess the significance of space assets in conflict and how space infrastructures have previously been employed in the past to provide military aid on the ground. Secondly, the conflict in Ukraine and private sector engagement will be examined in further detail as the case study. Chapter 5 will present empirical findings and discussion with three sections that will focus on space legislations, space security, and finally, a focus on the EU and the US and their initiatives in space put forward alongside in consideration of what is happening in Ukraine.

To better address the RQ and undertake more comprehensive research to answer it, the first section will analyse the legislative framework due to its shortcomings regarding the involvement of private firms in the space sector. Indeed, the purpose of this investigation is to explore at how the current regulatory structure may limit and/or impact military space applications and commercial space providers engagement. It will examine legal constraints and loopholes, together with other regulatory obstacles that have been demonstrated during the crisis in Ukraine, which has seen commercial space services used by armed forces for the first time in history. Understanding these limitations is also critical for determining whether or not there is a possibility for integration and collaboration between private-public sector and military space capabilities in the future. Secondly, integrating commercial space-provided services into military applications generates significant security concerns. As a result, the second section will investigate the security consequences of depending on private companies for essential military operations. Evaluating these safety issues will assist in identifying the overall dependability and resilience of commercial space technologies in military applications. The third section will narrow the analysis to two significant players in the space domain, the EU and the USA. Both have well-established space capabilities and have seen a growth in private space companies' commitment. By concentrating on these particular areas, the research will examine the policies and measures set in place by these two regions and better understand how to utilise commercial space services for military purposes, along with how to overcome regulatory limits and safety risks. These study's findings will provide light on the influence of commercialization in space, and its military and security ramifications, along with the impact on nations and the international environment. The research will help to better comprehend the changing dynamics of the space and international realm and their consequences for operational military services. New technologies, like small satellites, and

new private players have the potential to both progress humankind and endanger the safety of space operations as well.

It was challenging to get all the essential and trustworthy information, particularly while discussing the crisis in Ukraine, because multiple news articles needed to be carefully perused and the literature lacked more recent scholarly publications. Other limitations must be also acknowledged. Due to the existence of classified information, particularly regarding military space capabilities, access to sources was not always so feasible. Moreover, because of the topic's vastness and the challenging nature of interviews, it had to be necessary to address all aspects, not only the military ones.

To overcome every limit, data were gathered using a combination of primary and secondary sources. Interviews were conducted with prominent specialists and analysts in the fields of space law, space security, and defence, including government personnel, and representatives of the private sector. Semi-structured interviews have been used to generate fresh ideas and new interpretations, as well as broadening with the several thematic takes into question. Secondary sources were gathered through a survey of literature, which included policy and academic papers, trustworthy journal articles, and official records and reports. Being the study primarily conducted on constructivist basics, it is critical to integrate interpretivism epistemology. Rejecting the concept of objective knowledge, it is to grasp every outcome, context, and process as observed from many points of view in the literature.

3.1 Interviews

The interviews were very important for the construction of this research, particularly for a clearer understanding of what commercial and non-commercial means. They were also fundamental to comprehending the transition between Old and New Space and for being aware of all the contemporary players, whether with their positive or negative

leverage. Two months, in this case May and June, were used to conduct the interviews. In light of this, some of the interview sections were included at last in the thesis, and they were crucial to the analysis of the data and formulation of the final conclusions. The decision of who would participate in the "cross-examination" was not simple. Four candidates at the end accepted to be part of the interviews, each of whom had in-depth knowledge and competence in a certain issue. One is an expert in space law, another one is more knowledgeable about security, another one a member of an institution that engages in dialogue with private organisations, and another one a member of a very respectable space enterprise.

Prior to starting the interviews, it was required to secure the authorization of the Research Ethics Committee and confirm that ethics, morals, and respect should always be at the forefront of interactions with others. The four persons of interest were approached by formal emails after receiving the approval from the university ethics commission, and once they agreed to participate in the study, an "Informed Consent Form" was provided and signed by the respective parties. The interviews were carried out online due to the disparate geographic locations of the research and participants.

Because of the flexibility you can exercise throughout the questioning, semi-structured interviews have been chosen as the best course of action. Semi-structured interviews provide more leeway to choose the topics to be covered. They enable us to be open to changing and not adhere to a rigid set of standards. In semi-structured interviews, a limited number of leading questions are used as a starting point, and then additional follow-up and probing questions are added in response to the interviewee's answers. Increased openness, neutrality, clarity are all benefits of these interview formats.

Participation in the interviews was completely voluntary, and respondents were free to withdraw their participation at any moment. All the participants adhered to not remain

anonymous. For this reason, their identity will be revealed - John Stopher is a Senior Fellow supporting PSSI (Prague Security Studies Institute)'s Space Security Program and he has previously served as the Principal Assistant to the Secretary of the US Air Force, Maria Cristina Falvella is Space Attaché at the Italian Embassy in Prague, Veronica Moronese is Director of Legal Affairs and Space Law at Think Orbital, and Agnieszka Lukaszczyk is Vice President for Government Affairs, EMEA at Planet. Each interview was audio recorded with the agreement of the participants, who were informed that the audio recording would only be used for purely professional and private purposes. The audio recordings of the interviews have all been collected in the research's custody for being digitally transcribed, and after the publication of the thesis each audio-record will be destroyed. Since one particular interview was conducted entirely in Italian, only the portions of particular research interest were translated and placed in order to advance the dissertation. Despite some limitations aforementioned, interviews offered insights that cannot be attained by using other methods.

4. Case Study

4.1 The Utilisation of Space Assets in Previous Wars

Since the beginning, outer space has been nourished by political and military interests. Italy itself, for example, its first launch in 1964 was coordinated by Gen. Broglio (Falvella Interview, 2023). Although many of the more recent entrants into the space field were not designed with national security uses in mind, the early commercial space enterprises collaborated closely with the military from the outset (Borowitz, 2022). Initially, there was an obvious distinction between satellites used by the US and the USSR for military reconnaissance and intelligence collection and satellites utilised by

the public at large - military satellites were able to acquire more precise photographs and circumvent limitations linked to weather conditions or natural or manufactured disruptions, whereas civilian satellites were distinguished by a lower resolution (Rosanelli, 2011).

The military's use of commercial satellites has shown to be more practical, speedier, and feasible today, due also to the rising competitive realm. The commercial usage of satellites has seen growing private sector investment since the IT and telecommunications revolution of the 1990s (Rosanelli, 2011). A lot of government programmes have been pushed in the past with the help of private corporations. GPS (Global Positioning System) is just one example of a space asset that delivers terrestrial services. A military programme called Blue Force Tracker utilises GPS to enable US forces to distinguish between friendly and hostile troops or vehicles that are located far away (Johnson-Freese, 2016, p.5). In the event of battles that render entire regions inaccessible for extended periods of time, satellites are incredibly helpful to soldiers and civilians. For instance, Inmarsat and Télécoms Sans Frontières collaborated to deploy satellite broadband for educating children caught up in the Iraq conflict, where *“services were provided through mobile e-learning centres located in refugee camps”* (OECD, 2019, p. 52). The US Space Force also collaborates with commercial businesses, such as SpaceX, which with its Falcon-9 reusable launch vehicle propels services to the US Department of Defense and smaller privately owned satellites businesses (O’Sullivan, 2023). Another case to point out is the Skynet 5 satellite communications project. A collaboration between the UK Ministry of Defence (MoD), Paradigm Communications and Airbus, which involved a *“20-year contract signed in 2003 for the service delivery of a secure military telecommunications network, with the provision to sell spare capacity to specific foreign governments and NATO”*, although

an unanticipated consequence of a 20-year deal between the business sector, Airbus, and the UK MoD, resulted in a loss of command and authority for the MoD (Jones, 2018, p.11). Many companies, indeed, in order to have the freedom to then redirect and even decide what portion of the market to attack only accept non-repayable funding or sign at precise conditions, and it is clear that it is much easier to do this in areas that have dual value, because of more and better economic chances (Falvella Interview, 2023).

The fact that space capabilities provide sides in a battle an edge is nothing new. The Gulf War of 1990–1991, often referred to as "the first space war", was one of the first conflicts to use the benefits of space assets, and which emphasised the security facet of space (Johnson-Freese, 2016, p.68). By contrast, some experts referred to the conflict in Ukraine as "the first commercial space war" (Borowitz, 2022, p.4). During the Gulf War mobile satellite terminals were leased and utilised to connect communications systems in the theatre of the battle to offer services for field commanders and forces (Frankowski, 2017). Moreover, the war displayed the usefulness of the GPS satellite navigation system for troop mobility, force tracking, and the accuracy of shipments, which also caused the promptness of other actors to speedily develop their own satellite navigation systems (Johnson-Freese, 2016). The 1998 Kosovo War also demonstrated the value of GPS and its potential for interfering with the positioning, navigation, and timing (PNT) signals - a problem that has grown commonplace in many war zones (Kolovos, 2023). A more recent scenario is the 2003–2011 Operation Iraqi Freedom, where the deployment of satellite picture, three-dimensional radar detection maps, GPS guided munitions, more than 100,000 portable GPS receivers for troops, and a plethora of satellites deployed, allowed for military responses to take place in minutes instead of hours (Johnson-Freese, 2016).

Although the engagement of private companies in military confrontations is not new, what is new is dealing with eccentric billionaires who enter the field directly (Iyengar, 2022). Public safety should not be taken lightly when considering the use of space assets for military purposes (Stopher Interview, 2023). Compared to the Gulf War, or the Wars in Iraq and Middle East, or Kosovo where space infrastructures have been strategic, the particularity of the War in Ukraine is the involvement of private actors who can play an autonomous role and so take decisions independently from their government's preferences.

4.2 The Conflict in Ukraine

The advantages that come from using space systems are the result of more than 60 years of painstaking work by government agencies, both military and civilian, with aid from a number of commercial space firms (DIA, 2022). Satellites additionally provide a variety of services in real time. These services range *“from watching at breaking news to allowing our armed forces to collect vital intelligence on foreign threats, to navigate and manoeuvre rapidly, and to communicate with each other anywhere around the globe to ensure our security and quick response to international military and humanitarian crises”* (DIA, 2022, p.IV).

Companies and space organisations that gather satellite images are being pushed to share data on Ukraine and Eastern Europe, giving "actionable intelligence" in the ongoing conflict in Ukraine (Wakefield, 2022, p.2). There are actually two main types of satellite imagery that are being deployed helping in the war - SAR (Synthetic Aperture Radar) provided from firms like Capella, ICEYE, Airbus and SPACETY; and Optical Imagery, from company such as Maxar Technologies and Planet (Wakefield, 2022). Additionally, commercial radio frequency spectrum monitoring carried out by the US firm HawkEye360 has assisted in the detection of troop movements and GPS

jamming attempts (OECD, 2022). According to the US National Geospatial-Intelligence Agency, this unprecedented use of commercial geospatial intelligence involved information from more than 200 commercial satellites and almost 100 distinct companies (OECD, 2022). Commercial satellite systems' open access enables intelligence agencies to circulate their evaluations without revealing any sensitive information (Kolovos, 2023). This feature has proven to be instrumental in the conflict in Ukraine and makes it simpler for the military to communicate via satellite information among the allies (Borowitz, 2022). In this case, the magnitude of Ukraine's military success has depended on many factors that actually Kiev lacks control (Detsch & Gramer, 2023).

Early in March 2022, Mykhailo Fedorov, the Vice Prime Minister of Ukraine, requested data access from eight private satellite businesses and within two weeks the Ukrainian government acquired information on the fighting zone encompassing more than 40 million km² (Borowitz, 2022). On August 18, ICEYE, a Finnish company specialising in persistent surveillance with radar satellite imaging, agreed to offer the Ukrainian government with its SAR satellite imaging capabilities (Nasu, 2022). With twenty-one spacecraft deployed so far, ICEYE carries the world's biggest fleet of commercial SAR satellites, and its capability is seen as paramount in terms of supplying necessary and trustworthy data (Nasu, 2022).

SpaceX, on the other hand, is that exceptional private space company, which our case study will longer focus on. Elon Musk tweeted in March 2022, that he was setting up Starlink, his company SpaceX's satellite internet venture, to ensure Ukraine's continued access to the internet (Tobin & Borak, 2022). SpaceX is considered as an exception between private space companies and in the war in Ukraine its role can be compared to a government one (Stopher Interview, 2023). *“The Starlink system consists of about*

1,600 operational satellites in low orbit and is decentralised, with the main relay stations supporting Ukraine located in Poland, Lithuania, and Turkey” (Kolovos, 2023, p.19). Starlink, paid by private sources and selected governments, claims to provide high-speed internet for tactical and public communications, as well as for individual usage (OECD, 2022). It has assisted in restoring critical services and helping residents who are experiencing intermittent outages (Tobin & Borak, 2022). For Ukraine's military, portable internet hubs have proven a game-changer, keeping troops connected while operating in the field despite the nation's electricity supply and internet infrastructure being destroyed (Detsch & Gramer, 2023). Oleg Kutkov, a software engineer in Kyiv told Rest of World (2022), *“independent and reliable connections are not only important for government and military facilities but are needed to operate almost everything - connectivity is crucial.”*

Elon Musk, though, stated in February 2022 that the company intended to restrict the use of the online platform for what it considered to be “offensive” military actions, and according to SpaceX, Ukrainian forces have allegedly exploited the Starlink gateways to direct drone attacks on Russian spots (Detsch & Gramer, 2023, p.1). A choice that was not truly explored and made with consulting the American government. *“It was never intended to be weaponized, but the Ukrainians have leveraged it in ways that were unintentional and not part of any agreement”* SpaceX President Gwynne Shotwell said at the 2022 Federal Aviation Administration Conference in Washington (Detsch & Gramer, 2023). However, when you decide to be part of a war, it is almost inevitable that offensive measures can occur (Falvella Interview, 2023). Unfortunately, there is limited public information released about this issue, and no details about a written arrangement between the US and SpaceX have been publicly disclosed. Anyhow, the world needs to wrestle with this issue and agree to put some limits about

the potential of offensive space operations, whether it is for nations or for commercial entities (Stopher Interview, 2023). And this constitutes one of the major challenges for governments and privates, and security-defence purposes.

While utilising Starlink in Ukraine may have advantages, there are concerns as well. Concerns about the general use of private satellites. There is a *"dark side - that can generate dangerous liabilities, especially when it comes to prospective military and civilian targets"* (Wakefield, 2022, p.3). To prevent user-generated pins from being connected to missile attacks, Google, for example, declared that it is eliminating from Maps any user-submitted locations in Russia, Belarus, and Ukraine (Wakefield, 2022). Musk himself recommended users to only activate the terminals when necessary because the equipment used to receive the signal may be easier geographically recognised when in operation (Kolovos, 2023). In addition, worries regarding a private company's authority to determine a country's internet access have been raised in light of SpaceX's deliberate commitment (Kolovos, 2023). Elon Musk has put himself in a very difficult situation by clearly supporting Ukraine and trying to be on the line of the American government, while also having to maintain good trade relationships with countries that are aligned with Russia, such as China (Stopher Interview, 2023). Russia, meanwhile, views Starlink as fully supporting the Command and Control of all Ukrainian Armed Forces assets since its part in tactical communications and operations on the front lines (Kolovos, 2023). Dmitry Medvedev, the current Deputy Chairman of the Russian Security Council, declared Russia's intention to destroy Musk's Starlink satellites (Ray & Selvamurthy, 2023). A significant statement that attracted attention and concern from the international community. *"Despite the technological and economic drawbacks, Russia still maintains a wide array of counter-space capabilities and maintains substantial interests in maintaining and developing offensive space*

systems to deny access to adversaries' space infrastructure" (Doboš & Pražák, 2021, p.130). Nonetheless, this intention did not materialise in reality, at least for the time being. If this would happen, several diplomatic and geopolitical implications, legal consequences, and an escalation of hostilities, not in Russian favour, would influence Russian performances.

In order to assist the Ukrainian Armed Forces during power outages, SpaceX updated their software to allow the Starlink terminal to be utilised on a moving vehicle and use less power (Kolovos, 2023). However, there have been attacks on the terminals, including attempts to get access to the mobile satellites without authorization, in fact, some Starlink terminals close to the combat areas were initially blocked by virtual attacks (Kolovos, 2023). It is additionally relevant to bring up the satellite communications company ViaSat, whose outage severely damaged the Ukrainian intelligence infrastructure and elevated this incident to the status of an illustration of the flaws in dual-use infrastructure in a combative environment (Boschetti, 2022). Space industries have the chance to learn from these assaults and incorporate the lessons gained into their risk management procedures, even if the attack was not very sophisticated in comparison to other statecraft cyber-attacks (Boschetti, 2022).

Lastly, the Russian Federation and Ukraine have long been significant international players in this high-tech market - building on the USSR space programme - as trading partners and manufacturers of space systems, as well as launch service providers (OECD, 2022). However, the war not only had an impact on this relationship but also on global supply chains in the overall space industry. Especially the Russian space trade is facing serious challenges, also as a result of the sanctions placed on Russia during the conflict. For some Russian satellites 75% of the electronic components come from the United States and therefore it will be necessary to produce them inside

or import them from countries that do not observe the regime of sanctions (Caselli, 2021).

5. Empirical Findings and Discussion

5.1 Regulatory Framework Limitations

An arrangement known as a P3 is one in which the public and private sectors agree to share financial and risk burdens, so under this system, private organisations get both risks and rewards, and the more the risk, the greater the return on investment (Jones, 2018). Additionally, a public sector organisation should overtly outline the objectives of a P3 agreement, which may potentially include national security and defence (Jones, 2018). P3 requires careful consideration of security aspects, including safeguarding sensitive information, technologies, and national interests, as well as clear definitions of roles and responsibilities, mechanisms for cooperation, information sharing, and addressing security challenges (Interview Moronese, 2023). The Ukrainian case showed us that the private sector can, in democracies, have a full control of its services and data. It is also necessary to note the significant distinction between private “Western” businesses that can get government contracts and subsidies but are not directly controlled, and the restricted access and state dominance for Chinese or Russian private businesses (Doboš, 2022). *“Having governments to get commercial data vs the US government getting to sell satellites or getting Planet data, for example, and giving them to Ukraine, it is a service that the companies themselves offer directly to the Ukrainian Government”* (Interview Lukaszczyk, 2023). And not even P3 can regulate these dynamics between private-public sectors. Nothing in space law restricts the higher risks that commercial space enterprises can take, which allows private

players to evade punishment (Isnardi, 2019). Risk-taking is nearly impossible with government funding due to the politics of blame for failure, but businesses like SpaceX were initially founded without government assistance, and a good deal of current space companies are privately funded (e.g., SpaceX, Blue Origin) and not publicly traded (OECD, 2019).

Globally, co-funding and increased government usage of commercial services are becoming increasingly common, particularly for organisations like NASA and ESA, despite a lack of regulations. For instance, NASA might use a concession agreement to replace the International Space Station (ISS) with one or more commercial modules, though, if these commercial modules were owned, developed, run, and maintained by the private sector, the business model would change from a P3 model to full privatisation, transferring intellectual property or data rights to the private sector (Jones, 2018). Nevertheless, *“privatisation does not change the state of affairs with respect to state control, jurisdiction, responsibility and liability”* (Nair, 2018, p.2). Anyway, *“giving a closer look to the US, for instance, for a long time it has not had a rocket for bringing supplies to the ISS and that is why they were using a Russian rocket. So, in this case P3 would mean that the US was not having a choice but to listen to the companies that provided it”* (Interview Lukaszczyk, 2023). Also noteworthy is SpaceX's contribution to the ISS, which took the position of Russia as a more reasonably priced "company supplier". Years ago, a heavy lift launch was costing close to \$400 million and nowadays it is something below \$200 and Elon has come in low (Interview Stopher, 2023). The competitive pressure is considerable and Roscosmos - the main Russian State Space Corporation - is unlikely to be able to compete with the US private sector (Caselli, 2021). Starlink, SpaceX, Amazon's Project Kuiper, and other ventures that have substantial financial support on their own are what people

want to put money in (Jewett, 2023). Regarding our case study, “*from a commercial perspective, what Starlink has is unique in the marketplace right now,*” said Andrew Metrick, a fellow in the defence program at the Center for a New American Security, adding that US military communications are regularly developed and tailored for more specialised missions, resulting in restricted applicability (Iyengar, 2022, p.4). However, due to the difficulty of developing functional projects and record-keeping programmes, not every new private venture has a certain long future. In addition, overly optimistic aspirations in space ventures can result in a disastrous financial train wreck (Interview Stopher, 2023). Finally, P3s are good to solve certain problems and inconveniences between public-private that could arise from lacks in the current legislation - they are a sort of upfront agreement to put the goals in writing and match interests - but they are not a general solution (Interview Stopher, 2023).

International space law was elaborated during the Cold War and includes five “outdated” treaties drafted by the COPUOS (Ziemblicki & Oralova, 2021). Rather than the involvement of commercial entities in space operations, nations' main concern at the time was the militarization and control over space. Security concerns, such as cybersecurity, protection of sensitive technologies, and export controls, are also addressed within these frameworks (Interview Moronese, 2023). While at the beginning there was a great enthusiasm and the first 2-3 treaties were signed practically from every country, afterwards consensus started to be not so common to achieve (Interview Falvella, 2023). In the language of Article VI of the Outer Space Treaty (OST), international liability for space operations states that “*States Parties to the Treaty shall bear international responsibility for national activities in outer space, whether such activities are carried on by governmental agencies or by non-governmental entities*” (Ray & Selvamurthy, 2023, p.28). Space operations are

therefore subject to international responsibility of the individual states, to which a result duty is assigned, even if they are carried out privately (Rosanelli, 2011). A growing number of States have, therefore, passed national space legislation that establishes space regulatory institutions with jurisdiction to issue licences to private actors and enforce compliance with regulatory requirements to fulfil their international obligations, safeguard the public from harm, protect their budgets from accountability, and stimulate and advocate the advancement of commercial space activities (Dempsey, 2016). The particularity of space is its global nature, and it means that even if states have their norms and national space plans, they need to be shared and adapted internationally (Interview Falvella, 2023). In order to encourage private space operators' activities, the Western space powers are largely focused on the implementation of business-friendly legislation, pro-commercial policies, and incentives (Doboš, 2022). Meanwhile, the Chinese or Russian governments with their national strategy are constantly impacting to seize control of these private advances, being also these major corporations frequently co-financed from the governmental budget and work with the law enforcement agencies (Doboš, 2022). However, the OST, as well as national space plans, leave the kinds of operations that are permitted in space up for interpretation (Weinzler & Acocella, 2017).

Applying all these statements to the case study at hand reveals that, even though the private company SpaceX is free to make its own decisions regardless of what the American government plans, many people see the company as standing in for the USA. Starlink satellites, despite being private, are protected by the American government (Interview Falvella, 2023). As a result, if Russia attacked SpaceX, it would seamlessly target the USA as well, being also Starlink become a legitimate military object after its use in Ukraine (Nasu, 2022). *“Basically, SpaceX does not represent the US as a*

country, but it is an American company despite the fact that it was Elon's decision to get in the middle of the water. The American government was pretty much against it when it came to SpaceX's involvement – they thought Elon made a crazy decision, and did not consult anybody, but they could not really prohibit to do that” (Interview Lukaszczyk, 2023). Indeed, there becomes a risk when commercials enter in a war, a risk that government military operators do not like, and that is depending on something they do not fully control (Interview Stopher, 2023). At a time when governments have opened access to space to other sectors, they have allowed private owners with investment to access space, meanwhile privates justifiably claim their independence also in relation to the investments they made (Interview Falvella, 2023).

Similarly, we can also apply this casing to the ICEYE Finnish company. All operations in outer space, as defined by the OST, do not necessarily imply State liability for any globally illegal act performed through the use of satellite services, and Finland does not become a co-belligerent in the war just because a private corporation operating under its national space programme provides assistance to a belligerent side (Nasu, 2022). This does not exclude Finland from asserting claim under international law if ICEYE's satellites suffer harm, but the State must qualify as an "injured State" in order to invoke the attacking State's responsibility (Nasu, 2022, p.9). Furthermore, ICEYE's satellite array offers SAR data to a variety of organisations throughout the world, including Canada's MDA Ltd. and the Brazilian Air Force, implying that the targeting of a satellite must not only be legal under the law of armed conflict as it applies to hostilities with the target State, but must also be justified in relation to third-party rights that may be violated as a result of the assault (Nasu, 2022). In any case, the claim of liability and its consequences under international law persist to be controversial. In the long run, the growth of the space sector depends on space enterprises acting

responsibly by prioritising safety and risk management, as a result, excluding any accountability is counterproductive since it encourages businesses to take more risk (Ziemblicki & Oralova, 2021).

Finally, *“should the government protect the commercial companies if there is a harm coming their way?” - for sure they would, if it was SpaceX or somebody else to get engaged in the conflict, although, there is no right answer for that, because we are learning as we are going, this is so unprecedented, that nobody thought about it before*” (Interview Lukaszczyk, 2023). The increasing significance of non-state players in the space sector raises the question of their influence in policy-making. While non-state players, such as private companies, have gained prominence in recent years, it is important to recognize that governments still retain significant regulatory and policymaking authority (Interview Moronese, 2023). Air Force Deputy Undersecretary for Space Winston Beauchamp suggested in March 2016 that *“the space industry should take the lead in the development of norms for safe, predictable, and responsible space actions”* (Johnson-Freese, 2016, p.145-146). Governing actors’ behaviour in space should be a priority to avoid irresponsible actions, as well as players (King & Blank, 2019).

5.2 Security Aspects

“An environment where offensive options are cheaper and easier than defensive options, where the tyranny of both distance and physics prevail, and where ambiguity reigns, make reliance on military options” (Johnson-Freese, 2016, preface X). Space is being passively militarised and serves as a platform for military support services comprising *“reconnaissance, secure telecommunications, space surveillance, and eavesdropping”* (Pražák, 2021, p.493). This logistical assistance boosts the effectiveness of ground forces and combat operations on Earth. Although there are

currently no effective weapons in orbit, satellites are frequently used in land-based conflict, as a result, although militarised, space has not yet been weaponized (Johnson-Freese, 2016). The closest thing that could be seen as weapons are the anti-satellites weapons at the ground but is the type of behaviour that actors can adopt that can be aggressive (Interview Lukaszczyk, 2023). Aggressive behaviour can also be translated into other types of threats, such as cyberattacks, hacking or jamming. Three lessons can be drawn from the attack on ViaSat satellites, which was previously mentioned - first, satellite vendors must be cautious regarding their supply chains and ecosystems; second, aerospace firms should be aware of attacks occurring in non-adjacent industries; and third, operations still depend on sustaining a continuous security update and patch control programme, despite advances in security technologies (Boschetti, 2022). As a consequence, sharing interests and norms should be a priority.

Private sector entrepreneurs are collaborating with government organisations in never-before-seen ways (Johnson-Freese, 2016). *“Commercial companies are offering a different way of looking at conflicts, and efforts as Planet data have been used in Ukraine to raise awareness about what is happening on the ground, giving SSA for the Ukrainian government on the damages that are happening on the ground, the damages of the roads, the bridges, buildings, but also looking at crops”* (Interview Lukaszczyk, 2023). Commercial high-resolution and radar imaging helps to map military operations and almost real-time captured modifications on the battleground (OECD, 2022). What is innovative is the additive manufacturing that commercial companies are providing to the space sector shortening time-tables of building space furniture (Interview Stopher, 2023). *“Publicly available satellite images are a defining feature of 21st century warfare. Satellite maps shared in conventional and social media can offer tremendous insight at lightning speed”* Robert Muggah, principal of satellite and mapping firm

SecDev Group, told the BBC (2022). Also, in terms of food - it is a security aspect to see if the food is still being able to get to the places where it needs to go - but also to monitor the movement of refugees, and having SSA on the ground gives governments a better decision-making ability (Interview Lukaszczyk, 2023). Commercial companies are much quicker and much more efficient, and they do not have the same bureaucracy, they do not have the same blocks as governments. When you look at a commercial company from the concept idea to launch, it is usually 3-4 years, and if you look at nations, it can be even up to 10 years, and commercials are also willing to take risks to try new things, whereas government cannot do that because taxpayers' money, and so for a cost of one commercial satellite, they could buy services and data from multi commercial companies (Interview Lukaszczyk, 2023). Moreover, because the cost of private provision can be lower and private firms can provide services with outsourcing, it can be advantageous for developing states that lack the financial support to build their own independent systems to transfer the provision of services to private hands or to acquire from private entities on behalf of the state (Frankowski, 2017).

Today, more start-ups and small and medium-sized businesses (SME), as well as big players are betting on the development of very small satellites, not only for technology testing and education but also for operational missions (Denis, 2017). In order to also closely monitor authoritarian regimes with a nuclearization narrative, partnerships with commercial satellite businesses are critical for security-related operations (Kim, 2019). Partnerships provide think tanks with the capacity to investigate authoritarian regimes like North Korea without having to shell out exorbitant prices for images or have their searches stymied by inconveniently long bureaucratic delays in the procurement of imagery (Kim, 2019). What is really unique is that commercial data are unclassified, which is also very different from typical defence contractors and military satellites, so

that data used in Ukraine is open, meaning that anybody else could have access to that, and this is about transparency, and commercials are lifting the fog of war, getting the truth rather than manipulated information (Interview Lukaszczyk, 2023). In the past, satellites would only sometimes fly over a certain area every few days, but today they can pass over once or twice a day, and even nations with powerful military reconnaissance systems struggle to maintain constant observation (Kolovos, 2023). But if we maintain the pace of public-private cooperation and research and development (R&D), Chatham House, a think tank, forecasted that by 2035, satellites will return to the same location every hour (Kolovos, 2023).

Nowadays, commercial satellite performance is improving and is more and more in line with defence requirements, although there is significant demand to lower operating and infrastructural expenses (Denis, 2017). Satellites in orbit are not only a mere display of the nation's capabilities in the age of cutting-edge space technologies, but they are a potent tool that may assist key militaristic manoeuvres in thwarting any aggressor. Despite the fact that private companies allows for more efficient deployment, the hazards that arise when private enterprises operate in their own capacity without taking into account the greater ecosystem of procurement and crisis response are elevated, and the politics and portrayal of wartime support are complex, and there are reasons why governments take the time to assess what technology and training they can offer (Jayanti, 2023). Private companies still have a lot of control over how their assets are used, just as Elon has over selling his satellite, so, we can always immediately press the right button and stop the delivery of the data (Interview Lukaszczyk, 2023). *“In today’s space environment private actors would rather play the role of security regulators than security providers”* (Frankowski, 2017, p.144). Further elements of uncertainty such as the lack of precise boundaries for outer space

and the absence of a precise definition of the terms "peaceful" and "military" are the subject of analysis but also the applicability to space of the principle of legitimate defence, in analogy to what it is happening in Ukraine (Rosanelli, 2011, p.9). However, each company has its goals, that can be strictly civil or strictly military, or even both.

Despite the concerns about the dual-use type of technology, due to the possibility of transforming civil purposes into military ones without disclosing the prospective goal, *"it is unrealistic to expect countries to forego the use of space for both civilian and military purposes"* (Johnson-Freese, 2016, p.82). A space asset that takes pictures of the Earth, it can also be used to target weapons, therefore, it will be called a weapon (Interview Stopher, 2023). The dual-use nature of space technology presents challenges in ensuring responsible use and preventing unintended weaponization (Interview Moronese, 2023). The Starlink constellation exceedingly meets the criteria for a dual-use asset, giving the Ukrainian military a clear competitive edge while also providing emergency rescue assistance and internet connectivity for the public at large. In this regard, Starlink's actions not only can go beyond a few principles against human rights, but it is also conceivable that Russian targeting of Starlink's infrastructure, whether it be in space or on the ground, may draw the US into a closer confrontation (Ray & Selvamurthy, 2023). Therefore, any attack on Starlink would negatively impact civilian infrastructure services as "collateral damage" (Ray & Selvamurthy, 2023, p.35). Commander of U.S. Space Command Army Gen. James H. Dickinson has said in an interview: *"were conflicts to significantly escalate in space, the potential lack of distinction between military and commercial satellites could result in targeting of even commercial satellites that do not provide military services"* (Miller, 2022, p.2). However, these applications such as intelligence, surveillance, and reconnaissance (ISR) could also be used to avoid war, to intercept threats and try to solve them before

they actually occur (Interview Stopher, 2023). Fostering collaboration between civilian, military, and private entities may lead to better performance and use of space assets as well as the establishment of control mechanisms, shared responsibility, and increased transparency in dealing with sensitive technology, although, the risks of malicious intentions cannot be wholly disregarded (Pražák, 2021, p.501-502). Commercial firms can inadvertently or deliberately contribute to the weaponization of space through the development and provision of technologies with dual-use capabilities, and for this reason, it is crucial to monitor and control the export, transfer, and use of sensitive space technologies to prevent their misuse and unintended weaponization (Interview Moronese, 2023).

Nevertheless, in determining whether a space technology, such a GPS tracker, is a space weapon employed to help the military or not, poses several concerns. Today, 13 spacefaring countries are capable of autonomous launches, and almost every country depends in some way on space-related capabilities, many of which are offered by private companies (Robinson, 2018). The recent events have, in fact, reignited public anxiety over the militarization and weaponization of space, and some scholars underline the close affiliation that exists between privatisation and militarization as an effect of the exacerbated commercial competitiveness (Salin, 2001). However, the reliance on government assistance places the government in a position to potentially and strongly influence the space sector (Yonekura, 2022).

5.3 Focus on the EU and the USA

The European Union and the United States are the most involved countries as supporters for Ukraine in the war. In relation to the latter, it is essential to consider the differences, as countries and powers, between the Ukraine, the United States, and the European Union. *“If you are Ukraine, or if you are a country that really does not have*

much capability, then what is going on in the conflict and the commercial companies' support, it is absolutely helpful" (Interview Stopher, 2023). Military uses of space can have significant impacts on commercial space activities, particularly in regions experiencing conflicts or tensions (Interview Moronese, 2023). But when you think about the role of commercials in fighting wars, there is a considerable *"well it depends here"* - it depends on who you want to sell to, what kind of fight you are fighting (Interview Stopher, 2023). The war has been a significant driver of commercial imaging satellites and their ability to provide critical intelligence, whereas outside of the Ukraine scenario, this has not translated into increased demand for imagery, according to David Gauthier, former director of the NGA's Source Commercial & Business Operations (Erwin, 2023).

Since the conclusion of the Cold War, the defence spending in Europe have consistently and substantially decreased, additionally, due to unstable geostrategic conditions, countries like France, Germany, or Italy have more or less guaranteed their priority for space, but not enough to implement strong and reliable military space capabilities, such as *"equipment, human resources to operate and exploit, training, etc."* (Denis, 2017). The creation of more independent military space capabilities is being considered by European nations, for the crucial importance of their security as satellite imagery, and for their dependence on the United States, which is often thought of as "stingy" (Johnson-Freese, 2016, preface XVI). While the US has a sufficiently substantial market volume that allows for a greater feasibility of commercial exploitation, every European country alone has not (Interview Falvella, 2023). *"The Galileo constellation itself was built from Europe for major autonomy and dependence. All developed countries have their proper constellations. Russia has Glonass, China has BeiDou. Because without navigation services, we do not walk, and if there is no*

autonomy to go to space, we cannot always wait for someone to bring us there” (Interview Falvella, 2023). Different P3 models, with the commercial partner providing more finance and assuming greater risks, are being considered by both ESA and NASA (OECD, 2019). Unlike governments, commercial enterprises are ready to take the risk of failure (Interview Stopher, 2023).

Initially, R&D was the strongest field of relationship between public and private, especially for the EU, which only recently started to amplify its capacities in defence and security, interfacing with dual-use technologies (Interview Falvella, 2023). European member nations are now developing a new military space policy that will emphasise bolstering offensive and surveillance capabilities as well as the toughness of certain satellites and systems (OECD, 2019). However, the degree of government engagement is far lower than what is observed in the US with an influx of security and defence-focused New Space utilisations (Denis, 2017). That is also why the European Commission decided to readdress its governance in terms of space programs. In particular regarding the Space Program 2021-2027, it introduced a Directorate-General for Defence Industry and Space (DG-DEFIS), developing systems at citizens service, as well as military ones (Interview Falvella, 2023). *“From Earth Observation and satellite navigation, which latter is considered the most delicate in terms of military, it depends on the 12% of the European GDP (Gross Domestic Product) and that services are essential for every person and infrastructure on Earth”* (Interview Falvella, 2023). For the last two decades, the US administrations have encouraged commercial services designed to reduce the proliferation or unchecked circulation of extremely high-quality photos due to security concerns (Denis, 2017). *“We are talking about how we are going to expand our commercial partnerships during peacetime to ensure we have access to commercial capabilities during times of crisis or conflict, although many*

details would need to be fleshed out, including policies, statutes, contracting methods and technical issues,” said Col. Rich Kniseley, Chief of enterprise requirements at the Space Systems Command’s Space Systems Integration Office (Erwin, 2023). As seen during the current war in Ukraine, *“the fight is not going to be only with military space capabilities. It is going to be a joint fight with our commercial partners, and with our international allies”* he said (Erwin, 2023). The USSF (United States Space Force) and DoD face many decisions about the way of leveraging commercial potential, concurrently with building a comprehensive plan of action, including risk mitigation (Yonekura, 2022). These young businesses are backed by venture capital, developing their skills, forging connections with the US national security community through National Reconnaissance Office (NRO) study contracts, and searching for commercial, popular and institutional clientele (Yonekura, 2022). Even though there is a lot of uncertainty over the long-term viability of any particular provider, a successful transfer of these new providers would deliver skills that are extremely valuable to the DoD (Yonekura, 2022).

The war in Ukraine, finally, raised concerns in areas such as security and defence, but also in areas such as search-and-rescue operations, where the use of GPS, for example, has been helpful in identifying those seeking assistance (Kolovos, 2023). Although Galileo is unrelated to the Ukrainian conflict, the partial shutdown of it in 2019 has popped up in the EU’s memory to emphasise the need of protecting both private and public satellite infrastructures against interferences and threats (Kolovos, 2023). Regarding Galileo, the EU is predicting its dual-use - it expects to provide a Public Regulated Services (PRS), an institutional use encrypted navigation – *“if I have the GPS activated, I know in which building I am; if I have Galileo, I know in which room of the building I am; if I have PRS, I know on which chair of the room I am”* (Interview

Falvella, 2023). However, if someone wants to use the PRS' system in an offensive way, they could (Interview Falvella, 2023). Nonetheless, the EU is also thinking about partnerships with privates for the “new generation” of Galileo, most probably in civil terms than military ones, though, it is important to think about what kind of autonomy, risks and intellectual property it wants to be shared (Interview Falvella, 2023).

Lastly, the involvement of SpaceX in the war, due to the company's US registration, it is likely that its provision of C4ISR support to the Ukrainian military exploits a gap in the US National Space Policy (NSP) regulation regarding technology export, and at the same time despite the private company's decisional autonomy, it shares a joint responsibility with the American government (Ray & Selvamurthy, 2023, p.36). Such accountability would also compel countries to eliminate any comparable ambiguities in their space policies and set up checks and balances to stop actions by commercial space ventures that are not authorised by the state, since these not only undermine the sovereignty of the state but also have the potential to have serious, cascading global repercussions (Ray & Selvamurthy, 2023). Although there are stricter and more definite laws on Earth, such as for example those governing export and knowledge transfer, there are none of them in space (Interview Falvella, 2023). *“We have focused for many years on implementing the grades of R&D and innovation, and the paradox is that we almost have difficulties in using them, these new developments, because we do not have appropriate legislation”* (Interview Falvella, 2023). Powered by the crisis in Ukraine and rising rivalry, government demand for space resources, particularly in the United States and the European Union, is robust, and experts believe this is keeping the investing environment afloat, with an increased emphasis on innovative space capabilities (Jewett, 2023). All of what is happening leads to a higher level of interest

in national security, which will retain the governments as anchor consumers for space and influence budgets in the next few years.

6. Conclusions

6.1 Recommendations

Space offers skills that are required everywhere, which by itself raises concerns about authority and may even result in internal conflicts (Johnson-Freese, 2016). Regulations and policies must evolve to reflect the innovative and constantly changing character of space activities. It is essential to specify roles and ownership for better leverage future threats and enforce sustainability. Governments and public bodies need to guarantee that guidelines are complied with by all space users worldwide. However, this strategy does not have to limit the initiative of private participants in the space industry. The development of space weapons and the improper use of space technology cannot be discussed without taking into account private actors, regardless of the fact that states are the primary actors *"responsible for the registration and liabilities of outer space activities"* (Pražák, 2021, p.500). Creating the appropriate institutional structure and incentives for private enterprise is crucial to promoting the role of space as a source of socio-economic-security benefits (OECD, 2019). By working together, agencies and private companies can enhance their capabilities and operational efficiency in achieving common goals, and collaboration, support, and alignment of interests between the public and private sectors, and this can also contribute to the success and growth of startups, leading to innovation, job creation, and economic development in the space industry (Interview Moronese, 2023).

The implementation of more dual systems, notably in the field of hybrid security-defence, requires involving funding split among private operators, civic engagement bodies, and military agencies. More constellations and space assets will be owned and run by private businesses, with the government's cooperation inevitably ensured by national and military departments and clients to assure, and safe access to data (Davis, 2017). To boost the processing of the large quantity of space data by military operators' users, it will be needed to better apply national and international normative systems, as well as better sharing processes and more IT technology synergies (Davis, 2017). In relation to the private sector, the goal of defence players will be to employ more space assets with a smaller budget and with the assistance of more minds. The government might lean so on commercial enterprises and concentrate more effectively on other responsibilities. Additionally, this increasing and strategic use of space capabilities and data for dual purposes highlights the need of ensuring the security of these resources, which have become exposed to outside threats (Davis, 2017). Although the dialogue is still open, there is no effective solution today, but there is a commitment, an awareness to seek a solution as soon as possible because we are realising that practically both the pandemic and the war have done nothing but accelerate that process that there would be but more slowly – they are showing us all the faces of the medal - so first there will be regulation and then there will be protection for everyone, both for privates and for governments (Interview Falvella, 2023).

6.2 Conclusions

Private companies help with investments, for research and competition, and so they lower costs (Interview Falvella, 2023). Public support should be considered vital for maintaining funding of space activities, despite its expense (Johnson-Freese, 2016). Unlike nations, who could be interested in promoting relative power developments,

private companies are more interested in absolute gains (Pražák, 2021). When the War in Ukraine and the space services provided in support of Ukraine are looked at, this conflict highlights the rising importance of both space business enterprises and space resources in large for the military. Nevertheless, it is fundamental to consider whose military you are talking about. If you are referring to the Ukrainian military, they are currently implementing a variety of capabilities and communications, which are extremely beneficial in terms of military applications along with transparency, and having people reminded of what is happening is highly valuable for the rest of the world too (Interview Stopher, 2023). Now in the US it is a different question because the military space is still so far, so much more advanced than commercial, simply because the military spends tons of money on everything from encryption and reliability and all kinds of things that are just beyond what the commercial world is going to do (Interview Stopher, 2023).

The aim of the study was to evaluate space as a multifaceted, strategic sector that sits at the intersection of political, diplomatic, military, security, social and economic concerns in relation to an eclectic theoretical framework approach. Realism has shown that states would always perceive their own interests, in relation to power, autonomy and security, despite the fact they could encounter a war, like Russia invading Ukraine. Liberalism has shown that cooperation is possible but usually only if there are common interests, like P3s are a great useful tool to mitigate hazards. Constructivism believes that state identities and interests are malleable and may change over time. It has shown the power of ideas and underlined the importance of actors considered often marginal, indeed for the first time in history private companies have autonomously chosen to be part of a war, creating new trends that are shaping social and security policies. As a result, private companies may significantly influence policy and military planning, and

the public's perception of war (Borowitz, 2022). *“In some ways private companies are already complementing states’ military capabilities, but not entirely, because there are regulations of what commercial companies can do or not. There are areas so military classified that commercial companies cannot go into, and it is totally understandable. However, for a vast majority of activities, commercials can be pickier and more efficient than governments”* (Interview Lukaszczyk, 2023).

Independent businesses are quick to create and implement innovative technologies, such reusable rockets and new launch vehicles, resulting in the possibility of governments relying on their services. The private sector is generating remarkable capabilities that were formerly primarily the domain of governments but are now commercially available to any customer (Iyengar, 2022). *“Innovation or new capability, capacity augmentation, gap filler, increased resilience and flexibility, increased responsiveness, faster or more frequent technology refresh, and cost savings”* are some of the driving forces behind the increasing rivalry between space businesses, as well as the recent growth and importance of the commercial space sector (Yonekura, 2022, p.2). *“Another advantage carried by privates is their lower dependency on the state that could promote higher transparency of R&D processes”* (Pražák, 2021, p.502). By lowering costs and making it easier to execute more complicated space-based capabilities, these current innovations are also enhancing the effectiveness and speed of military operations. Contrary to previous government satellites that could rely on outdated systems or slower timing of launches, the private sector has grown to play a large role in the progress of satellite technology, generating spacecraft with brief lifetimes and constant updates (Kolovos, 2023).

Commercial satellite growth has resulted in increasingly congested, contested, and competitive orbits, making it somewhat and sometimes more challenging for satellites

to function properly, even for the military industry. This has a wide range of implications for government strategy and policy, as well as the need for solutions and coordination to reduce the risks brought on by having too many players in space, frequently irresponsible actors. The Starlink case is an excellent illustration that underscored the need of safeguarding space technology and the need for ongoing research and development in this field, alongside the need for a fast upgrade of our procurement and response mechanism (Jayanti, 2023). The evolution of space law and regulations may need to address these challenges and consider the potential risks and consequences associated with commercial actors' participation in military operations, striking the right balance between fostering commercial innovation and ensuring the peaceful use of space (Interview Moronese, 2023). It is also needed to remember that taking part in a world in continuous evolution requires taking part through establishing rules that considers this evolution (Interview Falvella, 2023).

Nowadays, there are lots of governments that are investing in their own security, and this gives an opportunity to develop the markets and sell but it will take a long time for commercials to build up the military capability that the nations really need (Interview Stopher, 2023). *“A private individual wants to work to earn money, wants to sell products, services and applications, research, operations, activities to the public. That is why there is a bit of scepticism about the private sector taking care of the security of a nation”* (Interview Falvella, 2023). In particular, in terms of security, it is still questionable whether commercial systems will be resilient in a conflict environment (Yonekura, 2022).

In order to fully understand the effects of commercialization on military space applications, additional investigation is recommended. Overall, for answering the RQ, the military performance is being significantly impacted by the increasing

commercialization of space, and the public and private sectors will surely continue to interact and compete in a constantly shifting space environment, hoping that the distinctive challenges that lie ahead may be tackled via cooperation. *“How space assets and commercial systems are being used in the conflict have demonstrated to be so helpful, that this will continue. All countries will start using it more and more and part of it is actually supporting tactical and strategic operations”* (Interview Stopher, 2023). Moreover, sharing sensible data with data from private companies does not require officials to go through a laborious declassification procedure, running the risk of disclosing knowledge about secret satellite capabilities (Borowitz, 2022). As a result, confirming our hypothesis - private actors are so already involved in space development that they are already contributing to amplify military capabilities, although they will always take as a first point of referring to the institutions (Interview Falvella, 2023). ICEYE Finnish’s company, for example, delivers unique capabilities in terms of its relatively simple nature of hitting an individual satellite rather than the entire constellation of communication or PNT satellites (Nasu, 2022). *“What is also really spectacular about the use of commercial systems in the Russia-Ukraine War is the way they shape world opinion. The fact that imagery is unclassified and can be shared around the world has several implications regarding the DIME (diplomacy, information, military, and economics)”* (Interview Stopher, 2023). At the same time, the survival and success of these private sector businesses depends on space standards and stability (Johnson-Freese, 2016). However, there is not a universal standard of practices (Interview Lukaszcyk, 2023). Looking ahead, the future of space law will likely involve continuous discussions, negotiations, and adaptations to address the evolving landscape of space activities and the challenges posed by military applications (Interview Moronese, 2023).

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Research Interviews:

Veronica Moronese (2023). Research Interview: Old Space vs New Space: New Actors between Space Economy and Space Warfare. Appendix 4.

Agnieszka Lukaszczyk (2023). Research Interview: Old Space vs New Space: New Actors between Space Economy and Space Warfare. Appendix 5.

Maria Cristina Falvella (2023). Research Interview: Old Space vs New Space: New Actors between Space Economy and Space Warfare. Appendix 6.

John Stopher (2023). Research Interview: Old Space vs New Space: New Actors between Space Economy and Space Warfare. Appendix 7.

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Appendix no. 1: Charles University Research Ethics Committee – Research Ethics Approval (CZ Version)



FAKULTA
SOCIÁLNÍCH VĚD
Univerzita Karlova

V Praze dne 17. dubna 2023

Věc: Stanovisko Komise pro etiku ve výzkumu

V souladu se svým úkolem, tj. „posoudit etické aspekty cílů, metodologie i potenciálních dopadů výzkumných projektů, resp. jejich částí, které uskutečňují nebo na nichž se podílí řešitelé, kteří jsou zaměstnanci UK zařazení na fakultě, a studenti fakulty“, projednala Komise pro etiku ve výzkumu Fakulty sociálních věd Univerzity Karlovy dne 17. dubna 2023 žádost „Old Space vs New Space: New Players between Space Economy and Space Warfare“, č. 72/2023, podanou Virginiou Maraglino. K uvedené žádosti, jejíž podoba je na vyžádání k dispozici na Fakultě sociálních věd, nemá Komise pro etiku ve výzkumu žádné výhrady a vyslovuje souhlas se záměry předkladatele.

Komise pro etiku ve výzkumu schvaluje žádost bez výhrad.

S pozdravem,

A handwritten signature in blue ink, appearing to read 'Ondřej Klípa'.

Ondřej Klípa
Člen Komise pro etiku ve výzkumu
Fakulta sociálních věd Univerzity Karlovy

Appendix no. 2: Charles University Research Ethics Committee – Research Ethics Approval (EN Version)



FAKULTA
SOCIÁLNÍCH VĚD
Univerzita Karlova

Prague, 17th April 2023

Subject: The Statement of the Commission for Ethics in Research

In line with its task, i.e. „to assess the ethical aspects of the objectives, methodology and potential impacts of research projects, or their parts, which are carried out or attended to by the researchers who are staff members of Charles University employed at the faculty and faculty students“, the Commission for Ethics in Research on 17th April 2023 discussed the application „Old Space vs New Space: New Players between Space Economy and Space Warfare“, no. 72/2023, submitted by Virginia Maraglino. The Commission for Ethics in Research has no reservations to the application and approves of the applicants' intentions.

The Commission for Ethics in Research approves of the application without reservations.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Ondřej Klípa'.

Ondřej Klípa
Member of the Commission for Ethics in Research
Faculty of Social Sciences Charles University

Appendix no.3: Research Interview Questions

1. The shift between Old and New Space has the potential to considerably boost the economic advantages of space activities and hence make space more accessible to a wider range of people and organisations due to the greater participation of those involved and resulting higher expenditures and funds. Could it be said that this will have profound effects, positives or negatives, on future economic controls, finances, and regulations?
2. NASA and ESA are the main entities that deploy space operations and directly interface with private space firms. How will the public-private relationship evolve? In which way are they considering pursuing these partnerships for future initiatives, especially in terms of security? How do you think public-private partnerships will evolve in the next future?
4. Do you think non-state players, who are of such significance nowadays, might ultimately have more influence in policy-making over decisions than governments? How do commercial sectors have an impact on governments decisions?
5. How do governments affect the ecosystems of their startups? What part do private businesses play in this?
6. Given the increased number of actors in space, which consequences, regarding challenges with space debris, lack of transparency in space activities, or willingness to cooperate, could result from the actions of irresponsible actors in space?
7. When examining the ongoing conflict in Ukraine, we observed that the deployment and use of satellites and modern space technology enhanced and boosted Ukrainian capabilities. Private firms have taken quite autonomous decisions, meanwhile have played a very significant role. So, how do military uses of space affect commercial space activities? Using the Starlink case as an illustration for what it considered to be dual-use operations, as well as offensive military operations (reason why Starlink decided to scale back its involvement in Ukraine) - how will commercial companies' place in terrestrial and speculative space conflicts affect future military tactics?
8. Space technology' dual-use nature raises significant concerns about its deployment. Could the widespread dual-use of space technology lead to the irreversible weaponization of space? What possible role may commercial firms play in the weaponization of space? And what should be the role of commercial entities in dealing with sensitive technology?
9. Do commercial systems complement existing military capabilities, and how? And what are the prospects for the future?

Appendix no. 4: Transcript Interview Moronese

The shift between Old and New Space has the potential to considerably boost the economic advantages of space activities and hence make space more accessible to a wider range of people and organisations due to the greater participation of those involved and resulting higher expenditures and funds. Could it be said that this will have profound effects, positives or negatives, on future economic controls, finances, and regulations?

The increasing involvement of private companies in the new space economy has wide-ranging implications. This shift from government-funded programs to a more diverse landscape with numerous private players entering the market has the potential to significantly impact economic controls and regulations in the space sector, as the participation of private actors promotes innovation, competition, and cost-effective solutions, which can lead to economic growth and increased accessibility to space activities. As space activities become more commercially driven, it becomes crucial to develop robust regulatory frameworks that strike a balance between encouraging innovation and ensuring safety, security, and sustainability. Existing space treaties and international law, such as the Outer Space Treaty, provide a foundation for space activities, but they require adaptation to address the unique challenges posed by the new space economy. In the future, we can expect the continuous evolution of regulations to keep pace with advancements in the space industry. This may involve addressing emerging issues such as space tourism, asteroid mining, and mega-constellations of satellites. Striking a balance between encouraging innovation and maintaining safety, security, and sustainability will be crucial for the long-term development and regulation of the new space economy.

NASA and ESA are the main entities that deploy space operations and directly interface with private space firms. How will the public-private relationship evolve? In which way are they considering pursuing these partnerships for future initiatives, especially in terms of security? How do you think public-private partnerships will evolve in the next future?

NASA and ESA, as prominent space agencies, recognize the value of collaborating with private companies for future initiatives. These partnerships allow agencies to leverage the expertise, innovation, and cost-effective solutions offered by private space firms. By working together, agencies and private companies can enhance their capabilities and operational efficiency in achieving common goals. NASA has actively pursued public-private partnerships through programs like the Commercial Crew Program, which aims to develop safe and reliable crew transportation capabilities to the International Space Station

(ISS) in collaboration with private companies. The Artemis program, focused on returning humans to the Moon, also emphasises public-private partnerships in areas such as lunar lander development. ESA has similarly embraced collaboration with private companies. For example, the recent launch of ArianeWorks, a European commercial space transportation services provider, demonstrates ESA's commitment to fostering partnerships to accelerate innovation and competitiveness in the European space sector.

P3s can improve SSA and information exchange between governmental and private organisations in terms of security. Collaboration can result in the creation of cutting-edge monitoring and surveillance technology for space, protecting space assets and operations. Looking ahead, P3s are likely to evolve further as collaboration deepens and expands. Increased cooperation, resource-sharing, and joint missions can enable agencies and private companies to collectively address challenges, such as space exploration, technology development, and space science. Collaborations may also extend to areas like space traffic management, space situational awareness, and cybersecurity to ensure secure and sustainable space activities. Space law provides a framework for defining the rights and responsibilities of states and private entities in outer space. Governments play a crucial role in creating and enforcing regulations to ensure the safe, peaceful, and sustainable use of space. Regulatory frameworks cover various aspects, including licensing, authorization, supervision, and oversight of commercial space activities. These frameworks also cover security issues including cybersecurity, protecting hypersensitive technology, and controls on exports. P3s need careful consideration of security issues, such as protecting technology, national interests, and sensitive information. They also need procedures for collaboration, information sharing, and dealing with security-related problems, as well as clear definitions of roles and duties. Effective space law and regulatory frameworks should strike a balance between promoting commercial space activities and ensuring that national security interests are protected. As the commercial space sector continues to grow, future developments in space law will need to address emerging challenges and advancements. This includes areas such as space traffic management, mega-constellations, space tourism, and the utilisation of space resources. The evolution of space law and regulations will likely involve closer collaboration between governments, international organisations, and private stakeholders to establish standards, norms, and best practices that foster innovation while maintaining safety, security, and sustainability in space activities.

Do you think non-state players, who are of such significance nowadays, might ultimately have more influence in policy-making over decisions than governments? How do commercial sectors have an impact on governments decisions?

The subject of non-state actors' effect on policy-making in comparison to governments is raised by the growing relevance of non-state participants in the space industry. Although non-state actors like private firms have become more prominent recently, it is vital to remember that governments still have a lot of regulatory and policy-making power. Governments play a fundamental role in setting the legal and regulatory frameworks that

govern space activities. They have the power to enact laws, establish licensing and authorization processes, and enforce compliance with international space treaties. Governments are responsible for national security considerations, diplomacy, and representing their countries' interests on the global stage. However, the commercial sector can have a substantial impact on government decisions, particularly in areas where innovation, technological advancements, and economic interests intersect. Private businesses contribute to governments' decision-making processes through various means.

Economic Influence: the commercial space sector has become a significant driver of economic growth and job creation. Private companies invest substantial resources into research and development, infrastructure, and the commercialization of space technologies. This economic influence can shape governments' priorities and policy decisions to support and foster the growth of the commercial space industry.

Technological Innovation: private companies often lead the way in developing cutting-edge technologies and solutions. Their advancements can influence government policies by showcasing the potential benefits and applications of these technologies. Governments may consider adopting or adapting policies to facilitate the integration of these innovations into their space programs or national strategies.

Public-Private Partnerships: governments increasingly recognize the value of partnering with private companies to achieve common objectives. These partnerships can leverage private-sector expertise, resources, and efficiency to accomplish shared goals, such as space exploration, technology development, and scientific research. In such collaborations, private businesses can influence decision-making through their active participation in policy discussions and shaping the direction of joint initiatives.

While non-state players can have an influential role in policymaking, it is important to note that governments retain the ultimate authority in setting regulations, ensuring national security, and upholding international obligations. The relationship between governments and the commercial sector is one of interdependence, where governments provide the legal and regulatory framework within which private businesses operate, and private businesses contribute to the growth and advancement of the space industry.

How do governments affect the ecosystems of their startups? What part do private businesses play in this?

Governments play a significant role in shaping the ecosystems of startups in the space sector. They have the power to influence the conditions, incentives, and support mechanisms that foster the growth and development of startups. Governments can affect the startup ecosystem through various means.

Funding and Grants: governments often provide financial support to startups through grants, funding programs, and incentives. These resources can help startups overcome financial barriers, invest in research and development, and scale their operations. By allocating funding and resources strategically, governments can steer the direction and priorities of the startup ecosystem.

Regulatory Frameworks: governments establish regulatory frameworks that govern various aspects of startup activities, including licensing, safety standards, intellectual property rights, and export controls. These regulations can impact the ease of doing business for startups and influence their ability to navigate legal and compliance requirements.

Incubators and Support Programs: governments often establish incubators, accelerators, and support programs to nurture and mentor startups. These initiatives provide access to infrastructure, expertise, networking opportunities, and guidance on business development. By creating a supportive environment, governments can foster innovation, entrepreneurship, and the growth of startups. Private businesses play a crucial part in the startup ecosystem as well. They can contribute in the following ways.

Investments and Partnerships: private businesses can provide financial support, venture capital, and investments to startups. By recognizing the potential of innovative ideas and technologies, private investors can fuel the growth of startups and enable them to bring their products and services to market.

Mentorship and Expertise: established companies can offer mentorship, guidance, and industry expertise to startups. Sharing knowledge, best practices, and lessons learned can significantly contribute to the success of startups and help them overcome challenges in their journey.

Market Opportunities and Collaboration: private businesses can provide market access, partnership opportunities, and commercial contracts to startups. Collaboration with established companies can offer startups valuable exposure, credibility, and the chance to validate and commercialise their products or services.

The relationship between governments and private businesses is essential in creating a conducive ecosystem for startups in the space sector. The success and expansion of startups may be facilitated by public and private sector cooperation, support, and alignment of interests, which will foster innovation, the creation of jobs, and economic growth in the space industry.

Given the increased number of actors in space, which consequences, regarding challenges with space debris, lack of transparency in space activities, or willingness to cooperate, could result from the actions of irresponsible actors in space?

The future implications of commercial companies' involvement in a various number of space activities are uncertain and subject to ongoing discussions among policymakers, legal experts, and industry stakeholders. The evolution of space law and regulations may need to address these challenges and consider the potential risks and consequences associated with commercial actors' participation in military operations. Moreover, the entrant in the scene of more and more actors creates a much better environment for irresponsible actors, increasing challenges and dangers. Stricter controls, transparency measures, and international cooperation will play critical roles in mitigating the risks associated with possible irresponsible behaviours and ensuring the peaceful and sustainable use of outer space. Striking the right balance between fostering commercial innovation and

ensuring the peaceful use of space will be crucial in shaping the future of space law in this context.

When examining the ongoing conflict in Ukraine, we observed that the deployment and use of satellites and modern space technology enhanced and boosted Ukrainian capabilities. Private firms have taken quite autonomous decisions, meanwhile have played a very significant role. So, how do military uses of space affect commercial space activities? Using the Starlink case as an illustration for what it considered to be dual-use operations, as well as offensive military operations (reason why Starlink decided to scale back its involvement in Ukraine) - how will commercial companies' place in terrestrial and speculative space conflicts affect future military tactics?

Commercial space operations may be significantly impacted by military space activities, particularly in areas where there are conflicts or tensions. An example of this can be observed in the ongoing conflict in Ukraine, where satellites and modern space technology have enhanced Ukrainian capabilities. As commercial companies provide critical technologies and services, they may become targeted or exploited in such conflicts. Private companies may need to assess the risks associated with their involvement and make strategic decisions to protect their assets and interests. Addressing the relationship between military uses of space and commercial activities requires consideration of international law, including the Outer Space Treaty and other relevant treaties. The Outer Space Treaty prohibits the placement of weapons of mass destruction in space, ensuring space remains a peaceful domain. However, the treaty does not explicitly address all aspects of space warfare or the role of commercial actors in conflicts.

Space technology' dual-use nature raises significant concerns about its deployment. Could the widespread dual-use of space technology lead to the irreversible weaponization of space? What possible role may commercial firms play in the weaponization of space? And what should be the role of commercial entities in dealing with sensitive technology?

The dual-use nature of space technology, with both civilian and military applications, raises concerns about its deployment and the potential weaponization of space, in fact, the issue of weaponization is complex and multifaceted. The weaponization of space refers to the deployment of space-based weapons systems intended to cause damage in space or on Earth. Commercial companies that develop and provide dual-use technology run the risk of unintentionally or deliberately contributing to the weaponization of space. In order to prevent abuse and inadvertent weaponization, it is essential to monitor and regulate the export, transfer, and use of sensitive space technology. Additionally, international export control regimes aim to regulate the transfer of dual-use technologies, including those with

space applications. To prevent the weaponization of space, future developments in space law and regulations need to address the evolving landscape of space technology and its potential dual-use applications.

Do commercial systems complement existing military capabilities, and how? And what are the prospects for the future?

Private firms have played a significant role in supporting military operations by providing services and technologies. The involvement of commercial companies in terrestrial and speculative space conflicts raises questions about their place and influence in military tactics and decision-making processes.

As a last question, I would like to address your past speech on "Space and Law - TedX Talks." You talk about the absolute prohibition of weapons in space or in general of the prohibition of the militarization of space. However, many theorists believe that such militarisation is inevitable – do you agree?

Also, as far as I can tell, the use or placement of weapons of mass destruction is strictly prohibited, but otherwise? Could legislation relating to public-private partnerships prevent this apparent militarisation? My perspective on this matter is that while the potential for militarization exists, it is essential to uphold the principles of space law and prevent the weaponization of space. While some argue that the militarization of space is unavoidable due to geopolitical realities and the strategic advantages it offers, it is important to remember that space activities have primarily been focused on peaceful and scientific endeavours. The Outer Space Treaty, as the cornerstone of space law, explicitly prohibits the placement of weapons of mass destruction in space and emphasises the peaceful use of outer space for the benefit of all humanity. However, as space technology advances and the commercial sector grows, the lines between civilian and military applications can become blurred. Space technology and its dual-use capacity, makes it difficult to ensure responsible use and prevent unintentional weaponization. Stricter controls and regulations are necessary to prevent the misuse of space technologies for military purposes.

In terms of legislations and partnerships, governments can play a crucial role in shaping the landscape of space activities. By enacting laws and regulations that address security concerns, protect sensitive information and technologies, and establish frameworks for public-private partnerships, governments can mitigate the risks associated with the militarization of space. Collaborative efforts among governments, space agencies, private companies, and international organisations can establish norms, standards, and best practices that discourage the weaponization of space. Looking ahead, the future of space law will likely involve continuous discussions, negotiations, and adaptations to address the evolving landscape of space activities and the challenges posed by military applications. It

will be crucial to strike a delicate balance between promoting innovation, fostering commercial space endeavours, and safeguarding the peaceful use of outer space.

Appendix no. 5 – Transcript Interview Lukaszczyk

The shift between Old and New Space has the potential to considerably boost the economic advantages of space activities and hence make space more accessible to a wider range of people and organisations due to the greater participation of those involved and resulting higher expenditures and funds. Could it be said that this will have profound effects, positives or negatives, on future economic controls, finances, and regulations?

It is evident that the competition favoured lower costs, and we started to build real effective technological tools. We are proud of the space environment so much and we are working internationally on many different norms of behaviour and best practices, but with mixed results. So, today we depend on those space technologies quite a bit here on Earth. And if you want to really take advantage of these tools, we need to make sure that they can operate in a safe environment, so we really need to put some sort of norms in place because you know, everybody says that the space is so huge, it is not because the amount of the area that we use, it is around the earth mostly and that is very, very crowded.

NASA and ESA are the main entities that deploy space operations and directly interface with private space firms. In which way are they considering pursuing these partnerships for future initiatives, especially in terms of security? How do you think public-private partnerships will evolve in the next future?

It is difficult if you are a smaller company or a new company to get a government contract. But if you enter a public-private partnership, this is really because the government and the public part gets the service, whatever the service is, whatever they want. But the commercial company is still able to generate revenue and grow in a truly kind of secure environment. So, I think this is great. This is what we are advocating for.

Do you think non-state players, who are of such significance nowadays, might ultimately have more influence in policy-making over decisions than governments? How do commercial sectors have an impact on governments decisions?

Somewhat it depends on the country, but we should consider lobbying too. There is a strong lobby business where companies are lobbying, but they are not always everybody on the same side. Another factor to consider is that space is considered a sensitive infrastructure. Giving a closer look to the US, for instance, for a long time it has not had a rocket for bringing supplies to the International Space Station, and that is why they were using a Russian rocket. So, in this case P3 would mean that the US was not having a choice

but to listen to the companies that provided it. So, for sure there is a substantial influence there.

Now, do you think that commercial companies really provide innovative and cost-effective solutions compared to the public sector?

For sure. I am not just saying that because I work for a commercial company, but I have worked for a public sector before. It is just different because, you know, commercial companies are much quicker and much more efficient. They do not have the same bureaucracy; they do not have the same blocks. For example, the European Commission focuses right now on discussing the next generation of Sentinel satellites. So, they are now securing the budget and they are now identifying their requirements and specs. And they preview that satellites are going to be launched in 2032. Now think about that. By the time they are launched, those requirements, those specs are already going to be old. In 10 years, and it is probably going to be delayed, let us be honest, things are always delayed, so it is going to be over 10 years. Before that goes up, there are billions of taxpayers' money that goes into it. And they are probably going to build something that is not going to be innovative, it is not going to be extraordinary. At the same time, it typically takes a commercial firm 3–4 years to get from concept to launch. I would say three. Additionally, satellites are becoming smaller and less expensive, and unlike governments, we are prepared to take risks and attempt new ideas, without being scared of failing. Indeed, governments may get multiple commercial enterprises services for the price of one commercial satellite. Now today, to answer the needs that are there, the global challenges are related to fractionize costs. Obviously, I understand in some ways for governments, they need to develop their satellites. And there are two reasons for it. One is that they want to be independent and have some sort of stability there. The second thing, that I think is more important, is that there are areas that are fundamental for the public good, but there is no commercial market there. So, I think the governments, if they are smart, should really look at what the commercial sector is doing and develop satellites to complement their capabilities and to find the niches and the holes and address those areas rather than just repeating what the commercial satellites are already doing quicker and cheaper.

Given the increased number of actors in space, which consequences, regarding challenges with space debris, lack of transparency in space activities, or willingness to cooperate, could result from the actions of irresponsible actors in space?

Plenty. Everybody wants to be in space now. Everybody wants to build their toys, which is kind of stupid in my view. You should first use the assets that are already there, but now they all want to focus on the speed of the satellite because it is a matter of prestige. But it is so expensive that they would be much smarter and quicker to use for instance the data or

the services that are coming from satellites that are already there. So, it is a matter of time. When a bigger accident is going to happen, it is a matter of time that somebody again is going to be stupid enough to do an anti-satellite test, and so yes, there are increasing every day irresponsible actors.

When examining the ongoing conflict in Ukraine, we observed that the deployment and use of satellites and modern space technology enhanced and boosted Ukrainian capabilities. Private firms have taken quite autonomous decisions, meanwhile have played a very significant role. So, how do military uses of space affect commercial space activities? Using the Starlink case as an illustration for what it considered to be dual-use operations, as well as offensive military operations (reason why Starlink decided to scale back its involvement in Ukraine) - how will commercial companies' place in terrestrial and speculative space conflicts affect future military tactics?

When you give somebody something, you need to make sure that the licences are very specific. But of course, in the time of war it is not possible to always control that, but if you feel that someone is doing something to your asset you do not want to be done, you just pull the plug. So, just as Elon has authority over selling his satellite, we still have a lot of influence over how our resources are used. Therefore, we may always push the appropriate button as soon as possible to, you know, terminate the data flow. However, some companies, like Planet, consider ethics and ethos, but not everybody. So, we would never want our assets abused in any sort of aggressive, violent way. That is very clear for us. It is in our statutes, in our DNA. But there are companies, commercial companies, that do not necessarily care as long as they have business, and they sell their assets. They are so-called “defence contractors” and once they sell the data out there, they wash their hands. For us, we always have full control of our data. But it really depends on the company. I just do not think there is a universal way of doing things. However, in this Ukrainian case, basically, SpaceX does not represent the US as a country, but it is an American company, despite the fact that it was Elon’s decision to get in the middle of the water. The American government was pretty much against it when it came to SpaceX’s involvement. They thought Elon made a crazy decision, and did not consult anybody, but they could not really prohibit to do that. Indeed, there are a lot of discussions about when these companies are getting involved in the conflict. So, should the government protect the commercial companies if there is a harm coming their way? For sure they would, if it was SpaceX or somebody else to get engaged in the conflict, although, there is no right answer for that, because we are learning as we are going, this is so unprecedented, that nobody thought about it before.

Having governments to get commercial data vs the US government getting to sell satellites or getting Planet data, for example, and giving them to Ukraine, it is a service that the companies themselves offer directly to the Ukrainian Government, and that has never happened before. So, this is an incredibly unique situation. Commercial companies are offering a different way of looking at conflicts, so not just in a sort of aggressive way, and

efforts as Planet data have been used in Ukraine to raise awareness about what is happening on the ground, so giving SSA for the Ukrainian government on the damages that are happening on the ground, the damages of the roads, the bridges, buildings, but also looking at crops for instance. Also concerning food. Assessing to determine if the food is still being farmed in Ukraine has security implications, as well as if it is capable of travelling to the necessary locations and is not being stolen. For example, our data has been utilised for these kinds of purposes alongside to track the movement of refugees. We firmly think that governments can make better decisions when they have this kind of scenario knowledge of the ground because you cannot manage what you cannot see, so they are more informed about what is happening, and I think this is what is making a big difference. Because before, for example, Sarah Technologies and conflicts were really only used for combat purposes. So, it was very specifically targeted for combat. And now these commercial companies are coming in, creating a network where people can communicate. A network that is really focusing on the civil society that is in those conflict areas and try to help them to have at least some sort of normality if possible, and I think this is where these tools come in handy. They can really help with daily life in those conflict areas. The fact that all of Planet's data is declassified sets it apart from other defence contractors and military satellites, which is what makes it so special today. Therefore, the information utilised in Ukraine is public, making it accessible to everybody. Consequently, transparency is another factor to take into account, allowing us to see clearly what is going on and receive accurate information rather than misinformation.

Space technology' dual-use nature raises significant concerns about its deployment. Could the widespread dual-use of space technology lead to the irreversible weaponization of space? What possible role may commercial firms play in the weaponization of space? And what should be the role of commercial entities in dealing with sensitive technology?

Well, it depends. First, we should ask ourselves the question - what is the definition of weapon in space? And there is not a common answer. This is why we also struggle as a community, as a space community. The Space Treaty that we still do have in place, clearly says that the space environment cannot be used for any sort of violent behaviour and should be only used for peaceful purposes. And then, this is the trick how we interpret that because we can use the space environment for military purposes, but we cannot weaponize the space environment in terms of putting weapons in space. But some assets are used for aggressive and violent behaviour. And you could almost argue that the fatality itself could be a weapon because if you hit one satellite with another they will destroy. So, this is more kind of a philosophical question, because you do not have the right now to put weapons in space. We have satellites but they are not weapons. But I mean one thing that it is important to mention. The type of behaviour that you have, that can be an aggressive behaviour. And there are ways to be aggressive in space. Especially via jamming and scooping. And with that you are freezing a space asset, and it is a frustration all of a

sudden. Anyway, the closest thing we have that could be seen as weapons are the anti-satellites weapons at the ground. You could shoot down a satellite, but also you cause a lot of debris, and that is another major problem that needs to be solved. So, to conclude I would probably say that we are making the space environment a little bit more insecure. But I would not say that we are weaponizing that.

To conclude, do commercial systems complement existing military capabilities, and how? And what are the prospects for the future?

In some ways private companies are already complementing states' military capabilities, but not entirely, because there are regulations of what commercial companies can do or not. There are areas so military classified that commercial companies cannot go into, and it is totally understandable. For instance, our resolution, the highest resolution we can have, it is 30cm. And the military setups can probably be 10cm, or maybe even below that which is, you know, classified. And nobody will tell you about it. So, the commercial company will never have that. There are areas where commercial companies cannot go into, and it is totally understandable that the government should have their assets there. But for a vast majority of activities, we can definitely do a good job and commercials can be pickier and more efficient than governments.

Appendix no. 6 – Transcript Interview Falvella

The shift between Old and New Space has the potential to considerably boost the economic advantages of space activities and hence make space more accessible to a wider range of people and organisations due to the greater participation of those involved and resulting higher expenditures and funds. Could it be said that this will have profound effects, positives or negatives, on future economic controls, finances, and regulations?

Ebbene sì, all'inizio lo spazio era gestito solo dai governi. Nel momento in cui i governi hanno aperto l'accesso allo spazio ad altri settori e attori, hanno permesso ai privati con investimenti propri di accedere allo spazio, e addirittura i governi se ne servono perché comprano i servizi di questi privati. Ma proprio per questo si è creata una discrasia tra l'autonomia dei governi e l'autonomia che i privati possono assumere. È per questo che serve una regolamentazione adesso. Perché da una parte il privato giustamente rivendica la sua indipendenza perché ha fatto un investimento. D'altra parte, il governo non riesce sempre a garantire tutti gli impegni che aveva preso a livello di governo che gli può garantire quella autonomia decisionale precedente. E qui subentra anche la piccola polemica del rischio, e della differenza in termini di "portata del rischio" che governi e privati possono adottare. Ad ogni modo, è stata un po' l'evoluzione naturale di quello che una volta era l'approccio puramente istituzionale di accesso allo spazio. E per lo spazio oggi non si può fare a meno di considerare la cooperazione tra governi e con queste compagnie private anche se però per far sì che questa cooperazione sia sfruttata al meglio e sia proficua bisogna regolamentarla.

NASA and ESA are the main entities that deploy space operations and directly interface with private space firms. How will the public-private relationship evolve? In which way are they considering pursuing these partnerships for future initiatives, especially in terms of security? How do you think public-private partnerships will evolve in the next future?

Io menzionerei più tre agenzie. La NASA, ovviamente. L'ESA che ha cominciato a farlo, cioè si interfaccia con le aziende private ma più nel campo della ricerca e sviluppo. Perché l'ESA, non ha vere e proprie competenze in materia di difesa e sicurezza. Quindi ha cominciato recentemente ad ampliare queste sue capacità e a interfacciarsi con tecnologie a uso duale. Infatti, come terza agenzia/istituzione è da menzionare la Commissione Europea, che, invece, ha un budget definito nei confronti dell'ESA, la metà del quale è dedicato alla sicurezza, al punto che un nuovo regolamento è stato redatto in termini di programmi spaziali europei. Quello in vigore adesso 2021-2027, ha cambiato un po' la governance, istituendo una DG per la difesa, ovvero DG-DEFIS (Directorate-General for

Defence Industry and Space). Fa capire quanto diciamo l'Europa, a differenza dell'ESA, sia un'agenzia intergovernativa. E l'Unione Europea, come mandato, ha proprio i servizi per i cittadini. Infatti, ha sviluppato due soli grandi considerazioni. Osservazione della Terra e navigazione satellitare, la quale ultima è considerata più delicata e diciamo anche la più importante a livello militare, dalle quali dipende il 12% del PIL Europeo, e quei servizi sono essenziali per ogni persona e infrastruttura in ogni dove e per molteplici ragioni. Se io guardo questo numero, aumenterà ancora nel tempo. Anche la Banca Mondiale, ad esempio, utilizza questi servizi per monitorare lo sviluppo dei cantieri nelle zone di guerra, spesso inaccessibili a causa di conflitti o epidemie. Quindi capire diciamo quale area uno sta guardando con precisione e in che modo la sta guardando è importante.

Allora, storicamente non avevamo il GPS. Il GPS è una costellazione di satelliti implementata per uso civile. L'Europa ha sviluppato Galileo per una maggiore autonomia. E ha stipulato anche degli accordi con gli Stati Uniti, promuovendo mutua collaborazione. Tutti i paesi già sviluppati hanno una propria costellazione. C'è quella Russa, Glonass, quella Cinese, BeiDou. Perché senza navigazione, non si cammina e se non c'è autonomia nell'andare nello spazio, non possiamo sempre aspettare qualcuno per andarci. Ricordiamoci di quando le navi si perdevano nell'Atlantico per raggiungere l'America, perché a un certo punto non capivano più, nel mezzo dell'oceano, dove precisamente esse fossero. Ma tornando al nostro punto, la costellazione Galileo prevede un uso duale. Anzi, a brevissimo, prevederà l'attivazione di un servizio PRS (Public Regulated Services). Prevede appunto una navigazione criptata ad uso istituzionale. Cosa c'è di nuovo. La differenza: io ho un telefonino con GPS attivato e posso capire in quale palazzo mi trovo; se ho Galileo posso capire in quale stanza mi trovo; se ho PRS posso capire in quale sedia della stanza sono seduta. Giusto per dare un'idea della dimensione della potenza del sistema. Però sono necessarie anche delle accortezze nell'operare questo tipo di sistema perché potrebbe anche essere utilizzato in maniera offensiva. È fondamentale la precisione di Galileo, per esempio, per la guida automatica. E l'Italia è stata la prima a utilizzare i servizi di Galileo per gli aeroporti ad esempio. Saranno fondamentali per i treni e il traffico su rotaia. E non ci sarà più un treno che si potrà scontrare perché lo si potrà intercettare molto prima, vista la precisione di 3cm del sistema.

Ora facendo riferimento ai partenariati più nello specifico, la Commissione Europea ha lanciato l'idea di fare dei partenariati maggiormente a livello nazionale. Però, c'è un problema, che, mentre gli Stati Uniti hanno un volume di mercato grande abbastanza che permette una maggiore possibilità di exploitation commerciale. Ogni paese d'Europa da solo non ce l'ha. Quindi l'Europa riesce a fare questi partenariati, se li fa a livello di Europa. Per dire, quando si deve fare la metropolitana lo Stato non mette i soldi, lo Stato dà la concessione e la ditta costruisce la metropolitana con i suoi soldi. Ma poi c'è una concessione, che per cent'anni la ditta vende i biglietti. E questa cosa può funzionare nel momento in cui tu hai milioni di persone che per cent'anni comprano i biglietti. Allora quali sono questi milioni e milioni di utenti che per decine di anni devono comprare i servizi spaziali? Ancora non ci sono, ce ne sono pochi, solo adesso cominciano a esserci perché molte aziende si avvalgono, ad esempio, di aziende che lavorano nelle assicurazioni, aziende che lavorano nei trasporti, aziende che lavorano nell'agricoltura e

che si avvalgono di servizi spaziali. Oggi, la Commissione europea ha piena consapevolezza della qualità inevitabile delle risorse spaziali. Quindi anche degli aspetti di sicurezza. E sia dell'importanza di avere un mercato sano, bilanciato e anche competitivo, e di creare un bacino di utenza più ampio possibile. Perché altrimenti i costi dei nostri prodotti saranno sempre talmente alti che non riusciranno ad essere competitivi con quelli degli altri paesi, e le nostre aziende non potrebbero lavorare a dovere.

Do you think non-state players, who are of such significance nowadays, might ultimately have more influence in policy-making over decisions than governments? How do commercial sectors have an impact on governments decisions?

Questo dipende da noi, perché al momento le cose non sono regolate quindi la responsabilità è dei governi, che sono responsabili di quello che viene lanciato dal proprio suolo. Cioè, se un satellite viene lanciato dal suolo italiano diviene un po' un satellite italiano. Le varie normative ad oggi presenti devono in qualche modo essere riallineate alla realtà. Fino ad ora per fortuna sono stati pochi i casi facenti riferimento alla responsabilità. Ad ogni modo, i contratti stipulati con i privati sono fatti in modo che il governo si affidi alle aziende, che cedono proprietà intellettuale. Nel momento in cui io voglio fare partenariati, individuo l'investimento, individuo il rischio e individuo anche l'autonomia dei diritti. Ad esempio, adesso per la nuova generazione di Galileo si sta pensando a dei partenariati e bisogna anche decidere su quali argomenti si vuole cedere autonomia. Probabilmente sui servizi civili, in questo caso e non militari. È bene anche però capire che entrare a fare parte del mondo dell'evoluzione vuol dire giocare con regole in evoluzione. Perché noi vorremmo l'evoluzione ma tenerci le infrastrutture logiche e giuridiche che abbiamo. Ma non si può più. Allo stesso tempo, è bene che la scienza e la tecnologia vadano avanti.

How do governments affect the ecosystems of their startups? What part do private businesses play in this?

I governi stanno investendo per quello che possono, anche perché la maggior parte delle start-up sono create da poche persone, per fortuna giovani che guardano la realtà con occhi diversi. Per aiutarli, i governi stanno facendo due cose, soprattutto in Europa, ma prendendo spunto dalla scuola americana. Allora, una è la creazione diciamo di “palestre per le aziende”, per quelle aziende che hanno delle buone idee e noi le aiutiamo per portare queste idee sul mercato. Dall'altra parte, ci sono gli “acceleratori”. Ovvero, quando l'azienda è pronta a lanciare sul mercato, io posso accelerare il tutto con un investimento, che può essere equity, investimento che può essere di partenariato o può essere semplicemente a fondo perduto, e tutto ciò si sta diffondendo sempre più. Proprio due giorni fa, se vai sul sito dell'ASI, l'Agenzia Spaziale Italiana ha firmato un accordo

europeo con Francia e Germania riguardante il viaggio lunare. Il primo fondo, diciamo con fondi europei di capacità solo inerenti allo spazio, è stato fatto in Italia, si chiama Primo Space Fund, ma l'Europa ne sta facendo altri. E lo fa tecnicamente istituendo, ad esempio, una rete di incubatori dove le aziende partecipano 50-50 e quindi le si aiuta a crescere. Le stesse aziende per fortuna hanno capito già da molti anni che la ricerca è importante. E molte di loro investono appunto personalmente e autonomamente dai governi. Investono facendo collaborazioni con istituti di ricerca. E lo fanno anche sviluppando cose nuove a loro rischio. Per questo anche qui lo Stato o, meglio, gli Stati europei attraverso l'ESA hanno preferito puntare in dei programmi dove le aziende possono proporre al proprio paese di appartenenza un progetto che può essere finanziato in toto o co-finanziato, e quindi portare avanti un'idea nuova. Questi programmi alla Carta servono proprio a permettere di sviluppare cose nuove, cose innovative che hanno un vantaggio in termini di performance, in termini di costo, in termini di tempi di approvvigionamento, in termini di indipendenza tecnologica. Perché l'Europa, per esempio, sta investendo molto e finanzia moltissimi progetti che consentono indipendenza tecnologica. Perché, se ogni volta devo andare dagli Stati Uniti per ad esempio un connettore, e gli Stati Uniti me ne danno uno ogni due anni, allora io non posso produrre niente con i miei tempi. Quindi produrre in maniera autonoma, insomma, è una cosa importante. Quindi ci sta un doppio cammino. Da una parte c'è lo stato giustamente e dall'altra ci sono anche le aziende che hanno capito che sono veramente innovative, e che devono investire nella loro parte. Inoltre, ad esempio noi abbiamo in Italia aziende che non vogliono finanziamenti statali. Oppure gente che accetta solo i finanziamenti a fondo perduto per poter avere la libertà di poter poi reindirizzare e anche decidere qual è la porzione di mercato da aggredire. È chiaro che è molto più facile fare questo in ambiti che hanno valenza duale, perché ho più possibilità.

Given the increased number of actors in space, which consequences, regarding challenges with space debris, lack of transparency in space activities, or willingness to cooperate, could result from the actions of irresponsible actors in space?

Fino a quando non c'è una normativa alcuni soggetti possono approfittare della situazione. Oggi è molto difficile a livello di COPUOS di Nazioni Unite, che è l'unico tavolo di convergenza diciamo globale, trovare una convergenza. Questa guerra soprattutto ha scatenato rivalità. Ma il dialogo è necessario, nonostante non potrà mai portare a una soluzione positiva per tutti, però è quello che si sta cercando di fare. E intanto bisogna cominciare a convergere a livello occidentale almeno con alcuni concetti. Per esempio, durante il G7 si è deciso di inserire nelle conclusioni un paragrafo dedicato allo spazio. I 7 paesi si sono impegnati per non colpire da terra infrastrutture spaziali per evitare di creare detriti. E hanno invitato gli altri paesi a fare lo stesso. Ma appunto gli hanno invitati, non è detto che lo faranno. Facendo questo, comunque, ha esplicitato che i debris non li possiamo produrre perché, se sono troppi creano un problema di accesso allo spazio, e inoltre anche le infrastrutture spaziali da terra non le dovremmo colpire. Ad ogni modo, la maniera migliore per ammazzare un satellite non è colpirlo ma distruggerlo

elettronicamente. E questa è una cosa che purtroppo avviene giornalmente. Ad esempio, questo è il sogno dei Russi in questo momento di accecare i satelliti Starlink. Ad ogni modo, questa presa di posizione del G7 è stata molto importante in Occidente, e non solo, diciamo per i paesi del G7, che riproporranno questi punti anche al G20, ma tutti i paesi dell'Occidente non dovrebbero mai sparare su un asset spaziale. E questa è una posizione molto forte, non dovranno mai sparare perché non devono creare detriti, ma al tempo stesso si predilige una visione che va contro l'attacco. E questa è una presa di posizione che comincia, diciamo, a mettere dei paletti. Inoltre, è bene far riferimento anche ai piani d'azione nazionali degli stati, la cui rigidità può un po' cambiare da paese a paese. Il problema è che più aumenta il numero di attori e più la situazione diventa complicata. Però chiaramente si può trovare una soluzione a tutto.

When examining the ongoing conflict in Ukraine, we observed that the deployment and use of satellites and modern space technology enhanced and boosted Ukrainian capabilities. Private firms have taken quite autonomous decisions, meanwhile have played a very significant role. So, how do military uses of space affect commercial space activities? Using the Starlink case as an illustration for what it considered to be dual-use operations, as well as offensive military operations (reason why Starlink decided to scale back its involvement in Ukraine) - how will commercial companies' place in terrestrial and speculative space conflicts affect future military tactics?

È importante prima di tutto menzionare che secondo il trattato inerente allo spazio, la responsabilità del satellite in orbita è data allo stato dal quale il satellite viene lanciato. I satelliti Starlink, sebbene siano privati, sono tutelati dal governo americano, perché sono stati lanciati dal suo suolo. Andare a colpire quel satellite significa compiere un'azione aggressiva sul suolo americano. Infatti, la situazione è molto complicata. In questo momento gli ucraini stanno utilizzando quei satelliti apparentemente in maniera offensiva, e quindi non rispettando i patti prestabiliti. Però è inevitabile che durante una guerra si vada incontro a ciò. È per questo che servono delle regulations. Ad ogni modo, il dialogo è ancora aperto, non c'è oggi una soluzione, ma c'è un impegno, una consapevolezza a cercare il prima possibile una soluzione perché ci stiamo rendendo conto che praticamente sia la pandemia che la guerra non hanno fatto altro che accelerare quel processo che ci sarebbe stato ma più lentamente. Ci stanno facendo vedere quali sono il dritto e il rovescio della medaglia, e quali possono essere gli impatti. Quindi prima ci sarà una regolamentazione e più ci sarà tutela per tutti, sia per i privati che per le agenzie istituzionali che si avvalgono dell'appoggio del settore privato. Cioè, solo in Russia e in Cina, o Nord Corea le aziende sono più controllate a livello statale in ambito militare e generale. Però, mentre sulla terra ci sono dei regolamenti molto rigidi, per esempio a livello di esportazione, a livello di trasferimento tecnologico, nello spazio tutto questo non c'è. E il paradosso è che quasi quasi abbiamo difficoltà ad usarli, questi nuovi sviluppi, perché non abbiamo una normativa appropriata.

Space technology' dual-use nature raises significant concerns about its deployment. Could the widespread dual-use of space technology lead to the irreversible weaponization of space? What possible role may commercial firms play in the weaponization of space? And what should be the role of commercial entities in dealing with sensitive technology?

Lo spazio di fatto è già, ma è da sempre stato, dalla ricerca spaziale, ad essere alimentato da interessi militari, da una parte all'altra della terra. Ma la stessa Italia, sin dal suo primo lancio nel 1964, grazie anche alla NASA, era gestito dal Generale Broglio. E ciò che si è cercato di fare agli inizi è stato sviluppare una grande capacità di accesso, perché accesso significa autonomia. Non puoi fare una strategia per lo spazio se non c'è l'autonomia di andarci, non è che devi stare sempre ad aspettare qualcuno che ti ci porti. Ad ogni modo, fino ad adesso, ci sono stati dei trattati internazionali, i Trattati delle Nazioni Unite. E di regolamenti dello spazio ci sono i famosi 5 Trattati. Mentre all'inizio c'era una grande eccitazione e quindi i primi 2-3 Trattati sono stati sottoscritti praticamente da tutti, poi, sull'uso delle risorse, sull'uso del suolo lunare si è cominciato ad avere meno consensi. Questi trattati, in realtà non hanno un'efficacia del 100%, perché la loro efficacia si fonda sul consenso. E il problema dello spazio è che la sua natura globale. Quindi, anche se un paese fa una normativa, se questa normativa non viene condivisa dagli altri ha un effetto molto limitato.

Do commercial systems complement existing military capabilities, and how? And what are the prospects for the future?

Dunque, gli attori privati sono coinvolti negli sviluppi a livello spaziale. Quindi, stanno già contribuendo ad ampliare capacità militari. Ma al punto di lavorare da sé, io non credo, ma lavoreranno sempre in relazione alle istituzioni. Cioè, un privato, vuole lavorare per guadagnare, quindi vuole vendere prodotti, servizi e applicazioni, ricerca, operazioni, attività al pubblico. È per questo che c'è un po' di scetticismo riguardo un privato che si dovrebbe occupare di garantire la sicurezza di un paese.

E quindi perché i governi approfittano del fatto di investire nei privati, anche a livello militare?

E perché questa cosa gli permette di accedere a più ampie competenze. Inoltre, se non ci affidassimo ai privati vorrebbe dire che sarebbe tutto statalizzato, e noi non siamo la Cina. Però ovviamente è una scelta. Se tutto è statale fai lavorare tutto e tutti per lo Stato, ma nel momento in cui tu hai il soggetto privato, tu quel soggetto privato lo coinvolgi. E poi il

privato ti aiuta anche a fare degli investimenti per la ricerca e fa concorrenza, quindi abbassa i costi.

Appendix no. 7 - Transcript Interview Stopher

The shift between Old and New Space has the potential to considerably boost the economic advantages of space activities and hence make space more accessible to a wider range of people and organisations due to the greater participation of those involved and resulting higher expenditures and funds. Could it be said that this will have profound effects, positives or negatives, on future economic controls, finances, and regulations?

A big difference between New Space briefly is the government funded thing. But firstly, it is crucial to think about - where does the money come from and who is deciding what you build? And I think that is kind of where we need to sort of understand this because that is the critical difference. Let us acknowledge there are a whole bunch of things that people are putting money into, but I am sceptical if they will ever work or be profitable. There are a lot of ideas that people are putting money into, and I would say all that stuff is New Space. But does any of that stuff have a role in the national security community? I would say not yet. But when you start thinking about this you probably ought to keep terms of viability. So, you can do what you want, but I would just suggest that there are a lot of these things that, of course, the government is not putting money into because they have no need or interest. At least yet. Anyway, it is really important to understand again where the money comes from. Because so many of these companies started with these early investors. There is private equity and there is venture capital and all kinds of different ways money flows into these companies. And they do develop early design, early development, exploration of concepts. But at some point, they start saying OK. I need an indication that the government is actually going to buy this and that is where many of these companies are having problems because the government will not, at least the US government, is not sure it will do it. It cannot commit anybody or anything in the future that it gets to do with how our Congress provides money for a certain amount of time and nobody can obligate a future Congress to guarantee that they will buy something in the future. So, this creates a bit of a problem for these new space companies because the government just cannot. Well, I do not want to mislead you. The government is required when it invests money in anything to receive something for it. So, it could write a contract with a company to say I want you to develop something. But when you buy something from a company, let us say, I am going to pay you to develop a satellite, then a satellite will be built. And then the question is - who owns it? And that is where the agreement gets created. They actually need to give and receive something. However, do not take what I said as the absolute rule. It is complicated. So, I would say that what is the definition of new space or commercial space has really got to do with the contract mechanism.

NASA and ESA are the main entities that deploy space operations and directly interface with private space firms. How will the public-private relationship evolve? In which way are they considering pursuing these partnerships for future initiatives, especially in terms of security? How do you think public-private partnerships will evolve in the next future?

Let us start from a very different perspective. I think of the government and then space programs first in three areas. One is national security. One is civil, meaning space exploration. And then the other is commercials. And these things can overlap a bit but let us just start with those three things. Now I want to turn to national space security. So, we are just going to talk about what we do in national security. What is the governments' role? I would say there are seven things that the governments do. They do communications. They do what we call PNT. They do GPS. They do weather. They do what is called Overhead Persistent Infrared (OPIR). You know, missile warning. They do launch, which is not really a mission per se, but it is an enabler. You need launch to do those. Then the sixth one, I would call ISR. Last category that I saved for last because it is kind of new is space superiority, and within that there are three categories. One is called SSA - sort of knowing what is going on. And then the offensive and defensive aspects. So now, what of those things is the commercial world also doing? They absolutely do a lot of commercial communications. They are now launching. Elon Musk is now a big leader in launch, but most launch companies around the world are government funded. If you look at the number of satellites that Elon Musk is launching, well, there are a lot of satellites, but they are a lot on one launcher and by the way, Elon Musk is launching on his own. So, it is not like he is changing the market for all of these other companies that want to get into the business. Anyway, then there are some commercials that do some ISR. There is now a company called HawkEye360, that is collecting electronic signs. But I would describe that as kind of the low end, you know, the affordable stuff. I would not say there is commercial weather. I would not say there is commercial PNT, although some people would say so. On the ground, of course there is. There are all kinds of navigation systems and a lot of commercials. Also missile warning is not a commercial thing. And there are some companies, on the space superiority side, particularly in SSA, that are trying to make money. So, if you look across all of those things, I do not know of any of them that are not trying to sell to the government and when I say the government, I mean the national security community either. Either the war fighters or the intelligence community. It would be hard to sort of pull this apart and say that is purely commercial or not. I just do not know of any company that does not believe that the government is a part outside their business model anyway.

Speaking of P3s now, I expect them to become increasingly useful in the future, but I think excessively high expectations for space companies will eventually lead to a financial calamity. Generally, the capital markets/private equity has provided a tremendous level of investment capital in a variety of space projects. Many, if not most, have come to terms that in order to close their business plans, there is a need for the government to be a reliable - even anchor - customer. Unfortunately, the government's budget is limited and

cannot possibly afford to be the anchor tenant, nor do they have the need for many of the capabilities, products, and commercial services. We are starting to see the capital become more difficult to raise, valuations are falling dramatically to reflect some of the challenges, and bankruptcies are starting to accumulate. P3s are a financial mechanism that forces some discipline up front. One challenge common to so many of the new space investments, is that businesses and investors want to be assured that if they build something, the government will be a customer. Unfortunately, at least in the US, the government is not permitted to provide a company any guarantee to purchase something in the future. P3s are one of the few mechanisms that help solve this restriction. One of the clearest examples I know is in the US Launch Industry. The capabilities provided by ULA (United Launch Alliance) were considered very expensive, and SpaceX showed extraordinary promise to reduce cost. However, there were a few problems – SpaceX was interested in selling launches for the medium class satellites, but not the larger satellites that required heavy lift. If the government took advantage of the SpaceX’ commercial offering, it could have reduced the number of launches to ULA, perhaps crippling their minimal launch rates. The P3 provided funding for both companies to invest in modernising their launch fleet, with the intent to become commercially competitive while also developing the capability to launch the government’s heavy lift needs. So, I think of P3s as a tool/relationship that enables partial government funding, typically during the challenging development years, that effectively aligns the interests of the government and industry up front – resulting in a win-win. But I see this helpful tool being buried in an avalanche of frustration as many companies are unable to secure the kind of government commitment for funding that they desperately need but did not anticipate the limitations. P3s are an excellent way to resolve some public-private issues since they represent an upfront agreement to formalise the objectives, but they are not a universal answer.

Do you think non-state players, who are of such significance nowadays, might ultimately have more influence in policy-making over decisions than governments? How do commercial sectors have an impact on governments decisions?

Yes, I think we are seeing that already. For instance, transparency around the globe is now being provided through space in a way that is no longer regulated by the government. Imagery of Ukraine was made available as the events were unfolding – it helped to shape the world’s opinion. Certainly, the private sector will advocate for policies and funding for things that they are interested in – that is part of our government process. However, they are still subjected to sanctions or rules. For example, for launching, companies need to refer to the national and international body that coordinates all. What I am trying to say is that military and commercial, or two countries or two companies, they all affect each other in terms of health and safety, regular operating things, but they are still working through all of those things. There are policy issues, operational issues like technical issues, there are all kinds of effects that people have to think about, including political implications of helping one and finding another. Let me say this - in our country right now, we now

understand that Twitter and Google were actively playing a role in public opinion, so now they kind of shape news. Elon Musk now bought Twitter. So, sure they play a role. Elon Musk is probably the one private sector person who can give you more examples of somebody engaged in government policy making. You know, he has done it in a couple areas. He has threatened to sue the Air Force if they did not buy things a certain way and the Air Force kind of said, OK, we will go along with you. It has been impressive. Obviously in Ukraine he has raised some significant issues and almost played a government role. And whether he uses twitter or not, he has an incredible influence. I think if you have money, if you have access to people, if you have a platform to reach them then your view will affect opinions. But it is not because it is space, it is just because it is.

How do governments affect the ecosystems of their startups? What part do private businesses play in this?

Companies that are starting up are always desperately need cash money investments, unless you are Elon Musk or Jeff Bezos or, you know, even Richard Branson ran into trouble with Virgin Orbit and said “enough, I am not putting more into this.” But they need money. But sometimes the government just thinks that the risk is not worth it. Anyway, to make money first they need to develop something and once it is developed - how do they make money to continue the operations? It is not easy, it is expensive, and it takes a long time. And if they are just saying everybody is going to have access to it, I would say: everybody who buys it will have access. Because they have to make money. Anyway, you need to consider roles and responsibilities between the government who has money companies that need that. P3s are one answer, and I am just suggesting in kind of a fairly limited example. Moreover, these startups normally start with some venture capital. But people like Elon Musk or other investors provide initial capital to develop the idea. Normally they do it in different phases. First, something to get started, then make it sure it is going well and then I will give you more. But right now, around the world I believe you will find that money is getting much harder to come by for space programs. Four or five years ago there were a ton of people investing. If you look at that sort of the same kind of environment it is much harder for these companies to find investors today. I think what happened is that investors realised it takes a lot of money in a long time before they can see any returns and so that is getting the whole environment in changing, which would suggest maybe the government is going to be even more important. But I think what is really going to happen is a lot of these companies are just going to go out of business in full because they cannot run like Virgin Orbit just did. Providing your money in this P3 it also helps them turn to investors and says, look, governments really interested in us, they are paying us. This gives you confidence that when it is operational they will actually buy the data. So again, that is an example of where P3 works because the government is interested enough in something the company is doing and so it is going to pay to make sure you do something. Anyway, the government cannot just throw money at a company and ensure investments forever.

Given the increased number of actors in space, which consequences, regarding challenges with space debris, lack of transparency in space activities, or willingness to cooperate, could result from the actions of irresponsible actors in space?

If you want to damage something or blow it up, that is a high consequence that you will create permanent damage. And the consequences of potentially causing an escalation of problems is high. So, the challenge that you bring up here is very important, but I am not sure what the solution is. Of course, we should put faith in sanctions and regulations.

Anyway, I see these challenges in two categories. First, I believe that going forward we will continue to make progress on requirements that will limit the debris and require end of life obligations to deorbit, etc. I would say that cleaning up the past will be a real challenge. This will take a long time and will be difficult to achieve consensus but seems like an obvious path. The second category is the one that I am concerned about – what do you do about the risk of a deliberate counter-space action? Unfortunately, there is general agreement on the theory of first mover advantage, in the event that a country that is capable of destroying satellites would be incentivized to do it first and do it comprehensively. In fact, I imagine that all the countries that I am currently concerned about, would happily render space useless to everybody, including themselves, because in the process destroying the space environment would be the single greatest move to gain parity they could make. I worry about how to stop a decision to deliberately destroy space systems. So, one category is how do you get people to behave well to ensure an environment that we all benefit from, the other is how you get people to not misbehave to create an environment that they have the most to gain.

Taking into example the US, it proposed to control sales of sensitive technology since it declines to provide it to China. Could private American companies gather some sensitive information and sell it to another entity? What should be the role of commercial entities in dealing with sensitive technology?

The US has very strict policies in place to control sensitive technologies. The regulatory regime is called ITAR – International Traffic in Arms Regulations -, and the list of technologies is identified on the US Munitions List (USML). All US companies must adhere to this or face extreme consequences. Having said that, there is always some debate about the effectiveness of this policy approach. Some would say that it incentivizes other countries to develop these sensitive technologies. I have even seen companies in other countries market themselves as ‘ITAR-free,’ meaning that it is beneficial to do business with them rather than a US company. From time to time, items are removed from the USML – I think communications satellites and related technology were removed several years ago – reflecting the fact that the technology was widely available around the world. In my opinion, it is a good time to review the long-term goals of how we partner and

cooperate with the international community. We assert that we are in an era of great competition with China and Russia and our policies need to support the long-term goals. I think being able to cooperate with partners and allies is critical, and our policies need to balance how we are able to do that with other national security goals.

When examining the ongoing conflict in Ukraine, we observed that the deployment and use of satellites and modern space technology enhanced and boosted Ukrainian capabilities. Private firms have taken quite autonomous decisions, meanwhile have played a very significant role. So, how do military uses of space affect commercial space activities? Using the Starlink case as an illustration for what it considered to be dual-use operations, as well as offensive military operations (reason why Starlink decided to scale back its involvement in Ukraine) - how will commercial companies' place in terrestrial and speculative space conflicts affect future military tactics?

Elon Musk, he develops his stuff primarily with his own money. But he does sell to the government. I never thought Elon Musk was going to spend the money to develop a rocket because I thought "Oh my God" That is a lot, but it turns out that it was not just all Elon Musk's money. You know, he got a ton of money from NASA to develop his rockets. So, he had lots of money, and he is a brilliant guy for sure. I was sceptical, anyway. In fact, I met with Elon almost 10 years ago, when I was working in the government down in Congress, and Elon came down with Gwynn Shotwell, who is still with him. They asked me if I would support buying their rockets. And I said no, I am not going to do it. And his argument was he could save money. He believed that the big rockets that we were launching on, which was at the time they were called Titans. They were like \$500 million at launch, and he said I could easily cut that price in half. But what mattered to me was reliability, because the satellite was multi-billion dollars and so I cared more about making sure it got to orbit than saving some money in a rocket that might be riskier. I said, "I am not in the business of taking risks here. I need every satellite to work." He did not like that. And that is funny. I met with Gwynn Shotwell years later. She runs the company. And she remembered meeting me. And I was like "oh you are successful." And I was very happy for them. But at the time it was about risk, and they had never launched before. That was anyway a funny story about how I actually am happy I was wrong. It was not that I was wrong. It was the right decision. I was not in the business of adding risk. What Elon has done, and this is how I look at it - he has driven the cost down compared to how we were buying. Let us simply imagine that a heavy lift launch cost over \$400 million, and since the price has dropped to around \$200, Elon has come in below that. He has caused the government to change how it buys things, a bit. That is an interesting thing. He has used reusability and he is maybe helping to make it cheaper.

Now coming back to Ukraine, two areas have been mostly talked about quite a bit. The use of communications. Like Elon Musk, who was known to deliver a bunch of terminals for Starlink. And that apparently has proved very helpful. And the commercial remote sensing. You know, imagery. You have now seen pictures of Russian tanks and all that. These are

two areas that commercial companies are kind of fully supporting. And let me approach this from two different perspectives. If you are Ukraine, or if you are a country that really does not have much capability, then what is going on in the conflict and the commercial companies' support, it is absolutely helpful. Ukraine did not have a lot of its own. So, it benefited greatly from commercials. It has also benefited from a lot of government sources but let us just focus on the commercial. Indeed, there is a risk that our military operators do not like and that is depending on something they do not control. And you raised the example - what if Elon Musk decides to turn it off? OK maybe it was not designed to be used in the kind of environment that they needed in. As an example. The US has been focused for a number of years now on shifting its focus from fighting Islamic extremists in the Middle East to what we call a near pure competition with China or Russia. The difference there is that China and Russia can fight back. They have systems to jam and blow up and do whatever they want in space. So, now you have to think, do I want to depend on commercial satellites or commercial capabilities that can be easily defeated? Or do I have to design my own satellites that can work through those kinds of things? That is a big issue for the US government when it says - should I use these commercial things that are not designed for what we call the high-end fight? That is a big issue here in the US, not a big issue in Ukraine because Ukraine will take whatever it can get. So, there is a great "well, it depends here" when you consider the function of commercials in waging wars. It depends on the buyer and the type of conflict you are engaging in. Our focus is on making sure the systems are going to work. Given that, you asked the question - what is the role of commercial systems in a war and how will it affect future military? Well, in Ukraine it is very helpful because they do not have any choice, however, they do not control it. And that is a factor. If you have no choice, you are going to have to hopefully think they help you and sell to you. Anyway, using commercial systems in the Ukraine-Russia conflict is absolutely useful. In my view, how space assets and commercial systems are being used in the conflict have demonstrated to be so helpful, that this will continue. All countries will start using it more and more and part of it is actually supporting tactical and strategic operations.

Now there are some big questions of whether the commercial markets are doing anything that is relevant to the military. You know again I would focus on communications, imagery and launch that are kind of the three obvious areas. However - do the needs of the military shape what the commercial companies are offering? Then yes, absolutely. Moreover, even Elon he builds rockets and things, those are all registered in the US, but some of these terminals and things, I think for example chips are made in China. So, this whole Russia-Ukraine issue raised a problem because Russia and China are aligned. And now Elon is supporting Ukraine. But he is depending on China for some commercials. You know, deliveries, ships and whatever. The sanctions now created a bad situation. They are relying on China to deliver parts that are needed for his system but now - is China going to continue to do it or is China going to sabotage it? That gets complicated. Let us just say that Elon Musk has placed himself in a very tough position by openly supporting Ukraine while also needing to keep positive commercial connections with nations that support Russia. It is almost like Elon has to act as a government himself. How do you balance that?

Very difficult, potentially. And you would think that, well, most companies would just stay out of it, just like, we are just a commercial company, we are going to provide support to whoever wants to buy it and try to play it safe. And maybe even say, we are not going to sell to the government to support the military, just to really be safe. But actually, I do not know of any examples of companies that do not want to sell to the government. There are so many ways that this relationship affects a company or a government, how they operate, who they trade with or who they provide service to. Even Elon Musk, I think for a little while, was just trying to get money out of the US government. Money is crucial.

The government surely invested in some of his projects. But I guess so especially for the more cost-effective solutions.

It is funny you bring this up. This is something that I actually think about a lot of. And let me poke at you. You just said that the commercial companies are more cost effective. Everybody says that, everybody believes that, and the question is - why? Well, our government has created decades of laws and regulations, and we have something called the FAR, the Federal Acquisition Regulations, which is very thick. Look at all the rules you have to follow in order to spend federal government money and that drives up cost and it makes it inefficient, and things are slow. And when they finally work, you know, they are years late and on and on. So many people complain about this, and they say, well, commercials are better. Well, it is better because they do not have to follow the rules. They follow their own rules, and they risk their own money. And that is great, right? One of the questions here is - why did we get to where we are? Somewhere along the line, people believed that this rule one at a time was helpful, good for the taxpayers, make sure we buy the right things, make sure nobody is cheating, make sure of all the stuff, and in the end, everyone hates it because it is so expensive and so slow. But nobody throws it out. Now, let us start over. Let us say the US government is absolutely stuck. They say, well, on the one hand, we need to build systems. But we like how commercials are doing it. And people in particular in Congress, are always saying "just buy commercially". They cannot stand the system they created, and they want to use the commercial system, and this is amusing to me. However, it is important to understand that when you say things like well commercial is more innovative and cheaper, it moves faster, yes. I would say that the only real commercial innovative thing is the additive manufacturing, technology of how you build things, and it has the opportunity to dramatically change how long it takes to design things. But the private does not build what you want it to be built and let us be careful - commercial companies are willing to fail. They can fail. It is a risk they do not accept. A system that is supposed to tell our president that we are under nuclear attack, we do not accept that might be wrong. It cannot be wrong. You do not want to wake the President up and say: "China just launched nuclear missiles; you have 10 minutes to counterattack." That cannot be right. So, commercials do not really care. So, now the struggle here is when it is appropriate for the US military to use commercials and when it is not.

Space technology' dual-use nature raises significant concerns about its deployment. Could the widespread dual-use of space technology lead to the irreversible weaponization of space? What possible role may commercial firms play in the weaponization of space?

The fact that a commercial system that was not designed to be a weapon could be used as a weapon, is absolutely going to happen. An example would be something that takes pictures of the Earth. If that picture is used to target a weapon, some people will call that weapon. However, there are no international agreements not to weaponize states. Right there, there is an agreement not to put a weapon of mass destruction in space.

Now, many satellites are also used for war, in terms of images of the Earth, ISR. but we would also argue that they are used to avoid war, you know, to see problems before they happen and to try to resolve them before they happen. So, we could say that is for peaceful uses. But now I do not know of any company that is offering that as only commercial. I do not see it being a business unless you are doing it for a government. Personally, I believe the world has to struggle and come to an agreement on some restrictions for offensive measures that are possible to deploy, both generally speaking and for business organisations.

Do commercial systems complement existing military capabilities, and how? And what are the prospects for the future?

So, commercials. Yes, affect military tactics, but what is revolutionary here is the way they can be used to shape world opinion. When you see imagery, I mean, oftentimes you see news, people on the ground, but now you can see in detail the devastation that Russia is doing, and it is hard for anyone around the world to look at that and say this is reasonable in any manner. What is really spectacular about the use of commercial systems in the Russia-Ukraine War is the way they shape world opinion. The fact that imagery is unclassified and can be shared around the world has several implications regarding the DIME (diplomacy, information, military, and economics).

Now, are privates' companies going to complement states' space military capabilities? Well, speaking of the US, I think that it has been a very hard barrier for them to break into the US military market because of a couple of things. The way we buy things. The way money is spent. And it is not only about the fact that commercials are cheaper. There is an article about a week or so ago. It basically says: for all the talk that the US military is doing about buying commercials, there is very little money in the budget for it and that was based on, I think just the budget that is being developed or considered right now. Now again, if you look around the world though, many countries are making investments in their own security. And while there is a chance to expand those markets and sell as a result, it takes time to establish the necessary capabilities. For example, you do not just sell pictures, you

have to sell the systems to analyse and report. And it is much more complicated, I would call it an ecosystem for consumption. Now, looking at Ukraine and seeing how commercials are used, makes me say “I want that right.” I want to start building and investing in those people, the training, buying the source data, all of those things, and I think that the market is going to grow. But at the same time governments will not buy everything. You know, they call it the Valley of Death when a company has a good idea but there is a huge gap between that idea and funds. Because they are not getting to the point where they are mature enough and they have a business enough viable. So, let me stop and say I think yes, I think you can call it new space or commercial space or whatever space is going to continue to play a larger role in security. But anyway, it will take a while. Finally, a lot of things are being impacted by commercials, but I would say more about public policy. But anyway, you got to kind of start with - whose military are you talking about? If you are talking about Ukraine's military, I could give you a long list of examples. They are now implementing all kinds of capabilities, communications, and that is a huge help for the military sector. Not only in terms of military applications but also in terms of transparency, and having people be warned of what is going on is also a huge help for the world. The question differs now in the US. Because the military spends a lot of money on things like encryption and dependability that are just beyond the capabilities of the commercial sector, the military space is still so much further forward than the commercial area. We are just sort of starting to explore how you add commercials and how you leverage it a little bit, but it is very slow.