Definition and Status of Space Security

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Abstract

Space security has gained increasing importance over the past decade as space becomes part of our everyday life. Yet, space security is not universally defined. The shift of paradigm and transformation of the space domain through new ways of utilizing space and recent technological advances such as mega-constellations, 5G, Internet of Things, artificial intelligence, and advanced materials have resulted both in major challenges and new opportunities. Over the years, space security has evolved. Since the signature of the Outer Space Treaty in 1967, space security has become a complex, broader, and multilayered concept. The topic dominates space

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law and space policy agendas at the United Nations General Assembly Committees and the Committee on the Peaceful Uses of Outer Space along with its subsidiary bodies. In this context, this chapter aims to effectively capture the multifaceted concept of space security and provide an overview of its current status.

Introduction

Space security entails the possibility to access and use space for all nations. Although traditionally it has been associated with military engagement, over the past years it has been enriched with safety aspects. The space race between the United States and the former Soviet Union in the 1960s triggered the first concerns regarding space security. The attempt to end an arms race in space was effected with the conclusion of the United Nations (UN) Outer Space Treaty in 1967 (United Nations 1967). The treaty sought to define boundaries for the security of outer space by establishing the principle of peaceful purposes in accordance with the UN Charter and by prohibiting the militarization and weaponization of space. The ratification of the Outer Space Treaty was a remarkable endeavor of resolving the space race tension, ensuring stability, and promoting international cooperation. Thus, space security – although not explicitly defined – was the result of the stabilizing effect of a treaty-based mechanism, and *vice versa* space security meant that activities in outer space ensure stability and peaceful uses of outer space (United Nations 1967). In this context, the interrelatedness between space security and stability was reinforced by the explicit distinction between civil and military uses of outer space.

Five decades later, the scope of space security has changed. As Sheehan notes in the chapter "Defining Space Security," of the previous edition of this Handbook, "space security includes now aside the military dimension, also, economic, societal and environmental dimensions" (Sheehan 2015). These elements are indispensable to space security, in view of the ongoing transformation of the space sector that moves away from the traditional confines of space activities. The so-called New Space encapsulates major changes taking place at unprecedented rate. These are related to the growing participation of private actors, the rising number of space-faring nations, and the emergence of the civil-military paradigm. This means that the dividing line between civilian and military uses of outer space has yet become artificial leading to uncertainty regarding governance of dual-use or hybrid areas. The terms "safety," "security," and "defense" are intertwined and used interchangeably with no clear separation between areas of action. In many languages there is no clear distinction between the words safety and security. The cultural aspects of safety, security, and defense vary from country to country and from region to region. What is more, the understanding of space security has been redefined considering the new often blurred borders between safety – a clearly civilian area – and defense – a clearly military one. Security lies in between and for some countries/regions is closer to safety while for others closer to defense. This debate extends to governance questions as to who has legitimacy to act in space security and for what type of actions. Also, what would the role of the civil and defense actors respectively be and

in which area. Accordingly, the various and divergent concepts, approaches, and definitions across the chapters of this Handbook are representative of an evolving space security landscape.

The absence of an internationally agreed definition – combined with the systemic nature of the space sector with multiple strategic objectives – presents challenges when endeavoring to build cooperative approaches among diverse organizational actors. As such, this requires the development of a mechanism that fosters new forms of cooperation among states in the advent of the new space era. Therefore, stability remains of strategic importance to the space sector, as it influences the effectiveness of states to manage the growing challenges and ultimately ensure space security. Accordingly, the remainder of this chapter will address definitional aspects and the current status of space security. It will provide an overview of space security perspectives in Africa, the Asia-Pacific, Europe, the Middle East, Latin-America, North America, and Russia. Such an approach will help to identify the underlying challenges related to space security and advance the understanding of the civil-military paradigm therein. The latter is a main challenge that needs to be taken into consideration for the development of space security enhancing mechanisms.

Definition of Space Security

There is no commonly agreed definition and uniform understanding of space security. Be that as it may, there are myriad definitions adopting either a "soft" or "hard" approach. Often, the concept of "security" is used instead of the term "safety" or the term "defense," or instead of both. This creates ambiguity concerning the content of space security and the set of underlying shared values and principles. As a result, the lack of clear boundaries between these concepts poses a major definitional challenge for space security, as depicted in Fig. 1. In attempt to address this definitional challenge, this section will first take a closer look into the security concept under international relations/law perspective and, then, it will examine the evolution of the security concept in the outer space context.

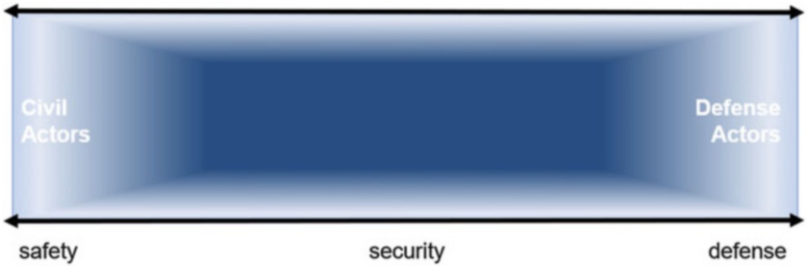

Fig. 1 Definitional challenge for space security

Security Definition

Security is derived from the Latin term *se* + *cura*, meaning free from care. Security means the quality or state of being secure, such as freedom from danger (safety) and something that secures protection. International relations scholarship has not agreed on a single definition of space security, due to its contested nature in the post-Cold War era as well as its overall subjectivity. In the words of Gallie (1956) security is often referred to as an "essentially contested concept" one for which, by definition, there can be no consensus as to its meaning (Williams 2013). According to Williams, "security is most commonly associated with the alleviation of threats to cherished values; especially those which, left unchecked, threaten the survival of a particular referent object in the near future" (Williams 2013). Maintaining international peace and security is the central mission of the UN as per Preamble of the United Nations Charter. As such, the UN has agreed to: "take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace, and to bring about by peaceful means, and in conformity with the principles of justice and international law, adjustment or settlement of international disputes or situations which might lead to a breach of the peace" (United Nations Charter, Article 1). Thus, although security is not defined under international law, it is perceived as closely influenced by the concept "peace" and "peaceful means."

The lack of clear definition has led to the interpretation of security from several perspectives, namely, individual, national, international, and global (McDonald and Brollowski 2011). Over time, security became intertwined with the concepts of territoriality and sovereignty of states, as reflected in the term "national security" and "defense." *Defense* is derived from the Latin term *defensum* meaning "thing protected or forbidden." In the broad sense it means "the act or action of defending." Defense pertains to the protection of states' territory, including its property and population, via diplomatic channels or by use of force (McDonald and Brollowski 2011). The use of force is stipulated in Article 2, paragraph 4 of the UN Charter while the right of a State to use force in self-defense is long-established in customary international law (Greenwood 2011). Provided that no definition of defense is provided, the main understanding of national security and defense in this context is interrelated with political and military security used by states (McDonald and Brollowski 2011).

Although the traditional concern has been related to security from external military threats and the use of force, the notion of security has evolved to include additional threats to a number of values: environmental security, economic security, physical security, human security, etc. (Baldwin 1997). In 1995, the United Nations Secretary-General called for a "conceptual breakthrough" of security which goes beyond the confines of "armed territorial security" to include also "the security of people in their homes, jobs and communities" (Rothschild 1995). This shifts the focus of security from states to people. This type of security stands closer to the notion of "safety" which is related to the human right perspective of security or the security of the individual as stated in Article 3 – right to life – of the UN

Universal Declaration of Human Rights. *Safety* is derived from the Latin term *salvus* meaning "uninjured, in good health." Safety means "the condition of being safe from undergoing or causing hurt, injury, or loss" and "something that secures protection." Accordingly, this notion of security – mainly associated with safety – has gained attention by international relations scholars as well as the UN, who seek to give a broader interpretation to security that includes economic, food, health, environmental, personal, community, and political security (Baldwin 1997; Osisanya 2015).

Space Security Evolution

The definition of space security is as elusive as the definition of security itself. Similarly, to the ambiguity of the security concept within the frame of international relations, there is no universally agreed definition on space security. As such space security is a multifaceted term that many have attempted to define yet no consensus has been reached. The evolution of the security concept over time combined with the evolution of outer space activities poses unique challenges to the understanding and definition of space security. What is more, a significant challenge remains the dual-use nature of space technology and applications.

The military perspective of space security, closer to the "defense" side, has to a large extent derived from the global agenda on international peace and security. The launch of Sputnik-1 in the 1960s, followed by the first manned spaceflights in the 1970s, marked a technological race between the former Soviet Union and the United States. This created the fear of an arms race in space and profoundly influenced the definition of space security. In this regard, the international community was concerned that space could be used for military purposes. Accordingly, the UN General Assembly adopted in 1958 the Resolution 1348 (XIII) "Question of the peaceful use of outer space," where it expressed the desire to "avoid the extension of rivalries into this new field." The principles set forth in this resolution combined with those of the subsequent resolutions (1961 and 1962) were ultimately embodied in the UN Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, with the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) being the most important UN body engaging in the development of international space law (United Nations 1967).

The Outer Space Treaty establishes outer space as a *global commons*, not subject to national appropriation. The States Parties to the treaty recognized that it was in the common interest of all mankind to commit to broad international cooperation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes. The 1996 UNGA Declaration on International Cooperation further elaborates on the modes of cooperation that are considered most effective and appropriate "including, inter alia, governmental and nongovernmental; commercial and non-commercial; global, multilateral, regional or bilateral and international cooperation among countries in all levels of development." In addition, the treaty makes explicit reference to the applicability of international law and the UN Charter

to outer space. Article III stipulates that: "States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, **in accordance with international law**, including the Charter of the United Nations, in the interest of **maintaining international peace and security** and promoting international co-operation and understanding" (bold by the authors). Furthermore, Article IV paragraph 1 prohibits the placement in orbit around the earth of "any objects carrying nuclear weapons or any other kinds of weapons of mass destruction," and it adds that "The moon and other celestial bodies shall be used by all States Parties to the Treaty **exclusively for peaceful purposes**. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited" (bold by the authors). Despite the premise of peaceful purposes, the explicit prohibition of the weaponization and militarization of outer space, and the application of international law, the boundaries of space security under the body of international space law remain yet dubious.

However, the distinction between civilian and military uses of outer space is not easy to draw due to the strong dual-use nature of space technology. From a technical point of view it is not easy to tell whether certain space technologies in the fields of satellite communications, positioning, navigation and timing, and space situational awareness are used for civilian applications and programs or for military and defense purposes. The dual-use factor is the main reason that the United Nations Group of Governmental Experts (GGE), aiming at exploring legal instruments that prevent the placement of weapons in outer space, failed to reach a consensus on a substantive report in October 2019. During the General Assembly's First Committee on discussing related draft resolutions one of the delegates stated that "Due to the dual-use nature of space objects, it is inherently difficult to define an outer space weapon or to know and verify intentions behind certain related activities." Another one highlighted "the current blurred distinction between civil, commercial and military activities in outer space, saying the international community must bring new ideas to discussions going forward" (United Nations 2019). This blurred dividing line between civilian and military applications is further exacerbated by the increasing commercialization of outer space and the new security paradigm of hybrid threats that are also applicable to outer space. On the one hand, the growing commercial sector enables the pursuit of military authorities to modernize space capabilities. Such a trend is reflected in a recently commissioned study to explore the possibilities and risks of employing commercial systems for the proposed US Space Force (SpaceNews 2020). On the other hand, the availability of civilian or commercial space assets to security- and defense-related missions contribute to the proliferation of hybrid threats to space. These include active operations, such as cyberattacks, jamming or spoofing, dazzling, and passive ones such as hiding or moving assets (Robinson 2018).

What is more, the increasing participation of private commercial actors in space security has raised some concerns related to the "softer" side of space security, namely space safety and sustainability of outer space activities. Space safety regards the use of space technology and applications with societal benefits, namely, water management, marine and coastal ecosystems, health care, climate change, disaster risk reduction and emergency response, energy, navigation, seismic monitoring, natural resource management, biodiversity, agriculture, and food security. Hence, space safety extends to the security of space systems in order to provide for security on Earth, as well as for space sustainability (▶ Chap. 15, "Space Safety"). In February 2018, at the 55th session of the UN COPUOS – Scientific and Technical Subcommittee, agreement was reached on nine additional guidelines on the long-term sustainability of the outer space activities, with the following definition: "The long-term sustainability of outer space activities is defined as the ability to maintain the conduct of space activities indefinitely into the future in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations" (▶ Chap. 17, "Space Sustainability").

Space Security Definition

Based on the above, the different perspectives of space security have led to myriad definitions. For instance, the Space Security Index (SSI) defines space security as "the secure and sustainable access to, and use of, space and; the freedom from space-based threats" (Sheehan 2015). Another example is that the European Union defines space security as "security from space, where Space-based assets and systems are critical to ensuring security on Earth, and security of space, where these assets need to be protected in the difficult environment of outer space." Since it will be difficult to reach consensus among states, and any definition might end up being obsolete provided the rapid transformation of outer space activities, it is imperative to narrow general applicability and tailor-made approaches. To that end, the following definition is provided in this Handbook:

> "Space security" is the aggregate of all technical, regulatory and political means that aims to achieve unhindered access and use of outer space from any interference as well as aims to use space for achieving security on Earth.

This approach helps to structure the myriads of definitions and cover the full spectrum of constitutive elements thereof. Such a definition is thus necessary to reach a common understanding and support cooperative and collective frameworks in order to tackle the inherent complexities of space security in a constantly shifting environment. A foundational challenge arising from space security initiatives at the national, regional, and intergovernmental levels is the need for collaboration and

synergies between civilian and military entities as depicted in Fig. 1. Such a challenge leads to uncertainty in governance, strategy, and policymaking aspects of space and security. In this regard, considerations need to be made for mechanisms that can effectively deal therewith and ensure stability and international cooperation for space security.

Status of Space Security

The new paradigm shift in space security has influenced the expectations of countries and regions around the world. This part will address the status of space security in order to identify strategic priorities and needs on space security.

Africa

Space activities in Africa have been increasing over the past decades, with different countries having reached different levels of investment and development. African actors include organizations that operate at the continental level, such as the African Union (AU), regional organizations, typically the Regional Economic Communities (RECs), technical organizations such as specialized agencies and institutes in different areas and the African space agencies (Giannopapa 2011).

Space security engagement in African countries is more visible on the civil side, in particular regarding the benefits that space can bring to Earth. African countries that engage on space can be split into three main categories: passive users, active users, and active developers. Passive users are African countries that do not have any space capabilities. They only receive information already processed by others. Active users are African countries that have the capacity to process the information offered. Active developers are those African countries that themselves have capacity in space activities and typically have also a space agency and more advanced space policy provisions, either contained in self-standing documents or as parts of other policies. Space security is perceived according to the user needs of the countries. Most considerations are related to the use of space security for societal purposes on Earth. Space applications can assist in providing solutions to people's basic needs such as providing food and water security, health care, education, early warning, disaster management, and emergency response. Nevertheless, the benefits of space applications are not sufficiently communicated to decision makers or the wider population, and there is not enough basic education at various levels to perform, manage, and operate space-based assets. Various space projects in different areas have been developed in Africa but very few are sustainable beyond the pilot phase. This is because often the local community of end users is not involved from the beginning and does not have a feeling of ownership. Appropriate bodies have not been identified within the government structure to take up the responsibility for running and maintaining the project. The projects developed in Africa are typically conceived by developed countries, which have not properly captured the societal

needs and infrastructure restrictions of the underdeveloped countries they purport to be helping (Giannopapa 2011).

African countries have been looking into the European model for regional cooperation on space activities with the African Union taking the lead, while countries that are active developers engaging in bilateral cooperation with global players. The 2017 African Space Strategy, which sets out the objectives for an African Space Program, is mainly focused on scientific and public good applications (African Union 2017). The strategy was adopted by the African Union heads of states and government, representing 55 member states on the African continent. According to the policy, satellites are enabling tools aimed to tackle challenges in Africa, including water resources, weather monitoring, security assistance in conflict zones, disaster aid planning, infrastructures, and food security. The focus is predominantly on space security for Earth. Food security enabled by space systems is further elaborated in ▶ Chap. 40, "Space-Enabled Systems for Food Security in Africa". The African Union has emphasized the importance of security and defense to the development of Africa (African Union 2015). As such, strategic priorities for the African Space Program focus on earth observation, satellite communication, autonomy and space science, navigation and positioning (UNOOSA 2019). Aside the civil use of space applications, the African Space Strategy outlines that earth observation data are important for military applications "where terrain profiling and mapping is critical for the deployment of ground troops, especially in hostile and remote territories" (African Union 2017). For example, at the national level, the 2018 South Africa National Space Strategy takes into consideration the dual-use of space activities and the interconnectedness of civil and military applications (Republic of South Africa 2018). However, no explicit reference is made in either document regarding the cooperation between civil and military authorities and the potential challenges of discrepancies between the regional and national levels.

Acknowledging the importance of coordinating the African space program, Egypt has been assigned to host the African Space Agency (African Union 2017). Yet, establishing the space agency has encountered many challenges due to governance issues and financial implications. In order to realize these objectives, the African Union convenes regular annual space conferences with African space actors as well as UN representatives, academia, and the private sector (African Union 2020). This inclusive approach is necessary provided the increasing number of countries that have national space programs. While South Africa has established links for space security cooperation at the bilateral and multilateral levels and is also finalizing a new space legislation (Lal et al. 2018), other countries in Africa are lagging. Accordingly, the next steps are focused on mobilizing resources across all African countries to facilitate the launching and implementation of the African Space Agency (African Union 2020). These steps are necessary in order to overcome the political fragmentation and improve the governance of the African space program. It is thus fundamental to form a coordinated regional approach for the development of space activities, which can also tackle safety and security challenges in the continent. Such approach can further facilitate the representation of Africa at the international cooperation *fora* and enhance international cooperation.

Asia-Pacific

Independent space powers coexist in Asia, namely Japan, China, India, South Korea, Pakistan, and Australia. Asia is the world's second-largest defense spender while it is becoming increasingly active in space. The geopolitical and military competition in Asia has an impact on the space efforts of these countries (▶ Chap. 27, "Space Security in the Asia-Pacific"). There are three key drivers to space in Asia: increasing use of space for military purposes; civilian use that could also lead to conflict because of congestion and competition; and investments in military technologies such as those for anti-satellite (ASAT) tests and missile defense. The growing space competition is demonstrated by the rapidly growing development of counterspace capabilities, such as kinetic ASAT missiles, electronic and cyber warfare capabilities, and new efforts at creating specialized military agencies devoted to space utilization. The Asia-Pacific Space Cooperation Organization (APSCO) is an intergovernmental space cooperation organization headquartered in Beijing, China, and its members include China, Bangladesh, Iran, Mongolia, Pakistan, Peru, Thailand, and Turkey. It was founded in 2005. Both Japan and China have been trying to set up regional cooperation under their respective leadership, resulting in two different formats for governance. While Japan established an Asia-Pacific Regional Space Agency Forum (APRSAF) in 1993, China founded the APSCO in 2008. Membership is somewhat overlapping, with institutions from 40 states (including non-Asian) participating in APRSAF, and 8 formal member-states in APSCO. This indicates the basic difference between the two: APRSAF is a coordination mechanism of institutions (space agencies, research establishments, space applications users, etc.), while APSCO is an intergovernmental organization.

China, over the past decades, has been rising as one of the major space powers worldwide toward establishing dominance. In a stepwise approach, it has set out its ambitions and a long-term strategic and programmatic development. Among other achievements, the landing of an unmanned mission on the near side of the Moon using its Chang'e 3 in December 2013 and the Chang'e 4 landing on the far side of the lunar surface in January 2019 have marked China's presence as an international space power. The engagement has been increasing on the civil side using space to provide space security on Earth, while information and communication technologies have gained impetus in overall national power and especially military capability (▶ Chap. 29, "Chinese Concepts of Space Security: Under the New Circumstances"). Many of China's satellites are dual-use, supporting urban planners and agricultural programs as well as the military. China's military-dominated and government-monopolized characteristics of space affairs aim to internationalize and commercialize the space industry (Nie 2020). Under the Belt and Road Initiative – expanding from China and Asia to Europe and Africa – China has been actively engaging in the Space Information Corridor project. The latter "takes communication, remote sensing, navigation satellites as the main body, with space-based information resources and ground information sharing network and aims at realizing co-construction and sharing of space information in the region" (Jiang 2019). Simultaneously, the emerging rise and engagement of China in the commercial

market will increase competition among other Asian states as well as with other countries. On the defense side, the relationship of space and national security has been evolving as part of a broader ongoing assessment of the role of information in future warfare (▶ Chap. 29, "Chinese Concepts of Space Security: Under the New Circumstances"). In 2015, China established the People's Liberation Army's (PLA) Strategic Support Force which saw the integration of the PLA space, cyber, and electronic warfare capabilities, which is considered a significant achievement considering the future of warfare that would see the interface between all these different capabilities. Due to the PLA's attention to information and communications technologies, the centrality of space dominance has grown as well. As with other Chinese military activities, the PLA's approach to space operates within the context of guiding thoughts. The guiding thoughts for space are "active defense, all-aspects unified, key point is establishing space dominance" (▶ Chap. 29, "Chinese Concepts of Space Security: Under the New Circumstances").

Japan's space policy has been influenced significantly by its overall foreign and security policy. At the start of its space activities, Japan was reluctant to engage in security-related uses of space, largely due to its pacifist constitution, which is interpreted to prohibit using space for security purposes. The Basic Space Law 2008 urged the government to use space systems "to ensure international peace and security and also to contribute to the nation's security" (▶ Chap. 30, "Historical Evolution of Japanese Space Security Policy"). This has been evolving over the past few years. The country updated in 2013 its Basic Space Plan. The latter aimed at creating new opportunities for the involvement of Japan in international efforts to address the most pressing space security-related challenges of the twenty-first century. As such, this update and its subsequent revision in 2015 marked the reorientation of Japan's space program toward tackling the changes in its surrounding security environment. The latest document reflects the new national security policy 2014 (military use of space) and establishes long-term and concrete public investment plan for the upcoming 10 years (Komiya 2016). In particular, the latest version of the Basic Space Plan aims at responding to the growing threat of ASAT weapons and the increasing quantity of space debris by putting emphasis on space security, through strengthening security capabilities and the Japan-US alliance and ensuring the stable utilization of outer space. The two key projects envisaged in the new plan are the development of a Space Situational Awareness (SSA) system with ground and space segments, and the establishment of self-defense forces. In addition, Japan is preparing a new series of Earth observation satellites to tackle natural disasters and limited natural resources. Accordingly, a new space security budget is developed with contributions of Japan Aerospace Exploration Agency (JAXA) and the Ministry of Defence (Euroconsult 2019). Therefore, the revised Basic Plan represents a completely new direction of Japanese space policy with increasing role for the military. On April 19, 2019, the United States and Japan reiterated their commitment to military space activities and highlighted that space, cyberspace, and the electromagnetic spectrum are priority areas to better prepare for cross-domain operations (Spacewatch.global 2019).

India over the past year has also been rising to a world space power. It has acquired multifaceted space capabilities with dual-use applications – both civilian and military – and focuses on achieving autonomy in space including launchers, satellite communications, Earth observation, and navigation. Overall, India has followed the policy of the use of space for socioeconomic development. Over the years, the Indian Space Research Organisation (ISRO)'s program has matured significantly, and, at present, Indian space program is regarded as one of the important space programs in the world. From launching small satellites to undertaking successful missions to the Moon and Mars, India has excelled in almost all areas of space experimentations (▶ Chap. 31, "India in Space: A Strategic Overview"). Additionally, India has made significant investments toward establishing its military architecture owing to its strategic needs. Space technologies have become central to strengthening this architecture, essentially as a force multiplier. The March 2019 ASAT test clearly communicated India's intention and capability to use space for military purposes. Soon after the test, India has announced plans to establish a Defence Space Agency along with a Defence Cyber Agency marking a shift in the evolution of the Indian space strategy (Euroconsult 2019). The launch program remains one of India's main objectives to ensure independent access to space. Starting with the development of the Satellite Launch Vehicle (SLV-3) during the 1970s, it has progressed through the Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV), and Geosynchronous Satellite Launch Vehicle (GSLV). Recently, the development of the next-generation launch vehicle, the Geosynchronous Satellite Launch Vehicle Mark III (GSLV MkIII), has been completed and has become operational. India's next milestone mission of Human Spaceflight has been initiated, and the first crewed flight is expected by 2022 (▶ Chap. 70, "Indian Space Program: Evolution, Dimensions, and Initiatives").

The space sector in *Australia* is experiencing an unprecedented level of public interest and government support. National security considerations and the economic benefits of a fast-growing world market for space products and services are inextricably linked as drivers for a range of government and industry initiatives (▶ Chap. 71, "Australia's Space Security Program"). The Government's clear intention is to enhance Australian Defence sovereign space capabilities progressively through dedicated Intelligence, Surveillance, Reconnaissance (ISR); space and cyber programs; SSA systems; and military satellite capability (Euroconsult 2019). In May 2016 the Australian Department of Defence announced that it is preparing a roadmap for a $2.3 billion next-generation satellite communications investment on mixing commercial and military capability. Australia is now treating space as an integral component of its role in the protection of its national security interests and in the advancement of its international responsibilities. In September 2017, the Australian Space Agency was established to take over the operational and regulatory activities. Regarding the development of space policy, the 2017 Space Industry Association of Australia (SIAA) White Paper suggests that ensuring long-term access to space, for strategic purposes requires both civil and military capabilities. Along the same line, the Australian Civil Space Strategy 2019–2028 focuses on seven national priorities: position, navigation, and timing; earth observation; communication technologies,

and services; "leapfrog" research and development; space situational awareness; robotics and automation; and access to space (▶ Chap. 71, "Australia's Space Security Program").

South Korea is implementing a pro-active space program in order to create autonomous operational capabilities in areas such as Earth Observation, as well as to develop domestic industrial capabilities for satellites and launch vehicles, and to build the associated infrastructure. Space development in South Korea is driven by the National Space Development Promotion Basic Plan, with the third pillar including exploration and navigation as two key elements for 2018–2022. South Korea has historically focused on satellite development, while more recently expanding into space launch vehicles. Furthermore, South Korea is trying to meet national user needs, to serve external needs commercially, and to increase its participation in international programs. The next challenge for the country is to complete the development of the launcher KSLV-2 (Euroconsult 2019).

Pakistan, despite political, technological, and economic constraints, is considered an aspiring space power, although with a relatively modest space program compared to the larger, more successful ones of China and India. The country aims to utilize available resources to improve its nascent space infrastructure through collaborative efforts to gain eventual self-sufficiency for socioeconomic and strategic purposes in the South Asian region (▶ Chap. 72, "Pakistan's Space Activities"). The Space Development Program 2040 approved by the National Command Authority aims to ensure space-based benefits for the country and focuses mainly on telecommunications and Earth observation. In addition, Pakistan has close ties to China via the China-Pakistan Economic Corridor (CPEC). It considers a manned space mission in 2022. Yet, SUPARCO's (Space and Upper Atmosphere Research Commission) lack of funding impedes technological advancement and innovation (Euroconsult 2019).

Europe

In Europe, the space sector is a particularly interesting and dynamic field, mainly because Europe includes several space faring nations with varying capabilities and priorities. Due to the inherent dual-use nature of space activities, responsibility for space has traditionally resorted under a State's sovereign competences. Traditionally, security- or defense-related space programs have been established and maintained at the national level or dealt with bilaterally or multilaterally in *ad hoc* cooperative programs. Only civilian space activities, including Earth observation, telecommunications, human spaceflight, space transportation science, and technology development, were the subject of cooperation at the regional and intergovernmental levels. However, the past years/decade the security dimension of space activities has increasingly been coming to the attention of European countries, as well as the European Union (EU) and the European Space Agency (ESA). "Space and security," both in its security from space and security in space aspects, is progressively contributing to the further integration of space activities in sectorial policies (Giannopapa et al. 2018). Today, space security constitutes the second pillar of

activities of the ESA as agreed by the Ministers of ESA's Member States in November 2019. Additionally, the European Commission in its new organizational structure creates a dedicated Directorate General Defense Industry and Space, with the new president Ursula von der Leyen viewing it as one of the EU's priorities to reinforce the European defense capacities. This directorate aims to exploit the growing possibilities that space offers for the security of European citizens, including the capitalization of synergies between the civil and defense sectors.

Over the past several years, the EU has formulated a space security strategy, including in the 2018 Proposal for a Regulation for a Space Programme for the EU which is based on the 2016 Space Strategy for Europe. One of the main goals of the 2016 Space Strategy for Europe is to "Reinforce Europe's autonomy in accessing and using space in a secure and safe environment." The Regulation for a Space Programme proposes the development of Governmental Satellite Communications (GOVSATCOM) and SSA programs to accompany the satellite navigation program Galileo and the earth observation program Copernicus. The European family of launchers includes the Ariane 5, Vega, and Soyuz that secure Europe's independent access to space and are launched from the Guiana Space Centre. At the same time, ESA has more explicitly formulated its space security policy, as reflected in the "Elements of ESA's Policy on Space and Security" and the safety and security program adopted at the Ministerial Council in 2019. During the Ministerial Council 2019, ESA adopted a safety and security program and also secured the transition to the next generation of launchers: Ariane 6 and Vega-C, as well as the Space Rider, ESA's new reusable spaceship. European institutional programs are intertwined with the national and multilateral programs of the European countries based on their national budgets and contributions to organizations such as and the EU. In addition to ESA and the EU policy and programmatic developments, in 2019 NATO Defence Ministers approved its first ever space policy.

The different space security policies of the various European countries are to a large extent determined by national needs and priorities as brought forward through their participation in relevant space and security organizations, including ESA, EU, the European Defence Agency (EDA), and the North Atlantic Treaty Organization (NATO). The largest groups of European countries are currently members to all four organizations (ESA, EU, EDA, and NATO): Belgium, Czech Republic, France, Germany, Greece, Estonia, Hungary, Luxembourg, The Netherlands, Poland, Portugal, Romania, Spain, and the United Kingdom (due to Brexit the UK is no longer an EU Member State). A few countries belong to ESA, EU, and EDA, but they do not belong to NATO: Austria, Finland, Ireland, and Sweden. Norway is part of NATO and ESA. Even though Norway is not an EU Member State, it still participates in EU space programs and to EDA programs. Denmark is a NATO, EU, and ESA Member State but is not an EDA Member State. It also opted out of the EU Common Security and Defence Policy (CSDP). Slovenia is an EU and EDA Member State, and an ESA Associate Member State. Switzerland is an ESA Member State. Overall, the current priorities and trends in space and security are reflected on the space and security elements stipulated in national strategic documents. Depending on each European state, either a dedicated space security strategy is in place or space and security

aspects are included in strategy documents covering other policy areas. For example, space and security aspects can be found in maritime strategies and arctic strategies that also stress the importance of space-based assets and applications in these domains. The space activities and programs of European countries are centered on the fields of Earth observation, satellite communication, Global Navigation Satellite System (GNSS), SSA, space transportation, satellite operations, and detection, tracking, and warning. The institutional space and security policy developments in Europe have been developing in parallel with the policies of the European countries. All in all, European space and security governance is multifaceted, thereby posing a major challenge to effective cooperation among the EU, ESA, and the European States (▶ Chap. 23, "Strategic Overview of European Space and Security Governance").

The Middle East

The United Arab Emirates (UAE), Saudi Arabia, and Iran have emerged as regional leaders in the Middle East (Euroconsult 2019). In the recent years, Middle Eastern countries have come together to collaborate on satellite programs. Namely, in March 2019 the UAE Space Agency launched the Arab Space Coordination Group to build the first pan-Arab Earth Observation satellite via cooperation among its 11 member nations: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Saudi Arabia, Sudan, and the UAE (National Defense 2020).

The UAE, a federation of six emirates with the world's sixth largest oil reserves and the Middle East's primary trading center, had essentially no involvement in space activities – other than shareholdings in communication satellites – until 2006, when the government of Dubai established the Emirates Institution for Advanced Science and Technology (EIAST). The latter was incorporated into Mohamed Bin Rashid Space Center (MBRSC) in 2015 which focuses on space research, satellite manufacturing, systems development, and Earth observation (Euroconsult 2019). In 2014, the UAE Space Agency was established with the mandate of overseeing and promoting the country's space sector and activities. With this mandate the agency is responsible for the development of the so-called National Space Framework consisting of four main components, namely, Space Policy, Space Strategy, Space Law, and Space Regulations (▶ Chap. 34, "UAE Approach to Space and Security"). The UAE Space Agency actively cooperates with several international and regional space agencies such as those in the United States, France, China, India, Japan, South Korea, Italy, Germany, Kazakhstan, Bahrain, among others. The UAE is in the process of establishing its regulatory framework for space activities. In December 2019, the National Space law was approved and came into effect, hence setting the regulatory basis for space activities by covering the organization and objectives of space projects undertaken by the country, including peaceful space exploration and the safe use of space technologies. In the field of satellite communications, Al Yah Satellite aims to provide commercial, governmental, and military services, while at the same time focusing

on further growth, empowerment of human capital, and quality enhancement (► Chap. 34, "UAE Approach to Space and Security").

Israel's space industry aims at achieving independence and national defense goals. The launch program – Shavit rocket – plays an important role in Israel's vision, making it one of the few nations with the ability to launch unmanned missions to space. The Shavit launch vehicle, operated by the Israel Defense Forces, was developed to enable Israel to launch its military reconnaissance satellites, the Ofeq series (Euroconsult 2019). In the past 30 years, Israel developed an indigenous space capability to develop, launch, operate, and maintain satellites in two main niche areas: Earth observation and communications, including the ground segment of communications satellites. Israel's focus continues to rely on a broad space infrastructure for defense and civilian applications under the auspices of the Ministry of Defence and the Israel Space Agency. The space agency aims at implementing a new space program, geared toward research and development while supporting multiple private and academic initiatives. In addition, the agency has forged bilateral cooperation with the United States and European countries (Euroconsult 2019). While security in the region has been Israel's key concern throughout its history, unsurprisingly security has also been the key driver of the country's space activities. It has, however, also resulted in the growth of the commercial space sector. Israel has expanded, in recent years, its cooperation with international partners, as well as established a civilian space policy backed by modest government funding. Within the context of protecting and encouraging this nationally important ecosystem, Israel considers international space security, safety, and sustainability to be of importance (► Chap. 32, "Israel's Approach Towards Space Security and Sustainability").

Iran is a member of the Asia-Pacific Space Cooperation Organization (APSCO) since 2004 (Spacewatch.global 2016). Iran planned to build and launch satellites in 1996, but made little headway until 2004, when a broad review of plans and policies led to the creation of the Iranian Space Agency (ISA) and the allocation of a sizable budget under the sixth Five-Year Development Plan. ISA, which falls under the Ministry of Information and Communications Technology, along with the Ministry of Defence has cooperation agreements in place with Russia, Bolivia, Azerbaijan, and Kazakhstan. The Iranian space program is sustained by substantial research and development capabilities in its universities and defense industry, robust funding, and high-level political support. As such, the space program aims to fulfill both civilian and military objectives (Euroconsult 2019). The "Comprehensive Document of Aerospace Development," which was adopted in 2012 and emphasizes the capabilities of Iran for space activities extending to both civilian and military entities. In February 2007, Iran tested a Sounding Rocket Vehicle (SRV) for research purposes which was followed by SRV 1. SRV 2, which was successfully launched into space, provided the opportunity for Safir SLV to launch the first national satellite, Omid (► Chap. 33, "Policies and Programs of Iran's Space Activities"). Iran's space program up to that point had been based on ground stations that relayed Intelsat communications and received Landsat data. In recent years, Iran has made steps in space science, space technologies, and space applications for civilian purposes mainly through communication satellites (Tarikhi 2015).

Latin America

Currently, at the forefront of Latin America's space ambitions are two of Latin America's largest and most technologically advanced countries, Argentina and Brazil (Harding 2015). The Argentine National Space Activities Commission (CONAE) is responsible for Argentina's national civilian space activities, which are free from military control and entirely promote the peaceful uses of outer space. Its program is focused on Earth observation (Euroconsult 2019). In Chile and Peru, the current Earth observation satellite systems provide imagery for both military and civilian applications including disaster management (Euroconsult 2019). The Union of South American Nations (UNASUR) is an intergovernmental union established in 2008 (came into effect in 2011) to encompass all South American Countries. UNASUR previously discussed establishing a South American Space Agency; however, this has not yet been created (Sarli et al. 2018). In addition, the Space Conference of the Americas (CEA) is a continental forum of regional and international cooperation, created in the early 1990s by the United Nations General Assembly to achieve a convergence of positions on issues of common interest related to the peaceful use of outer space by its Member States. The objective is to agree on strategies to promote the practical use of space applications to support programs with a high degree of social content for the region, to encourage progress in and development of space law, and to strengthen educational programs and training in space science and technology (UNSPIDER 2010). Notwithstanding the value of these organizations, there is still no regional understanding or approach about space and security.

Despite the status to the economy in the region, *Brazil* has managed to sustain growth since the end of 2017 with an industrial production growing slowly. The Brazilian Space Agency (AEB), created in 1999, is responsible for the coordination of Brazilian space activities, with significant effort undertaken in Earth Observation and launcher development. AEB oversees implementing and coordinating Brazil's space policy in cooperation with the Ministry of Science, Technology, Innovations and Communication and the Ministry of Defense (Euroconsult 2019). National launching facilities were developed in Brazilian territory, including the Alcantara Launching Center (*Centro de Lançamento de Alcântara*), designed in 1983. Due to its geographic position, launchings benefit from the Earth's rotation in order to achieve greater speed, allowing fuel economy and increased payload capacity. Brazil's space-related objectives are described in the *Programa Nacional de Atividades Espaciais (PNAE) Planejamento* 2012–2020. The final segment of the Brazilian space program revolves around the development of a national launching vehicle, thus securing independent access to outer space. Named VLS (for Satellites Launching Vehicle, "*Veículo Lançador de Satélites"* in Portuguese), the program has faced budgetary and technical burdens since its conception operations (▶ Chap. 35, "Space Security in Brazil"). In 2012–2014, Brazil set out to indigenously develop a geostationary communications satellite, continued to support the joint China-Brazil Earth Resources Satellite (CBERS) program, developed two indigenous Brazilian space launch vehicles, supported its joint Brazil-Ukraine

Cyclone launch vehicle program referenced above, and established a science and technology research satellite program. Recently, the Brazilian Ministry of Defense signed, in December 12, 2018, a Space Situational Awareness agreement with US Department of Defense, as part of a larger effort to increase safety of space operations (▶ Chap. 35, "Space Security in Brazil").

North America

The *United States* remains the world's leading space program, both when it comes to civil and defense space components. The space program has been further expanded by the Trump administration, for example through civil and defense budget increases, through policy and legislative initiatives, and through a proposed Space Force. In the United States, space policy has remained relatively consistent over the last 60 years with a focus on international cooperation, peaceful uses, and development of outer space for the common good. Throughout this time, the right of self-defense in space has been linked to military activity. Yet, the 2017 National Security Strategy made a notable shift regarding the security aspects, while at the same time the National Space Council was revived (▶ Chap. 20, "War, Policy, and Spacepower: US Space Security Priorities"). Accordingly, US Space Policy Directives 1 and 2 aim at fostering commercial activities through an appropriate regulatory framework, while Space Policy Directives 3 and 4 address the creation of space traffic management and the establishment of a space force respectively. The Space Policy Directive 1 calls for the United States "to lead an innovative and sustainable program of exploration with commercial and international partners," while the Space Policy Directive 2 calls for the streamlining of regulations on commercial use of space. The Space Policy Directive 3 on Space Traffic Management (STM) aims for US leadership in space by stipulating the need to "set priorities for space situational awareness (SSA) and STM innovation in science and technology (S&T), incorporate national security considerations, encourage growth of the U.S. commercial space sector, establish an updated STM architecture, and promote space safety standards and best practices across the international community." The Space Policy Directive 4 establishes the US Space Force as a sixth military branch of the United States Armed Forces within the Department of the Air Force.

Under the Space Policy Directive 3 responsibility for providing SSA data for civil use is assigned to the Department of Commerce (DoC), while the Department of Defense (DoD) will focus on maintaining access to and freedom of action in space. In particular, the Department of Commerce becomes the agency responsible for SSA data sharing and timely warning of collision avoidance, including conjunction assessments and maneuver plans, available to the public through the publicly available portion of DoD authoritative catalogue. The availability of the data is and will remain to be free of direct user fees. The Department of Defense, therefore, shifts the civilian part of its responsibilities to DoC and will oversee the military part of authoritative catalogue of space objects (U.S.FR 2018). Shall the Space Policy Directive 3 proposal be approved it does raise the following fundamental question:

first, how distinctive can the military SSA activities be from the civilian SSA activities and, second, will it be possible for them to integrate under one comprehensive regime? This has implications not only for the governance of the safety of operations and national security but also for the exchanges and coordination with other national and international organizations (Hitchens 2019). Managing STM ultimately boils down to balancing between to seemingly contradictory objectives; one being the safety and sustainability of outer space activities, and the other one being the national security concerns of the government as further depicted in the proposal for the creation of a space force.

Regarding space programs, the US military and intelligence organizations' programs combined constitute by far the world's largest space program. The services provided by these programs include telecommunications, surveillance, missile early warning, meteorology, positioning/timing, radio interception, nuclear detonation detection, and data relay. Space systems provide both tactical and strategic services to the US military and intelligence agencies and in some cases to those of its allies. Strategic functions include monitoring international security treaties, analyzing the security forces of current and potential adversaries, and providing information to the President and the Secretary of State. Tactical functions include supporting US military and intelligence forces around the world. Overall, the US military space program continues to dwarf (a) the military space programs of all other countries combined and (b) of US civilian agencies such as NASA. The USA is unique in deploying military satellites of all types and on a global basis, and there is little sign that this will change in the next decade (▶ Chap. 59, "Satellite Programs in the USA").

The *Canadian* new Space Strategy 2019 issued by the Ministry of Innovation, Science and Economic Development Canada recognizes the importance of space as "a strategic national asset which underpins everything from national security to the ability to connect Canadians living in rural and remote communities." Since 2016, the Ministry has committed to new investments worth over $2.6 billion. Space systems are also considered vital to the Canadian Armed Forces, which rely on them to effectively conduct operations for the defense of Canada and North America and to contribute to global peace, safety, and security. One of the most important objectives of the strategy is Canada's future mission to the Moon by joining the US-led Lunar Gateway mission (Government of Canada 2019). The Canadian Space Agency (CSA) focuses on accelerating space business and modernizing investments through the Space Technology Development Program. The CSA also participates to the European Space Agency ARTES program. Concerning satellite communications, the Department of National Defense (DND) has ties with the United States in the context of the Wideband Global Satellite (WGS) System and the US Advanced Extremely High Frequency program with protected military satellite communications. The DND has also contributed to the Maritime Monitoring and Messaging Microsatellite in the field of automatic identification system (Euroconsult 2019). The DND and the Canadian Armed Forces are seeking to develop a common operating picture of space assets, based on the program Innovation for Defence Excellence and Security (IDEaS). As such, new space-based technologies will enable them to

maintain space situational awareness for informed, expedited decision making in support of space system operations (Government of Canada 2019).

Russia

Outer space has become an important area for Russia which aims to rebuild its global status and prestige as a space power by intensifying the links between space and defense. Russia considers outer space predominantly as a strategic region to enhance its military capabilities on Earth, provide intelligence and communication functions, and achieve international esteem. Russia is reactive to US strategy and counterspace technologies The latter, including electronic weapons that can jam satellites, have been developing to provide Russia with an asymmetrical edge to offset US military advantages. Hence, military efforts are but one part of a complex set of tools, employed to navigate what Russia perceives as an increasingly hostile world. Already in 2011, Russia brought about certain institutional modernizations creating the Russian Aerospace Defence Forces which are meant for space security-related activities (▶ Chap. 21, "Russia's Space Security Policy"). The Federal Space Program 2016–2025 places emphasis on telecommunication satellites and the need for space technology to generate direct socioeconomic benefits. In March 2018, the Russian Defense Minister Sergey Shoigu stated that Russia must deploy a modern fleet of military satellites to support its army and navy. To quote him: "only with support from space will it be possible for the Armed Forces to reach maximum effectiveness" (DIA 2019). However, Russia's economic, military, and technological weaknesses compared to the United States and NATO have led Russia to pursue asymmetrical tactics which include working through bilateral bodies and those affiliated through the UN on space policy (▶ Chap. 21, "Russia's Space Security Policy").

Russia can be considered today as having the most complete launch program in the world. Russia currently operates four types of launch vehicles, the Rockot, Soyuz, Zenit, and Proton. The "Russian Space Launch Program" chapter explains how Russia has been successfully engaged in space activities for more than 60 years, having entered the space age as part of the Soviet Union and striding on as a separate state. On the one hand, after the dissolution of the USSR, Russia inherited the large scientific and technical potential and technological developments of one of the two most powerful space nations of that time. But on the other hand, Russia was deprived of a large part of technologies and infrastructure put in place earlier. The launch vehicles that used to be Soviet became foreign, and the key launch site turned out to be located outside Russia's national territory. Also, it proved to be difficult for Russia to use remnants of its own technologies. For Russia, space is thus not only a question of national defense and security or its position in the market of commercial launch services but also, and more importantly, a question of the status of Russia as a highly

developed nation in terms of science and technology (▶ Chap. 60, "Russian Space Launch Program").

Key Priorities

The priorities and trends in space security as seen in the countries and regions presented above can be grouped in Fig. 2 below. The identified space, security, and defense priorities areas are related to "Security from Space" and "Security in Space." The "Security from Space" priorities constitute: (1) disaster management, (2) resource management, (3) transport and communications, (4) environment, climate change, and sustainable development, (5) external security including foreign policy and border surveillance, (6) internal security including support to justice and home affairs, (7) military, and (8) financial. The "Security in Space" priorities constitute: (1) defensive space security and control, (2) offensive space security and control, (3) space surveillance and tracking, (4) space weather, (5) near earth objects, (6) orbital debris mitigation, (7) space traffic management, (8) active debris removal, and (9) access to space. These trends demonstrate an evolution of European countries priorities from strictly civil-oriented applications to also encompassing security and defense ones. The grouping of priorities allows for a clear overview of the status of space security. However, the lack of explicit boundaries between "safety," "security," and "defense" makes it rather difficult to clearly distinguish among the different positions of countries and regions. In some countries it seems that space security is closer to the safety side (i.e., Africa, UAE), while in others it is closer to the defense side (i.e., the United States, Russia). Several countries in the regions presented have demonstrated a clear shift of their space policy and programs

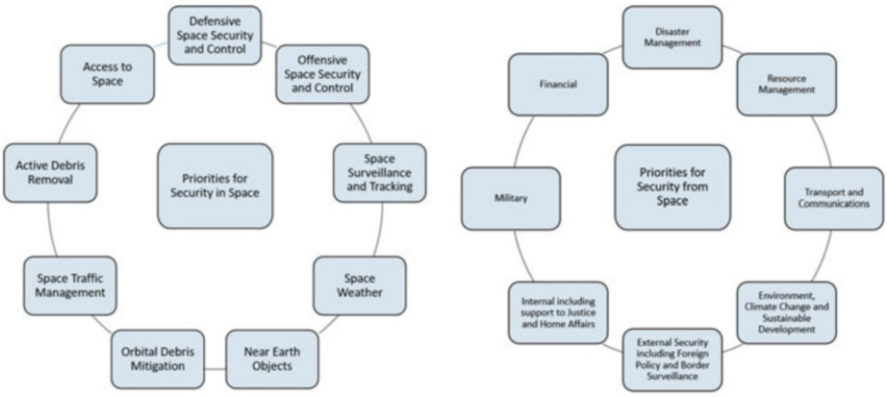

Fig. 2 Priorities for space security in space and from space across countries/regions

from safety to defense, notably Japan. In some cases, it is even more ambiguous to identify an approach due to the absence of a regional understanding such as in Africa and Latin America.

Concluding Remarks: The Way Forward for Space Security

The significance of outer space as a strategic focal area with geopolitical consequences is widely recognized. Outer space, which was perceived during the Cold War as another theatre of operations for the United States and the former Soviet Union, has now become a common strategic medium for governmental and non-governmental activities around the world. Accordingly, the concept of space security has been changing over time. Traditional defense strategic concepts remain relevant in the face of hybrid threats, counterspace, and proposed Space Forces rendering thereby space as a warfare domain. Even though space security used to consist of exclusively military and defense elements in states' relations, it has evolved to encompass increasing activities of private and commercial actors and their implications for safety and sustainability. In this regard, space security cooperation ensuring the peaceful uses of outer space is absolutely necessary.

The wide range of space security perceptions has been further intensified by the technological and organizational transformation of the outer space environment. The increasing technological advances; the growing interdependencies between governmental, civilian, and commercial actors; and the emergence of the civil-military paradigm have created diversified interests across countries and regions in the world. In this context, multifaceted and interactive space security perspectives with ranging safety, security, and defense elements present a rising concern for cooperation mechanisms in place. Hence, the debated and different understanding of the concept of security is reflected in the various policies and programs across the world, emphasizing the civil-military nexus and the associated challenges. Definitions and concepts of what is encompassed by the term "space security" are diverse, imprecise, and evolving along the strategic priorities and needs of countries and regions. This presents problems when endeavoring to build cooperative approaches among diverse actors. The definition provided in this Handbook allows to structure the uncertainty created by the multitude of definitions, while allowing to reach a common understanding fostering cooperative and collective frameworks in space security. This definition allows to approach space security in its full spectrum capturing all elements of space security instead of differentiating among the various conditions. Hence, the definition manages to resolve the civil-military challenge by incorporating it in a flexible manner instead of turning it into a fixed and obsolete concept. In line with the principles of international cooperation and peaceful uses of outer space, this definition ultimately enables common understanding which is a starting point aiming to ensure strategic stability at the international level.

Based on this definition, the way forward for space security calls for its operationalization through the development of stability-enhancing mechanisms that tackle

the challenges of the evolving security notion. Such mechanisms should be underpinned by mutually understood concepts that are translated in a comprehensive regulatory solution at the international level. In this direction, recent developments at the UNISPACE+50 process, prepared by the United Nations Office of Outer Space Affairs in 2018, have considered the development of international legal mechanisms that cope with the broader concept of space security – safety, security, and sustainability. In this regard, Space Traffic Management (STM) is considered as a solution that can ensure space security in the broad sense by resolving practical concerns of the international community, such as in-orbit collisions and interferences. The definition of the STM in the 2006 International Academy of Astronautics Cosmic Study as "the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and, return from outer space to Earth free from physical and radio-frequency interference" complements the operational side of the space security definition in this chapter. Hence, STM can serve as the basis of ensuring space security while safeguarding the principles of international cooperation and peaceful uses of outer space.

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