# NATIONAL AEROESPACE SECURITY STRATEGY

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This National Aerospace Security Strategy has been approved by Spain's National Security Council.

The following were involved in the drafting process: Ministry of the Presidency of the Government, Relations with Parliament, and Equality; Ministry of Foreign Affairs, the European Union and Cooperation; Ministry of Justice; Ministry of Defence; Ministry of the Treasury; Ministry of the Interior; Ministry of Infrastructure; Ministry of Industry, Trade and Tourism; Ministry of Economy and Business; Ministry of Science, Innovation and Universities; National Intelligence Centre; Department of National Security.


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*"For my part I know nothing with any certainty, but the sight of the stars makes me dream," said Vincent Van Gogh, one of the artists who have most audaciously captured the mystery of the heavens.*

*The world has always looked to the stars, but in recent decades this gaze is no longer just wistful; it has become scientific, positivist, and strategic. The stars already form part of our everyday human reality. They are part of what we are actually able to touch.*

*Van Gogh could not have imagined that in 1957 an artificial satellite would orbit the Earth, or that in 1961 a human being would travel around the world in a spaceship, much less that in 1969, another human being would set foot on the Moon. And not even Jules Verne—who predicted almost everything else—could have imagined that in 1973, a space probe would reach Jupiter, or that in 1990, a space-based telescope would truly reveal to us, without any doubt, how small we are in an infinite universe.*

*Humans' spectacular approximation to the stars—to space—has never stopped, and is not going to stop now. On the contrary: our speed is supersonic. Now we measure distances on our planet in time, in hours. Now we understand trade as Marco Polo never could. Now, thanks to satellites, we know nearly all the secrets of our Earth (and its many faces). And now we look forward to a near future akin to the very best science fiction stories, with crewed spaceships and a humanity linked to the stars.*

*It is possible—although I do not believe it—that we could cease to be inspired by the stars in the way that Van Gogh was, but the extraordinary advantages that outer space has to offer must now form part of our daily lives. A part of how we engage with reality.*

*These advantages, obviously, are not free from vulnerabilities. We already know that whatever opens up many pathways, also unleashes many risks. To evoke galactic imagery from popular culture, we could say that there is a light side and a dark side.*

*For Spain—a peaceful, open country interconnected with the entire world—preserving and promoting the positive use of aerospace is, above all, a moral obligation, but it also represents a guarantee of progress. This is why our National Aerospace Security Strategy is a major milestone. This is why we believe that it is not just another strategic issue, but one of the key pillars upholding our responsibilities in the world. The right security strategy makes us a better country, and a stronger country.*

*This National Strategy was conceived to address these pernicious vulnerabilities, and make Spain more secure. At the end, our main concern is always our society. Our people. Their security, their privacy, their ability to live their lives without unwanted interference.*

*Aerospace is, undoubtedly, a crucial element of national cohesion, and an essential pillar of Spain's industry and its economy as a whole. Like all advanced societies, Spain is highly dependent on everything encompassed by the aerospace sector—not only aircraft, rockets, and satellites—but also mobile phones, airport controls, and artificial intelligence.*

*This dependency compels us to be prudent. To prevent and counter any threat or challenge that could cause disruption or danger. To prevent any attempt to use technology to warp not only the freedom of our citizens, but the very essence of democracy.*

*The high level of technification and interconnectivity in aerospace makes everything move very fast. Complications must be prevented, rather than managed—we cannot allow haste to lead us into difficulties. This is why it has been essential to design a strategy in which the decision-making structures work around the clock, and are able to respond in almost real time. A strategy supported by command and control systems that are reliable, available, and coordinated both nationally and internationally.*

*Based on research and analysis of the current situation, the National Aerospace Security Strategy is a reliable compass by which to determine the course of our national capabilities, coordinate the different public and civilian organizations, establish the critical infrastructure that must be protected, and define the national and international agreements that must be reached. It is also a reliable compass by which to set forth the legal provisions that must be implemented, guide consolidation of our industrial base in this area, and promote greater awareness of an aerospace security culture.*

*Ultimately, this National Strategy is the result of an open institutional collaboration, with consensus on every level, which has also been open to contribution from the private sector—as to be expected in the 21st century. Implementing these measures will be difficult, but with the hard work, commitment, and loyalty of everyone involved, it will be of capital importance for the future of Spain.*

*Theodore Roosevelt said almost the same thing as Van Gogh did, only the other way around, because one was a politician and the other an artist: "Keep your eyes on the stars, and your feet on the ground." This is what Spain's National Aerospace Security Strategy does: safeguard our dreams, while keeping us firmly grounded.*

Pedro Sánchez

President of the Government of Spain

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# Executive Summary

# Executive Summary

The National Aerospace Security Strategy implements the provisions of Spain's 2017 National Security Strategy for airspace and outer space security, considering its general objectives, objectives specific to this area, and the lines of action established to achieve them.

The document is structured into four chapters. The first, "A Comprehensive Vision for Aerospace Security", describes general aspects of the air and space sectors and their regulatory framework, justifying the existence of a single aerospace security strategy to protect Spain's main national interests in this area.

Aerospace products, services, and applications are so important to modern Spanish society that we can barely imagine how it could function without them. In parallel, the widespread use of technology and Spain's very high level of connectivity make us especially vulnerable to threats and challenges, and mean that any crisis affecting aerospace would unfold very rapidly.

The aeronautical sector is a crucial infrastructure for Spain, as well as a strategical sector for the national economy. This steadily growing field is seeing exponential growth in uncrewed aircraft, which will enable economic development in many other areas.

Spain's assigned airspace, which it must protect, entails a great deal of responsibility; to this end, the country has a powerful, comprehensive system—integrated into that of NATO—to monitor, control, and manage all the necessary means of defence, around the clock. The Combined Air Operations Centre at Torrejón (CAOC-TJ) serves as headquarters for the air defence of NATO's southern flank (from Turkey to the Canary Islands), and also plays a crucial role in Spain's aerospace security.

In the space sector, Spain is an important member of different international organizations, participates in the major European and international projects, and hosts important space infrastructure on its soil. Here, Spain is currently engaged in capacity-building at the national level for space surveillance and tracking, to contribute to the drawing up of a catalogue of all the space objects in orbit.

The aerospace industry is very important for Spain, because of its contribution to GDP and the many positions for highly qualified workers that it creates. The unique capabilities of our aerospace and defence industry must be preserved and protected.

Given that there are no physical or functional limits between airspace and outer space, from a security standpoint both are considered a single area—aerospace—where threats and challenges can occur very quickly. This means that reaction times must be very short, and consequently, there is a need for command structures able to work nearly in real time, supported by command and control systems that have the right capabilities, are reliable, are perfectly coordinated at the national and international levels, and are constantly available.

From a regulatory standpoint, the legal frameworks for the use of airspace and outer space are based on substantially different principles; whereas in airspace, the principle of national sovereignty and flexible use applies, outer space is considered the common heritage of all humanity. Nevertheless, current regulations leave grey areas, such as the definition of the upper limits of national sovereignty in airspace, which in the near

future could become a source of conflict, as could outer space itself. An example of this is the emergence of new actors in the space sector, grouped in the so called *NewSpace*, primarily comprising private companies, which are seeking new business models, with aspirations beyond Earth, and which are challenging—or outright rejecting—the regulatory capacity of States in outer space.

Chapter 2, "Threats and Challenges in Aerospace", defines the concepts of threat and challenge, concluding that the main vulnerabilities of aerospace stem from its being a global commons, all of whose operational infrastructure is highly technical, with a very high level of connectivity, enabling cascade effects.

These threats are grouped into the six areas defined in the 2017 National Security Strategy: armed conflicts, terrorism, organized crime, proliferation of weapons of mass destruction, espionage, and cyberthreats. Specific threats to aerospace are described within each area, such as unauthorized incursions; skyjacking, including the possibility of using the aircraft itself as a weapon; sabotage of aircraft and facilities; disruption of communications, positioning, and surveillance systems; cyberthreats; the use of air transport for organized crime, such as trafficking in illegal goods, human beings, and animals; and the use of unmanned aircraft for terrorist attacks or illicit trafficking. However, the two principal threats, due to their devastating destructive potential, are the use of airpower instruments in armed conflicts, and the proliferation of weapons of mass destruction.

Similarly, the challenges are grouped into three areas: emergencies and disasters, epidemics and pandemics, and air and noise pollution; and within each of these, specific challenges for aerospace are described.

Given the nature of aerospace, many of these threats and challenges can occur outside Spanish sovereignty and jurisdiction, making it necessary to select a response based on national responsibilities as well as on Spain's international commitments.

Chapter 3, "Purpose, Principles, and Lines of Action", applies the guiding principles of the 2017 National Security Strategy (unity of action, anticipation, efficiency, and

resilience) to the five lines of action defined therein for aerospace, setting forth measures for each one.

1. *Promoting coordinated action from all public administrations and ministries with responsibilities in matters concerning airspace and outer space, enabling synergies and cross-cutting solutions.*

   This line of action involves measures in the areas of coordination, organization, training, and security culture, to improve decision-making, advanced staff training in crisis management, awareness-raising on aerospace security among the general public, and the organization necessary for smooth and appropriate responses.

2. *Capacity-building for national bodies and institutions—both public and private—with responsibilities in these areas, to address the different threats and challenges inherent to airspace and outer space.*

   This line of action is implemented through legal measures to expand and improve capabilities in such areas as airspace surveillance, control and defence; outer space surveillance and tracking; survival of critical infrastructure; industrial base consolidation; and environmental protection..

3. *Continuing to pursue risk analysis and assessment of measures to counter cyberattacks, terrorist acts, crimes and other conflicts affecting airport facilities or air transport within or outside Spanish airspace.*

   The approach to this line of action includes measures in the areas of cyberthreats, terrorism, and other challenges, highlighting the need to develop a comprehensive aerospace cybersecurity policy, special distribution channels for intelligence on specific threats, and capacity-building in Spain's space surveillance and tracking system.

4. *Promoting the implementation of legal provisions concerning civilian use of remotely piloted aircraft, ensuring the necessary balance between the safety*

*and security of people, facilities, and other airspace users, and the technological and economic development of a thriving industry in Spain.*

Regulating the myriad aspects involved in unmanned aircraft operations is an essential prerequisite in order to unleash the industry's potential. This is a highly complex issue, because any regulation—whether national or international—has to be compatible with other regulations in the same space. As regards aerospace security, any legal measures must be accompanied by awareness campaigns regarding the use of drones, and the development of anti-drone capabilities along with their implementing legislation.

5. *Supporting Spain's role at the international level in terms of the commitments and responsibilities assumed in the field of security and safety in airspace and outer space.*

   This line of action includes a package of measures for investment, participation, and representation; bilateral and multilateral agreements; improvements in interoperability; dual programmes; coordination on meteorology and space weather phenomena; and coordination to prevent contagious diseases.

Chapter 4, "Aerospace Security in the National Security System", defines the architecture of Spanish aerospace security. Under the President of the Government, it comprises three bodies: the National Security Council, as the Government's Delegate Commission for national security; the National Aerospace Security Council, which supports the National Security Council and assists the President of the Government in managing and coordinating national aerospace security policy, as well as promoting coordination, collaboration, and cooperation among the different levels of public administration and the private sector; and the Situation Committee, whose actions complement the National Security Council and which, with the support of the National Security Department, manages those crisis situations involving aerospace that overwhelm the response capacity of the usual mechanisms, due to their scope or cross-cutting nature.

# Chapter 1

## A COMPREHENSIVE VISION FOR AEROSPACE SECURITY

# A Comprehensive Vision for Aerospace Security

## General aspects of aerospace

Aerospace connects every point on Earth, and is the setting for many activities that are so essential for modern life that it is difficult to imagine our lives today without them. It enables and strengthens the growth potential of every area, so that the disruption or breakdown of aerospace services, for any reason, can potentially have a severe impact on the economy and society of the entire nation, as well as its security, even becoming a destabilizing factor if it is protracted.

An area that is experiencing rapid, constant growth, its value is reflected in the services based on or made possible by aerospace infrastructure in such important sectors as security and defence; meteorology; energy; telecommunications; transport by land, sea, and air; engineering; urban development; entertainment; and tourism. All

of them depend—regularly and intensively—on aerospace services in order to run smoothly.

Aerospace technology is indispensable to modern societies; its assets constitute critical infrastructure, and play a vital role in meeting the needs of our citizens. Without it, the advances that have enabled today's social development would have been impossible. Its protection and the protection of its infrastructure are a priority for the life and growth of the nation.

*Aerospace technology is indispensable to modern societies.*

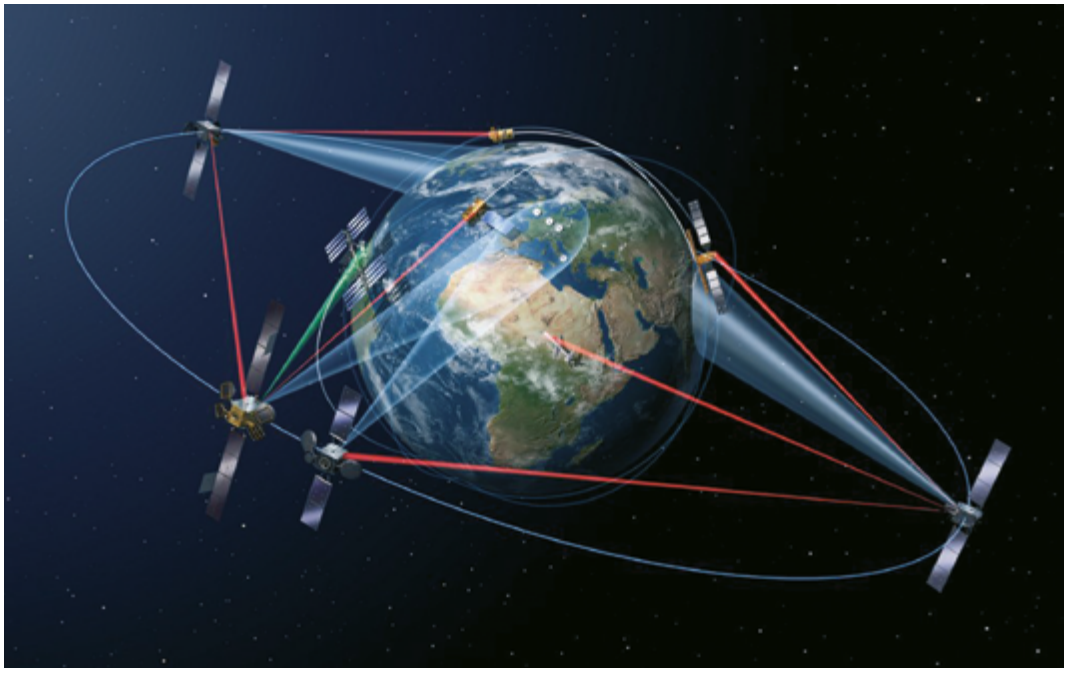


*Figure 1: Growing communication with data highways in outer space* *Image: ESA*

Airspace and outer space are also a source of opportunities and risks. The services that depend on them must be protected from the threats and challenges that could cause their disruption or breakdown, whether due to the weather or other natural causes, human error, or accidents—or to malicious or violent uses, such as illicit interference (terrorist attacks, hijacking, or sabotage), disruption of signals being sent from space, espionage, cyberthreats, terrorist actions, and armed conflicts.

Spain's 2015 National Security Act includes airspace and outer space security among its areas of special interest, and the 2017 National Security Strategy considers that any disruption in global commons (cyberspace, maritime space, airspace, and outer space) could lead to a rapid operational and data disconnection, and therefore the Strategy advises creating a crisis management mechanism.

Spain, in keeping with its capabilities and the weight of its economy, is a leading European partner in aerospace. This sector is crucial for national security and economic development, and consequently, it is essential to guarantee access to this area. Therefore, it is necessary to develop a standard aerospace strategy, from the general perspective of national security, to make it possible to reach the objectives set forth in the current National Security Strategy.

## General aspects of the aviation sector in Spain

Spain, due to its unique geography, has a considerable area of airspace responsibility (2.19 million km2), which poses a huge challenge and requires a major effort with regard to national and international commitments: services for air traffic control, search and rescue, and aerial surveillance related to migratory flows and illicit activities at sea.

To continuously ensure the defence of our national airspace, Spain depends on its Defence and Air Operations Command, which has a powerful command and control system for surveillance, detection, identification, classification, and if necessary, neutralization

*Figure 2: Defence of Spanish airspace* *Photo: Spanish Air Force*

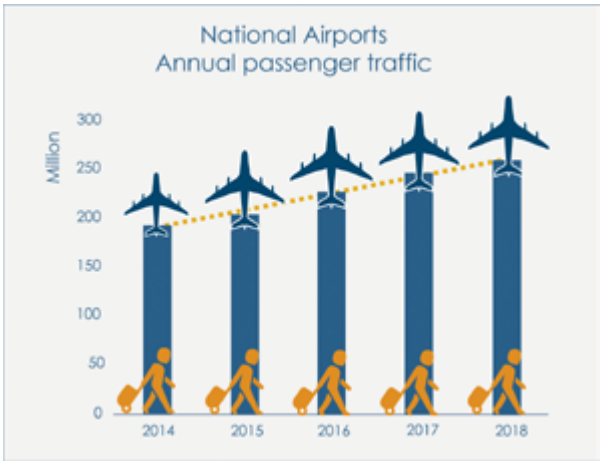
of aerial objects that penetrate sovereign airspace or airspace of national interest. It is connected and coordinated with the civil aviation control and management system of ENAIRE. The Defence and Air Operations Command system is integrated into the NATO air defence systems, and ENAIRE into Europe's intergovernmental air traffic management organization EUROCONTROL.

*Air transport is a crucial infrastructure for the Spanish State, in addition to being strategic for the national economy.*

As regards civil aviation, air transport is a crucial infrastructure for the Spanish State, in addition to being strategic for the national economy. The distribution of Spain's national territory across the Iberian Peninsula, the Canary and Balearic Islands, and the enclaves of Ceuta and Melilla, as well as Spain's strategic location between the continents of Europe and Africa—with its

coasts open to both the Atlantic and the Mediterranean—offer Spain considerable advantages in terms of becoming a major intercontinental air transport hub (Europe-Africa-the Americas).

The constant growth of annual air transport figures in recent years illustrates the industry's importance for the national economy: the latest figures show 266 million passengers; 690 airlines operating in Spain, linking its 48 airports to 350 destinations in more than 140 countries; 36 Spanish airlines that carried 88 million passengers; 2.3 million operations; 1.1 million tonnes of cargo. Spain's airport management firm AENA, whose majority shareholder is the Spanish State, is the world's largest airport infrastructure manager.




*Source: DSN, with AENA data*

The direct contribution of the Spanish aeronautical sector (air transport, air navigation,, and aeronautical industry) represents 2.5% of GDP, and directly generates more than 100,000 jobs that have high added value due to their stability, quality, and the levels of qualifications required. The aeronautical industry carries 80% of the tourists who visit Spain; and tourism, which is our leading national industry, contributes 15% of GDP, employing nearly 3 million people.

Spain's aeronautical industry is a world leader, with many of the top global companies and a strong international presence. The strength of Spain's aerospace industrial base provides us with the capacity to control the entire life cycle of a complete aircraft (design, development, production, post-sales support), integrate aeroplanes and systems, and develop and produce cutting-edge equipment and composites for aircraft, all supported by highly qualified tech services and parts companies.

*Figure 3: Air industry: International cooperation* *Photo: AIRBUS*

The field of unmanned aircraft has seen exponential growth, and the National Air Security Agency (AESA) has already registered more than 3,600 operators, 4,600 drone pilots, and 5,400 aircraft. The entry into force of Royal Decree 1036/2017 has expanded the number of scenarios in which air operations may be conducted with remotely manned aircraft, enabling economic development in such industries as agriculture; energy; film, photography, and video; and aerial surveying (topography and photogrammetry). The new law has provided strong impetus for this sector's growth, stepping up Spain's competitiveness, promoting the creation of highly qualified jobs, and lessening environmental impact.

## General aspects of the space sector in Spain

Spain is highly dependent on the use of space systems, with its own space capabilities in telecommunications, Earth observation, meteorology, remote sensing, and space-based surveillance and tracking. Moreover, as an EU Member State, Spain has access to the capabilities developed by the EU space programmes.

*Spain has an extensive catalog of space means in the form of infrastructures, research centers, industrial resources and space systems.*

Spain is a member of such international organizations involved in space as the European Space Agency, the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the European Defence Agency, the EU, NATO, and the United Nations. Spain participates in major European and international space projects, and hosts important national and international space facilities in its territory.

*Figure 4: Space facilities: Maspalomas station* *Photo: INTA*

The Spanish administration's management and coordination of space policy is regulated through different coordination committees: the Inter-ministerial Committee for Global Navigation Satellite Systems (GNSS), the Steering Committee of the National Earth Observation Programme, the Inter-ministerial Commission for Industrial and Technological Space Policy, and the Inter-ministerial Monitoring Committee for Space Surveillance and Tracking Systems.

Spain currently has an extensive portfolio of space resources, including infrastructure, research centres, industrial capacity, and operating space systems, making us one of the leading actors in the international space industry. These resources meet the needs of public and private organizations and of our citizens, as well as Spain's defence and security needs. We have secure communications systems, Earth observation systems, and satellite positioning systems—all thanks to the constant, growing efforts of this sector, mainly backed by investment from the public administrations.

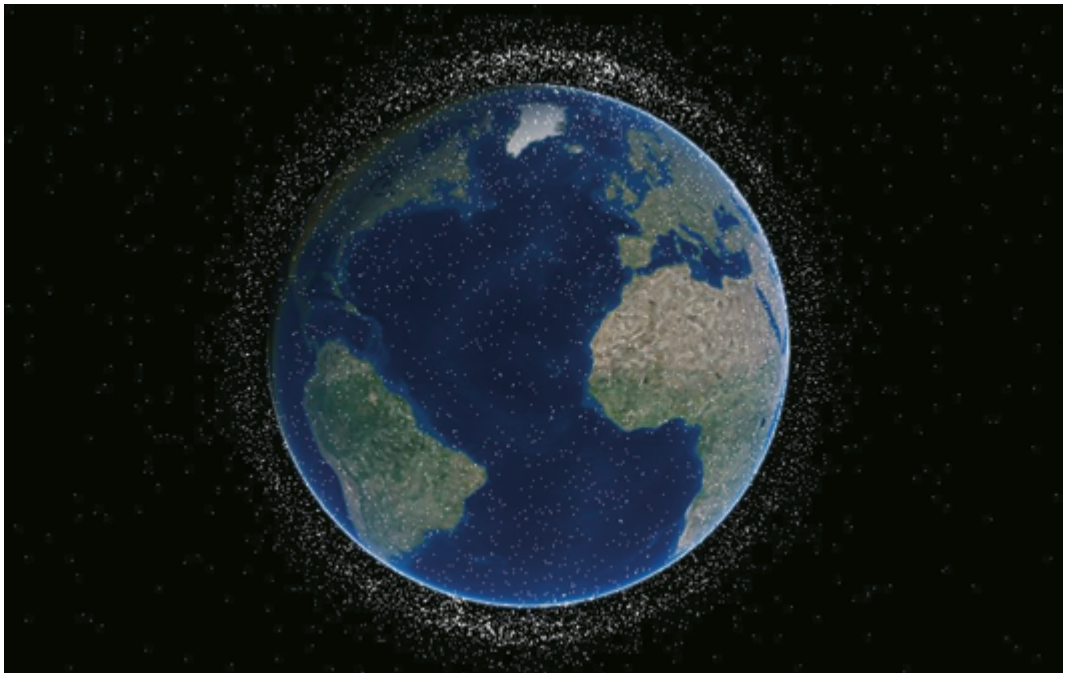


*Figure 5: Space debris* *Image: ESRI Australia*

In the area of GNSS, the European Geostationary Navigation Overlay Service (EGNOS, the satellite-based augmentation system used to improve the performance of such GNSS systems as GPS and Galileo) provides the EU's solution for positioning systems, and is the only infrastructure that it fully owns. The EU estimates that in the future, 11% of European GDP will depend on positioning systems, due to the growing number of applications that use them.

In Spain, we are currently engaged in national capacity-building with regard to space-based surveillance and tracking, making it possible to engage in monitoring atmospheric re-entry, fragmentation studies, collision prevention, and support for space launches. To this end, as a national contribution to the European Space Agency, Spain has created a Space Surveillance and Tracking Programme.


This capability makes Spain one of the few nations able to contribute to drawing up the essential catalogues of space objects in orbit, thanks to our combination of optical and radar systems that are integrated into an operations centre. Spain is, therefore, prepared to participate in future initiatives for pooling surveillance and tracking capabilities in outer space. Moreover, Spain is likewise prepared to advance in the field of aerospace security, given the possibility that in the near future, space could became a field of contention for the great powers—the USA, Russia and China—that are currently competing for world leadership in space.

Spain's space industry has a wide range of capabilities in every area (flight, land-based installations, launchers), ranging from the manufacture of equipment to the integration of complex systems (such as satellites and operations systems). It also has a high profile in the applications and services sector, including several satellite operators. The sector employs approximately 3,500 people, most of them highly qualified workers.

Space is profitable for industry, society, and the nation: It is a knowledge repository enabling important applications to improve our citizens' quality of life, with major

security repercussions, and drives the creation of highly qualified jobs. The demand for satellite services will only continue to grow, and the Spanish State will support the sector in order to have the greatest possible autonomy, reducing our dependence on other powers in the provision of services that are essential to the life and economy of the country.

Space provides discretion and freedom of action; it is loosely regulated, except for the field of communications; it has enormous economic potential; and the growing ease of access is bringing in new actors, both State and non-State (organizations, corporations, individuals) who are competing for resources. All of this makes space a potential flashpoint for disputes, threats, and challenges, which nations will have to face both individually and collectively.


## Aerospace regulatory framework

The rules on using airspace and outer space are based on substantially different principles: Whereas the principle of State sovereignty applies in national airspace, outer space is considered the common heritage of all humanity; this can be explained by the different historical periods during which activities in each realm have been developed, and the different perceptions of threat they represent.

The legislative framework of airspace is closely tied to the steady technification of air transport resources, and it functionally encompasses the areas of operational safety, the protection of civil aviation from illicit interference, and other aspects including trade, economic, and environmental issues; quality; and passengers' rights. The International Civil Aviation Organization (ICAO), a specialized UN

agency, is the primary source for the majority of laws and regulations of the 192 current ICAO Member States; a great deal of ICAO regulations have been directly transposed to Spain's legal system, through EU Regulations or Directives.

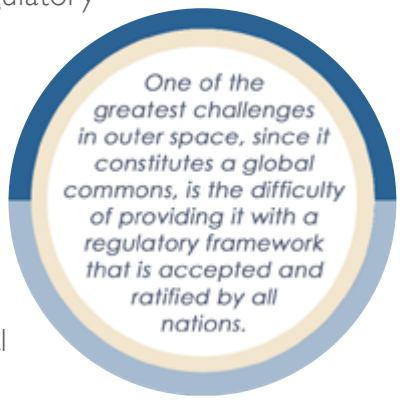
Spain's national aerospace security is based on a number of essential laws: Act 36/2015, on National Security; Act 8/2011, establishing measures to protect critical infrastructure; Act 5/2005, on National Defence; Act 21/2003, on Air Security; and Act 48/1960, on Air Navigation. With regard to civil aviation, the bodies responsible here are the National Commission on Civil Aviation Security, created by Royal Decree 550/2006, and the State Air Security Agency, created by Royal Decree 184/2008.

Although Act 48/1960 has been updated and partly overturned by subsequent legislation, it continues to serve as a basic reference when addressing the legal environment of Spanish airspace. Regarding Spain's sovereign airspace, the law clearly defines it horizontally, but not vertically, since there is no international agreement on the limits of outer space from which the sovereignty of the State below ceases to be effective. This legal vacuum is becoming increasingly important in the face of ongoing technological advances, including the space race, and is still pending resolution by the international community.


As regards unmanned aircraft, Spain's national laws (including Royal Decree 1036/2017) regulate, within airspace under national sovereignty, civilian use of remotely piloted aircraft weighing less than 150 kg, enabling the development of the industry and ensuring operational safety. This sector's enormous potential requires further regulation, both nationally and internationally, on the operation of unmanned aircraft in the whole airspace, which represents an enormous technical and security challenge.

In space, the lack of sovereignty rights, and the freedom of exploration under equal conditions explain the nature of the international instruments regulating

its use. One of the greatest challenges in outer space, since it constitutes a global commons, is the difficulty of providing it with a regulatory framework that is accepted and ratified by all nations.




The Cold War brought with it the regulation of activities in space, and the United Nations promoted a series of treaties, agreements, conventions, principles, and interconnecting resolutions that are currently at different stages of ratification, signature, and acceptance of rights and obligations—although not one has been ratified by all countries, except for that of the pre-existing International Telecommunication Union (founded in 1865).

The most important treaties include the Outer Space Treaty of 1967—the cornerstone of governance in outer space—and the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, both ratified by the major powers.

All of these legal instruments were formalized before 1983, at a time when the conventional wisdom was that satellites' cost and technology meant that they were only available to the most powerful countries. In recent times, this vision has been changed by the new ease of access to outer space created by the use of standard commercial components that reduce production costs and development times. This has led to today's NewSpace, in which mainly private companies are emerging with new technologies and new ideas on management and competition, creating a new business model with its sights set beyond the Earth's atmosphere. Here, their aspirations range from operating small low-orbit satellites to mining in outer space, space debris collection, and even colonizing other planets. Forecasts expect exponential growth in coming years, given the efficiency, reliability, and profitability of such companies.

Under the UN agreements that Spain has ratified, the State bears subsidiary responsibility for the activities in outer space of its nationals (whether individuals, State-owned enterprises, or private corporations), and consequently a need has been identified to regulate activities that could be carried out by non-State operators.

With the growing ease of access to outer space comes greater competition, especially with regard to assigning and using orbits and radio frequencies. In this setting, the need for regulation is unavoidably becoming greater, testing the international legal framework. Consequently, several countries are already taking steps to protect their outer space assets, or to deny other actors' access to them; safeguarding access is such a critical issue that outer space is beginning to be seen as a future theatre of conflict.

## Two areas, one security strategy

From a physical and functional standpoint, airspace and outer space are not separate. Physically speaking, it is impossible to establish a clearly defined limit between them, since they present a clear continuity, and there is no obvious point where one ends and the other begins, nor are there natural barriers to delimit them.

Airspace and outer space are highly technified, constantly evolving, and with a huge potential for development. From the standpoint of electromagnetic spectrum use, they constitute a single environment whose development capacities are completely dependent on cyberspace.

Legally speaking, international treaties present a lack of widely accepted definitions regarding the vertical delimitation between airspace and outer space. Therefore, there is no altitude at which a country's sovereign airspace is clearly demarcated. Currently, the practical limit for civil air traffic is an altitude of 18 km. Satellites usually operate higher than 160 km, although technological advances are contributing to an increasing use of this "intermediate layer" for scientific, commercial, and military purposes. However, at present there is no regulation in force here, although ICAO and different

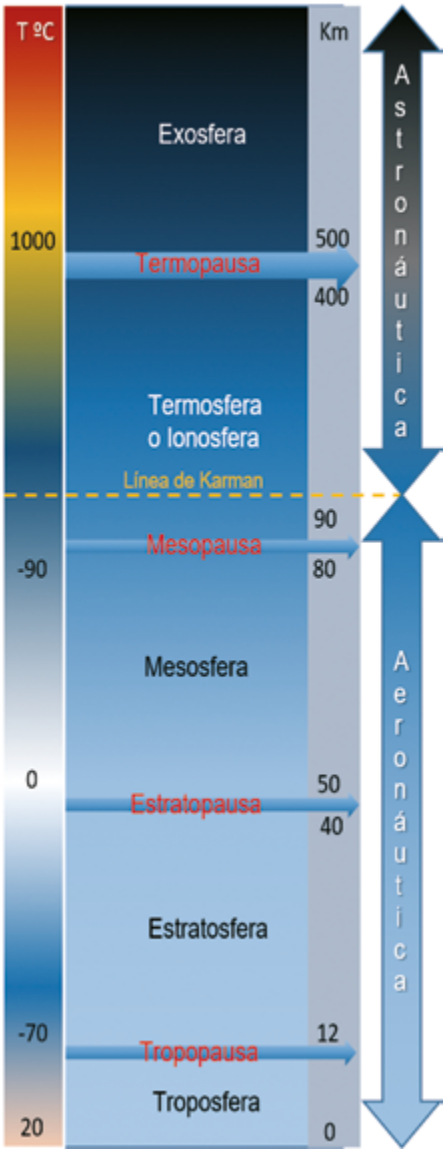


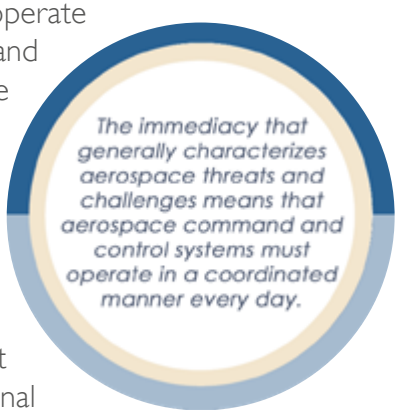

*Figure 6: Layers of the atmosphere*

European bodies are studying "high-altitude airspace", and the transition of airspace from the orbital to the sub-orbital zone.

From a security standpoint, it must be borne in mind that any object able to reach the Earth's surface from outer space, and which could constitute a challenge or threat, will inevitably have to transit the "intermediate layer" and airspace, which makes it necessary to extend the surveillance, detection, identification, and classification of these objects in order to decide on an appropriate response. Many of the systems currently used for airspace surveillance and control are also used for outer space surveillance, and increasingly, eyes are on this "intermediate layer" of the atmosphere.

Here, it is important to remember that airspace is shared by a high number of stakeholders, sometimes with different interests: airlines; military, private, and sport aviation; air works; and also, more recently, remotely manned aircraft, which present both the greatest growth potential and the greatest source of threats and risks.

The immediacy that generally characterizes aerospace threats and challenges means that aerospace command and control systems must operate in a coordinated manner every day, around the clock, and be provided with the necessary elements to monitor the situation and a command structure able to make decisions almost in real time, enabling the necessary anticipation and speed of response.




Airspace and outer space are, in sum, a unified and continuous space, a truly substantial element in which all of these activities are carried out, and which is subject to common threats and challenges, with absolute functional interdependence. Its security must be considered in a unified, coherent manner, in keeping with its very nature, through an aerospace security strategy that treats them as a single environment, enabling increased effectiveness in measures regarding surveillance, control, and intervention involving both air and outer space activities, by the responsible authorities..

## National interests to be protected

The hijacking in 2001 to attack the World Trade Center in New York and the Pentagon showed that civil aircraft could be used as a highly destructive weapon against buildings or facilities of any kind, sowing mass terror and causing thousands of victims. The 2015 hijacking of a Germanwings aircraft by a suicidal crew member ended with the murder of the 149 people on board when the plane crashed into the French Alps.

Incidents like these were considered improbable—until they happened. There seems to be no limit to the imagination regarding ways to sow death and destruction, panic and terror, for any rational or irrational cause; and unfortunately, today there are many ways available to do it.

All of this leads us to identify the principal national interests to be protected against threats and challenges in aerospace:

- The life, security, well-being, and privacy of the Spanish people, whether on land, in the air, or in space;
- Compliance with national and international aerospace laws;
- Freedom of air navigation and the security of aircraft transiting airspace under Spain's national responsibility;
- Airspace of national sovereignty, responsibility, or interest, in the face of unauthorized incursions of any kind;
- Free access to and secure exploitation of outer space;
- High-value outer space infrastructure, media, and services, in the face of threats and challenges proceeding both from aerospace or other areas;

- The capacities of the national aerospace industry;
- Public health, in the face of intentional or unintentional propagation of pathogenic agents or toxic substances through aerospace;
- The aerospace environment.

*Figure 7: Aiport infraestructure* *Photo: AENA*

# Chapter 2

## THREATS AND CHALLENGES IN AEROSPACE

# Threats and challenges in aerospace

## Introduction to the concept of threats and challenges in aerospace

The 2017 National Security Strategy presents a general list of threats and challenges to national security which must be detailed in the sphere of aerospace.

The threats to consider are all those that compromise or could undermine national security, understanding as threats any potential harm resulting from a deliberate criminal or illicit act. Noteworthy among these, for their potential effects on national security, are those that could affect infrastructure with an impact on strategic sectors such as defence, energy, financial information flows, and the normal operation of certain services that are essential to society.

*Figure 8: Launching missiles* *Photo: AP Images*

Challenges are not intentional, but they may cause situations of instability, or foster the appearance of threats, aggravate them, or accelerate their manifestations. The National Security Strategy 2017 considers emergencies and disasters, epidemics and pandemics, and the effects of climate change as factors with a potential impact on aerospace security.

Aerospace has a number of distinguishing features that heighten its vulnerability. These features are: its intrinsic nature as a common global area, the high level of technification of practically all the infrastructure involved, and the strong likelihood of ripple effects resulting from its great interconnectivity.

Threats and challenges in aerospace can occur in areas under Spain's air sovereignty and jurisdiction, and outside them. In both cases, the response would depend on national responsibilities and on the international commitments undertaken by Spain.

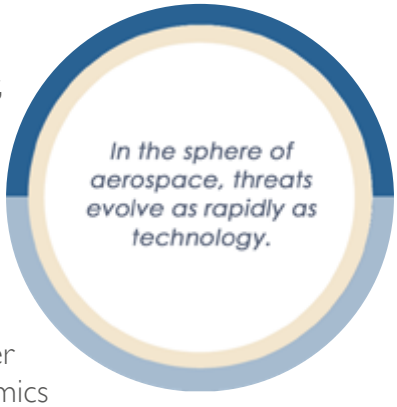
Generally speaking, unauthorized incursions constitute the most obvious threat that can occur in airspace. These incursions take the shape of threats when they are

*Figure 9: Eruption of the Calbuco Volcano in Chile* *Photo: Stringer Chile / REUTERS*

deliberate man-made actions, such as the hijacking of aircraft for terrorist purposes, the overflight of ballistic missiles, unauthorized suborbital flights and pseudo-satellites over national sovereign territory, incursions by unauthorized military and civilian aircraft, unmanned aircraft for intelligence purposes, aircraft used for smuggling or illegal border crossing, devices with elements that could cause electromagnetic disturbance, etc.

Cyberthreats seeking to exploit the vulnerabilities of aerospace-related IT systems and telecommunications are considered unauthorized incursions. These are particularly critical when they affect navigation, air traffic control systems, control systems on board aircraft, communications, meteorology, earth observation, etc. Their disruptive potential here is very large, because since this is such a high-tech and synchronized area, the effects would be felt immediately.

In the sphere of aerospace, threats evolve as rapidly as technology, and the risk consists in not having the necessary means and organization to counter them and react in time.



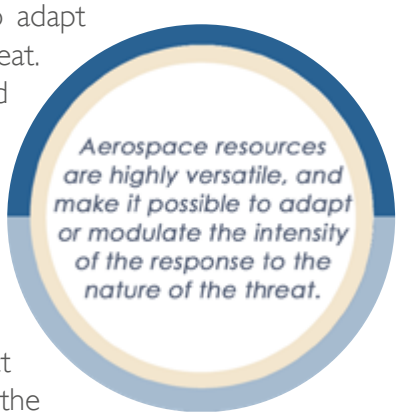

Challenges in the sphere of aerospace mainly stem from unintentional phenomena and disasters, such as the fall of meteorites; uncontrolled space debris; volcanic eruptions; earthquakes; severe atmospheric phenomena; space weather phenomena; accidents; emergencies; and epidemics and pandemics that may spread through aerospace and be transmitted to humans, animals and plants.

# Threats

## Armed Conflicts

The use of aerospace instruments has a decisive impact on the results of armed conflicts, and constitutes one of the most lethal threats that a State can face, because these instruments can act in a precise, forceful, rapid and thorough manner against centres of gravity, i.e. against a nation's vital and strategic interests.

Aerospace resources are highly versatile, and make it possible to adapt or modulate the intensity of the response to the nature of the threat. Their high availability and speed makes them one of the most rapid response options, and their manner of operation makes it possible to reduce their political and media impact, as they do not need to occupy the adversary's territory.




Noteworthy among aerospace instruments are surveillance and control systems, because they are the "eyes" that make it possible to detect and identify threats occurring in aerospace and to direct the appropriate means of defence (aircraft, land-air missiles on the

*Figure 10: Air defence aircraft* *Photo: Spanish Air Force*

ground or on board, etc.) to counter them. Moreover, civilian air traffic control systems ensure safe and orderly air traffic flows, contributing to the identification of hostile air activity and, as appropriate, controlling and neutralizing such activity.

Consequently, the physical, electromagnetic and cyber protection of civilian and military surveillance and control systems, as well as their capacity to affect the corresponding resources of a potential adversary, are a priority for aerospace instrument.

*The physical, electromagnetic and cyber protection of civilian and military surveillance and control systems, are a priority for aerospace instruments.*

One of the areas which has evolved the most is the development of capabilities that impede the access of own forces to certain areas or domains in dispute, due mainly to substantial improvement in air defence capabilities, and to the improved range and technology of air-air, land-air, and land-land missiles, which hugely limits the strategic autonomy that the NATO

and EU countries had previously enjoyed in their aerospace operations, forcing them to develop new capabilities to counter these new challenges.

Due to the growing possibility that certain State and non-State actors will be able to access the technology necessary to develop them, ballistic and hypersonic missiles represent one of the threats of greatest concern to the international community. Effectively countering such threats requires major intelligence capabilities, as well as the means to detect them, and command and control capabilities enabling the necessary actions, with appropriate resources, both autonomously and in collaboration with partners and allies.

Satellites may be threatened in conflict situations. Every passing day the probability is rising that the majority of nations—and even terrorist or criminal organizations—will have access, in the short- to medium-term, to the capabilities necessary to neutralize a satellite. Countries that have the capacity to launch a lethal attack on assets in orbit are not likely to do so because of the risk that destroying the enemy's apparatus would damage their own systems if this triggered a chain reaction produced by the space debris cloud. What is conceivable is the neutralization and disablement of space systems by other means, fundamentally, infiltrating their ground control systems with the aim of supplanting their legitimate operators or, simply, to disable them through directed energy systems, electromagnetic disturbance, and cyberattacks.

Any attack on satellites—vital for providing essential services to Spain (e.g., communications, weather information, navigation)—would have enormous economic, social, and security impacts.

Considering the above, the main threats in aerospace in the event of armed conflict are the aerospace capabilities of the adversary, including:

- Air-air and air-land armaments, and their means of delivery;
- Ballistic and cruise missiles, including hypersonic missiles;
- Directed-energy weapons;

- Devices able to disrupt essential services (communications, navigation, monitoring, positioning services, weather information);
- Satellites and anti-satellite weapons;
- Aerospace systems capture mechanisms;
- Cyberattacks.

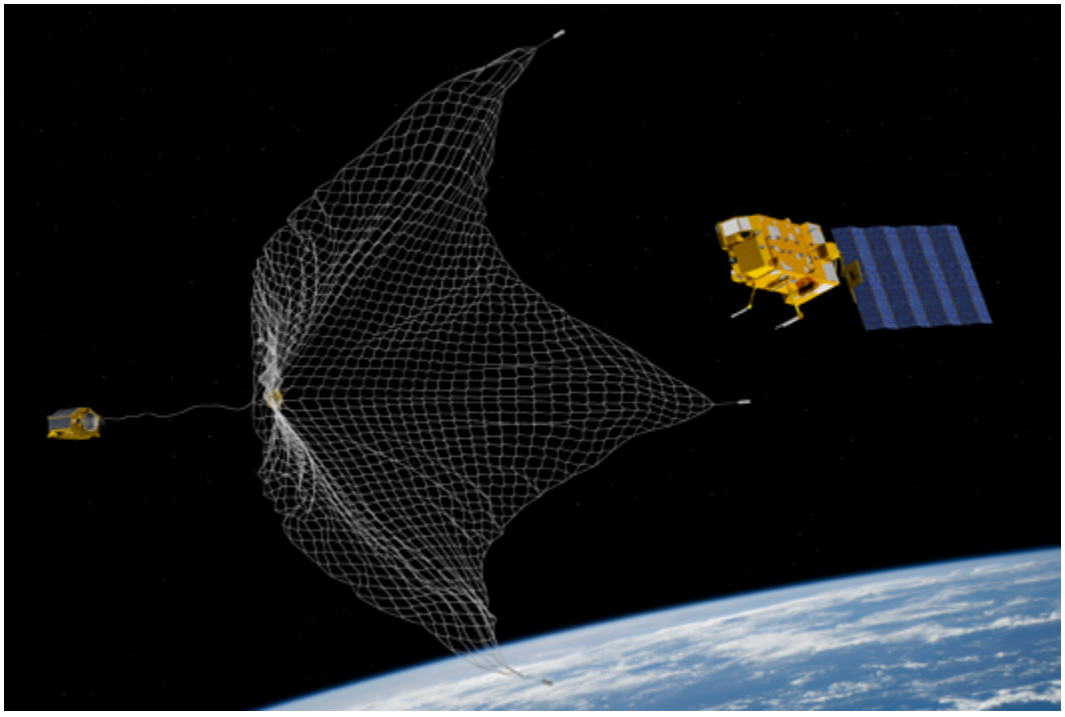


*Figure 11: Conceptual representation of satellite net capture* *Image: ESA*

## Terrorism

Terrorist organizations have always had the air industry—mainly commercial aviation (aircraft and airports)—among their top-level targets to achieve maximum immediate economic and media impact and a high number of victims. These organizations exert continual pressure on the sector by taking advantage of the many opportunities offered by technological progress, generating a constant concern to maintain adequate security levels which requires an enormous economic effort that has a significant effect on countries' economies.


## Principal threats in aerospace include:

- Aircraft hijackings. The purpose of these hijackings ranges from using the passengers as hostages in some kind of negotiation to using the aircraft itself as a weapon; this threat, which first occurred in the September 11 terrorist attacks, is termed a "renegade plane".

- Air sabotage, which includes the deliberate destruction or disabling of aircraft; airport and aerospace infrastructure; navigation, communication, and positioning systems; and aeronautical services.

- An attack on an aircraft in flight using land-based weapons (e.g., man-portable air-defence systems, light weapons, anti-aircraft weapons), even direct-energy weapons.

- The use of equipment, such as lasers, to dazzle or blind pilots, and more rarely, air traffic controllers, constitutes a growing potential threat that could have catastrophic consequences.

- The use of light aircraft to commit terrorist attacks.

- The use of unmanned aircraft to provoke an air incident or accident, using them directly as weapons, as elements to disrupt air activity, or to deploy arms, explosives, harmful substances, etc.

- Cyberattacks.

- Ideological radicalization and recruitment targeting individuals in the air environment— crew members, air traffic controllers, and airport workers— to induce them to participate in, plan, and commit terrorist acts.

Moreover, terrorism has other targets for which aerospace or technological elements can be used to carry out attacks.

- Unmanned aircraft are the newest air element in the terrorist arsenal. The ease of acquiring and using these platforms, their relatively low cost, the difficulty of controlling their operations, and their many potential uses—only limited by the attackers' own imagination—make them ideal candidates for use by terrorist groups. The lack of comprehensive regulation regarding their production and commercialization facilitate their use for illicit purposes.

- Intentional disturbance, interference, or deception involving the electromagnetic signals used by communications, navigation, surveillance, and aerospace control systems constitute a threat whose impact could be critical for the operations of essential services—not only in aerospace, but also as regards commerce and finance.

## Organized Crime

Illicit trafficking is the main activity of transnational organized crime groups, which often use aircraft to transport illegal goods (e.g., drugs, counterfeit products, contraband, small arms and light weapons) and the profits obtained from this illicit trade.

Air transport is also one of the principal means for smuggling human beings, and for human trafficking. Spain's air connections—especially with South America and Asia—constitute the principle risk area, whether for destination or transit.


*Figure 12: Drug trafficking using air routes* *Photo: Civil Guard*

For criminal organizations, aerospace represents an important, easy-to-access operational option for illicit trafficking. Especially over short distances, the most used means (light aircraft, gliders, helicopters, and unmanned aircraft) are very difficult to detect, identify, and classify, and consequently, response capacity is enormously hindered.


Criminal organizations can sometimes rely on the collusion of airline employees, and the assistance of airport workers, which makes this an especially vulnerable area.

By its very nature, the main activity of illicit trafficking and its associated conduct (e.g. providing fake identity documents for passengers or merchandise, or cyberattacks to support an operation) constitute an important risk activity, in that they breach preventive control capacity over air routes and infrastructure.

## Proliferation of Weapons of Mass Destruction

The proliferation of weapons with potentially devastating effects— nuclear, radiological, biological, chemical (NRBC)—and the air methods used for their transport and their delivery systems (mainly missiles) constitute one of the major threats for any nation.

The growing ease of access to this technology for any actor, and to the specialized information necessary for developing weapons of mass destruction (WMDs) and delivery systems, is especially concerning to the international community. At present, more than 30 countries have missiles able to hit targets tens of thousands of kilometres away, delivering conventional warheads or WMDs (nuclear, bacteriological, or chemical).

An even bigger, and very real, threat is that these kinds of arms could fall into the hands of non-State actors, criminal organizations, or terrorist groups. Therefore, having the capabilities necessary to counter them—regardless of the means of transport and dissemination that could be used—must be a priority for the nation and for the entire international community.

*The proliferation of weapons of mass destruction (WMDs) and delivery systems, is especially concerning to the international community.*

*Figure 13: The UN Security Council, against weapons of mass destruction Photo: United Nations*

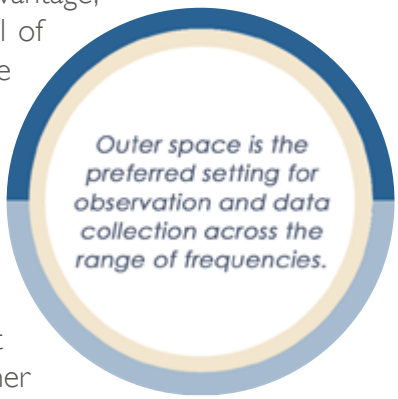
## Espionage

One of the first uses of hot air balloons was military reconnaissance. Over the years, the advantage provided by dominating the third dimension has driven the development of aerospace inventions that collect data across every frequency band, and process them for a specific purpose.

Today, information available on the internet reaches every level, from heads of State to common citizens, meaning that espionage increasingly uses open sources. However, the information obtained from aerospace devices (manned and unmanned aircraft, satellites and microsats) belonging to States, international organizations, alliances, corporations, and individuals, is greater than ever before.

*Figure 14: Predator XP remotely piloted aircraft* *Photo: General Atomics*

Outer space is the preferred setting for observation and data collection across the range of frequencies. Its global scope provides an enormous advantage, making it possible to operate outside the sovereign control of States. Aerospace resources that operate in airspace are especially useful in times of conflict because of the quantity, quality, and accuracy of the data they can obtain; however, they cannot be used in other circumstances without other States' permission.




Middle airspace is not formally sovereign airspace, since there is no international agreement that defines the limit between airspace and outer space, although its use by another country without the permission of the country being overflown would probably be interpreted as a violation of airspace, which could even lead to the neutralization of the device.

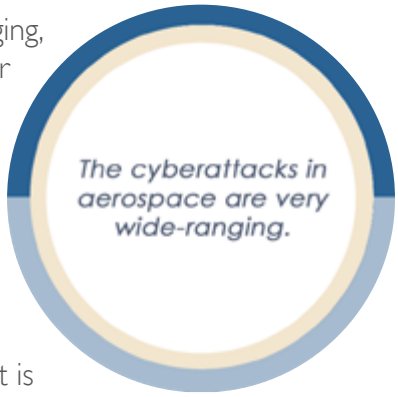
Communications constitute a crucial part of espionage. The interception of communications that travel through airspace and outer space, using instruments based on land, in the air and in space, represents a threat to security which, although difficult to quantify, is very real. The transmission and content of especially sensitive communications, such as those of the military or the government (through such methods as encryption), and the development of these protection capabilities is strategically essential for the country.

Espionage broke out of its traditional context long ago; today, industrial espionage is especially important. To this end, countries and corporations use all kinds of techniques, and of course they often turn to aerospace (e.g., aircraft, unmanned aircraft, and satellites) to obtain sensitive information. Special technologies and capabilities of national companies in the aerospace industry or related sectors must be protected from this threat.

## Cyberthreats

Aerospace is highly technological, and intrinsically linked to the cyber domain, constituting a target of high strategic value. It encompasses a huge technological component made up of advanced data and telecommunications systems—whether isolated or integrated into networks—that are distributed globally and serve a complex network of tracking and control centres, radar systems, digital voice and data communications, aircraft and their on-board systems, and different kinds of airport facilities. The outer space component of this domain includes such infrastructure as satellite control and tracking stations, operations centres for space surveillance, and space communications and data processing centres, all with a very high degree of cybernetic interconnection.

The targets of cyberattacks in aerospace are very wide-ranging, from unauthorized modification of information in customer databases, leaking sensitive information, altering the air traffic market, or weakening the competitive position of industrial competitors, to disruptive attacks against aircraft systems, ground control systems, navigation assistance or national air traffic coordination systems, which could affect the safety of aircraft, air transport, and passengers.




To be able to carry out complex cyberattacks in this domain, it is necessary to have a huge amount of resources; since this is not within everyone's reach, the most probable attackers would be foreign States, as part of a hybrid operation.

Technology is susceptible to failures in design, programming, or manufacturing, which can originate serious vulnerabilities in aerospace components and systems. Rapid advances in the tech industry sometimes mean that systems and components development is more oriented towards operational and functional security than towards protection from external aggression, which could become the source of vulnerabilities susceptible to exploitation. To attain a high level of aerospace security, it is necessary to previously ensure the cybersecurity of component systems.

*Figure 15: "Hack he Air Force": Uncovering the USAF's vulnerabilities* *Image: USAF*

Cyberattacks in aerospace can be extremely profitable. An effective cyberattack can totally or partially knock out the operational capacity of the component or system attacked, or create a lack of reliability due to fake information the system sends out or contains. This could lead to anything from an interruption or minor deficiency in non-essential services, to the complete disruption of certain systems and services that are critical for the nation. Given this very real possibility, it is essential to protect aerospace resources and services from cyberattacks.

# Challenges

## Emergencies and disasters

As set forth in the current National Security Strategy, emergencies and disasters continue to be among the modern world's main challenges. Their impact not only affects people's lives and health, but also their assets, the environment, and economic development.

In aerospace, emergencies and disasters can have a major impact on the ordinary course of business.

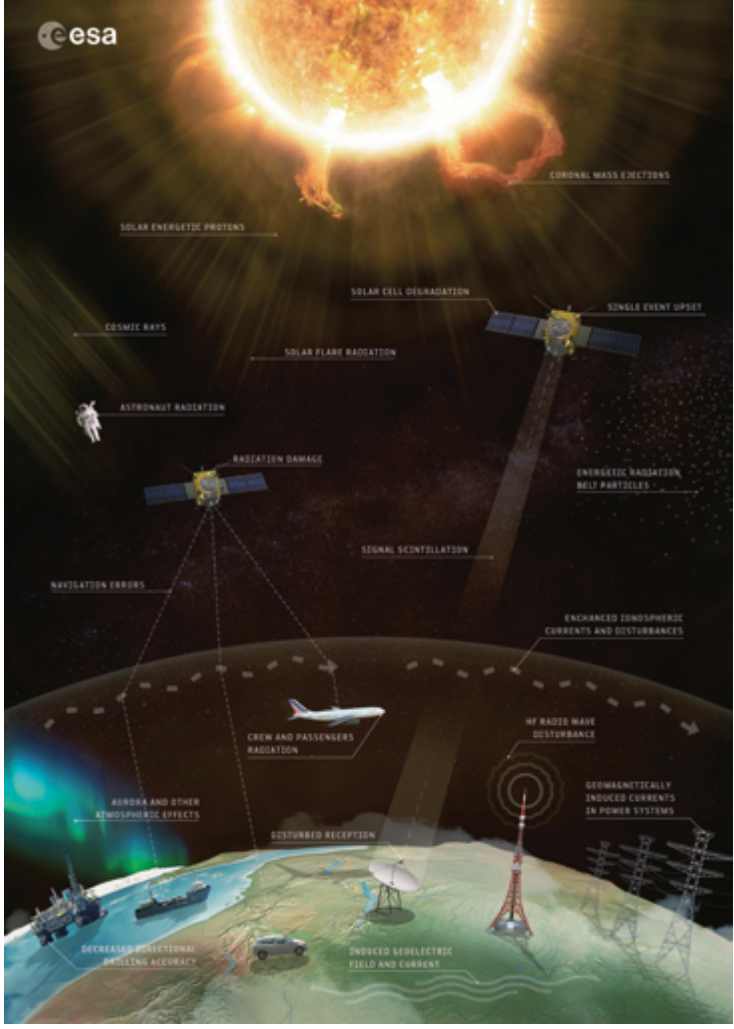


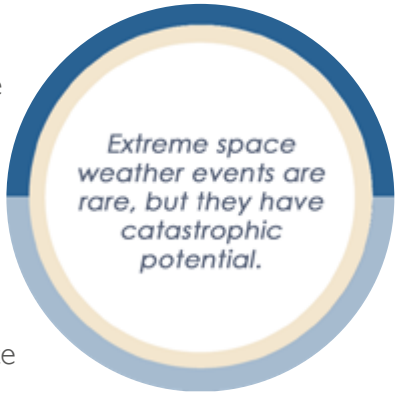

*Figure 16: Effects of space weather* *Image: ESA/Science Office*

The main challenges proceeding from space include:

- Alterations caused bywhat is called space weather, due to solar activity (storms, coronal mass ejections, solar wind, emissions of particles and radiation), cosmic radiation, and high-energy particles coming from interstellar space, cause changes in the Earth's magnetosphere, ionization of the upper atmosphere, and geomagnetic storms. Their most adverse consequences are blocked radio communications, damage to the electronic components of satellites and to electricity transmission networks, the degradation of signals from satellite navigation systems, and radiation damage to the crew of spaceships. Extreme space weather events are rare (statistically, they occur every 100-200 years), but they have catastrophic potential.

- Entry into Earth's atmosphere of asteroids and comets. There are an estimated 10 billion near-Earth objects orbiting the Sun that are larger than

1 m, and more than 10 million larger than 20 m. The probability of the entry of an object larger than 10 m is every 1 to 5 years; these objects have the potential to damage buildings and injure people (such as the 2013 event in Chelyabinsk, Russia).




The major challenges proceeding from artificial space objects (space debris, space vehicles, satellites) are:

- Collisions between these objects,
- Their explosion or fragmentation,
- Their uncontrolled entry into the atmosphere.

There are an estimated 750,000 objects more than 1 cm in size orbiting the Earth, with destructive potential if they collide with active objects. Annual uncontrolled entries of objects into the atmosphere are estimated at 100 tonnes of objects, at a rate of one medium-to-large-sized event per week. This is a growing problem due to the launching of objects into space (small satellite mega-constellations and small launchers), increasingly cheap access to space, the consequent entry of new countries and actors into the space race, and what is known as the Kessler syndrome, with the proliferation of space debris leading to a cascade of collisions.

The major challenges coming from the atmosphere are:

- Space weather that could affect the quality of satellite data transmission and reception links, and of satellite optical imaging. Severe weather phenomena diminish the security of air operations, conditioning flight routes and the airports that can be used as alternatives.

- Volcanic eruptions have already shown their power to disrupt air transport: In 2010, the eruption in Iceland of the Eyjafjallajökull volcano caused mass cancellations and re-routing of flights across Europe. Volcanic ash from eruptions can form clouds that put flights at risk; since they tend to remain in the atmosphere for a considerable amount of time, they can have a severe environmental and economic impact.

- Climate change (understood as a change in the statistical distribution of weather patterns over a prolonged period of time) can increase the number of extreme and adverse weather events with disruptive consequences for aviation.

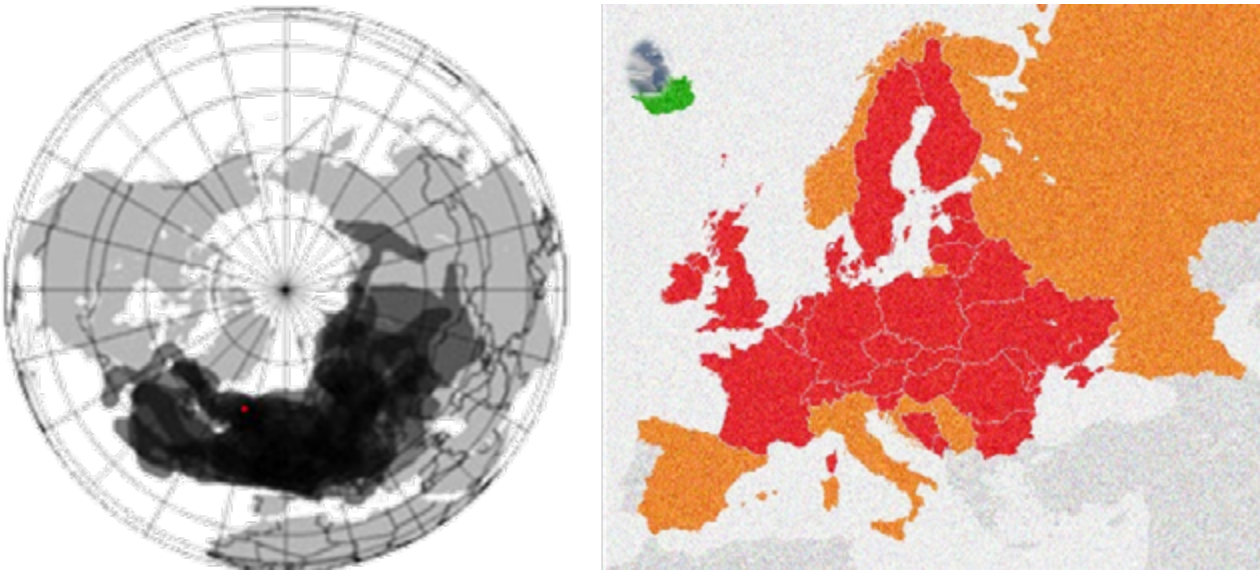


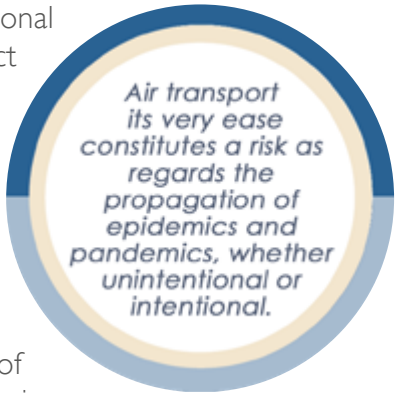
*Figure 17. Eyjafjallajökull 2010. Dispersion of volcanic particles and impact on air traffic. (Red: closed. Orange: partially closed)*

The aeronautical disasters or accidents they cause have a huge media impact, causing panic and eroding trust in the industry.

Moreover, air emergencies can become disasters if they are not addressed effectively by the bodies in charge of executing response and civil protection plans, search operations for stricken aircraft, providing notification on incidents and accidents, and assisting victims and their families.

## Epidemics and Pandemics

Air transport has enabled exchanges between societies as never before in the history of humankind; its very ease constitutes a risk as regards the propagation of epidemics and pandemics, whether unintentional or intentional, since in many cases it is impossible to detect disease carriers before they board a plane, or during a flight. Ebola and Zika are examples of viruses that can potentially be propagated through air transport if adequate prevention mechanisms are not put in place.




Fresh, matured or cured products of animal origin, transported by air from areas affected by contagious diseases in cattle, can also carry viable pathogens, acting as a source of infection for other animals. Foot-and-mouth disease and swine fever are some examples.

Likewise, plant products can carry pests or diseases that can seriously threaten forests and crops.

In recent years, there has been an increase in animals (including birds and reptiles) being transported in passenger aircraft, without any kind of health controls. Moreover, there is the risk of imports hidden in baggage of species classified in national regulations as invasive aliens, which have the capacity to wipe out native species.

*Figure 18: Arcraft equipped for aeromedical evacuation.* *Photo: Spanish Air Force*

Lastly, the aircraft themselves can serve as a vehicle for spreading certain species of insects, such as mosquitos, which can cause epidemics if appropriate disinsectization measures are not taken. For example, insects are vectors of Xylella fastidiosa, a bacterium that attacks different plants, including grapevines, laurels, and olive, almond, plum, peach, and lemon trees, and whose means of eradication have yet to be found.

## Air and Noise Pollution

A key factor for national aerospace security is the compatibility of air operations with the environment, promoting measures to reduce noise and other factors with an impact on the natural environment, including pollutant emissions.


With the coming decades' projected growth in air traffic, environmental problems associated with aircraft operations could represent a significant limitation to economic development in certain cities and regions.

Space systems have a negligible impact on air pollution, except for launch vehicles and falling objects which can vaporize upon re-entry into the atmosphere and may contain toxic substances (e.g., hydrazine). As regards noise pollution, the only impact is that of launchers, which only affect the population very slightly due to the remote location of launch bases, the short duration of launches, and their low number.

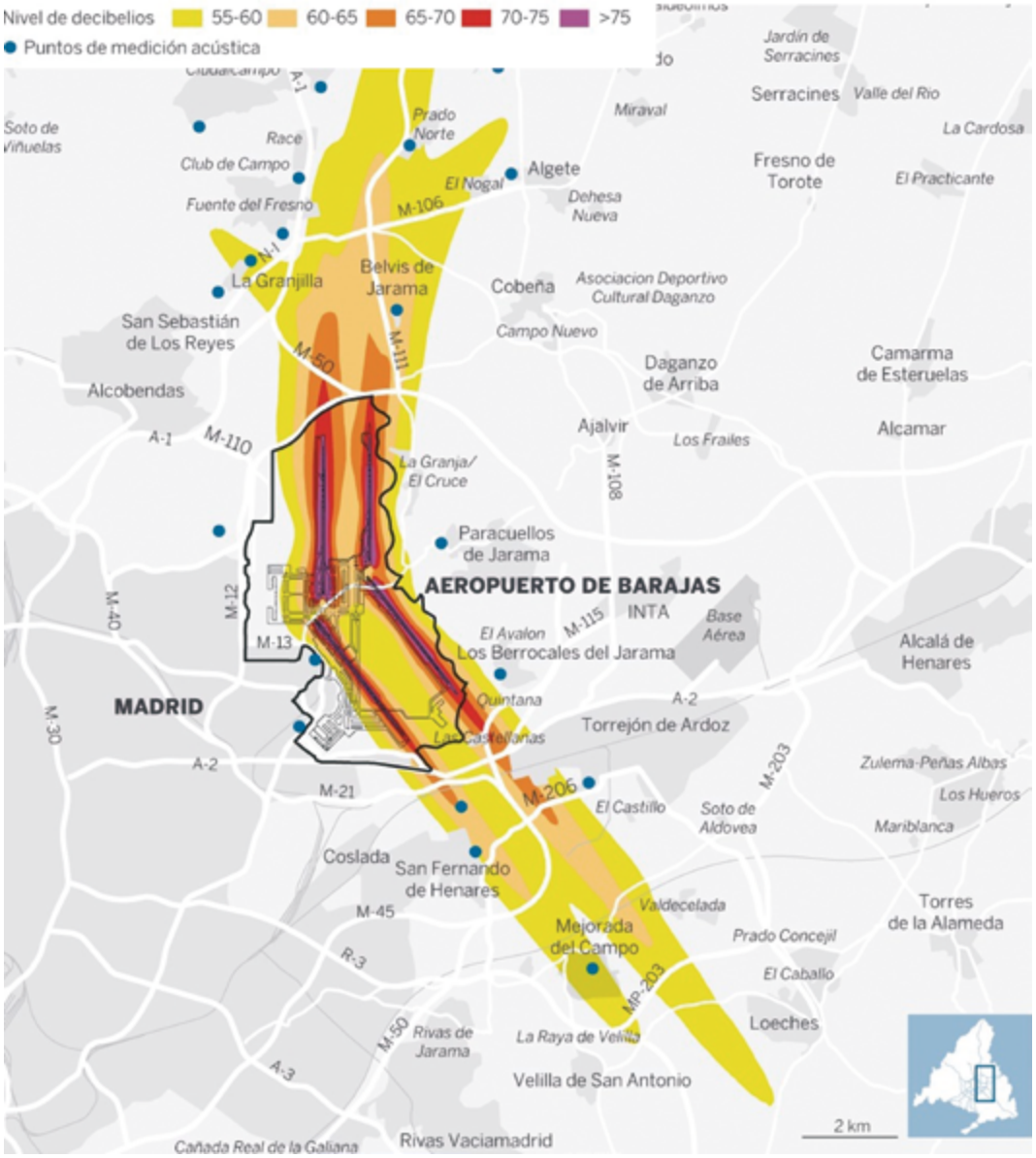



*Figure 19: Noise map of an airport* *Image: Ministry of Infraestucture*

# Chapter 3

## PURPOSE, PRINCIPLES, AND LINES OF ACTION

# Purpose, Principles, and Lines of Action

## Purpose. The Guiding Principles

Spain's 2017 National Security Strategy defines the goal for aerospace as *"Guaranteeing security in airspace and outer space within a shared framework aimed at counteracting the threats and challenges that arise in these environments, and neutralizing the consequences thereof, in accordance with the principles of efficiency and utmost coordination, in both use of analysis and assessment capacities and of capacities to respond to challenges".*

The different administrations in Spain have a solid permanent structure which, duly coordinated, should provide the public with an acceptable level of protection against the threats described above, which are shifting at the speed of technological change. Since aerospace is a complex environment in which many countries are acting, ensuring external coordination with our allies through bilateral and multilateral consultations—among other measures—is vital to achieving greater efficiency and resilience for our

aerospace security system, whose internal coordination is absolutely essential to achieving a high degree of external coordination.

The Guiding Principles set forth in the 2017 National Security Strategy— unity of action, anticipation, efficiency, and resilience—are fully applicable to aerospace security.

**Unity of Action:** Any response to an aerospace security incident potentially involving different State agents will be strengthened if it is coherent, coordinated, and resolved quickly and effectively—all of which is achievable through the proper preparation and organization of the State's unity of action.

Specialized, well-prepared staff is necessary to achieve this, through training and the proper dissemination of information among the agencies involved.

Centralized management of aerospace crises makes it possible to maintain a comprehensive view of the threat or challenge, enabling the use of available resources as quickly, efficiently, consistently, and comprehensively as possible.

**Anticipation**: The special nature of aerospace and of the stakeholders involved demand anticipation mechanisms in specialized agencies to provide the necessary aerospace intelligence to guide national action in crisis situations.

Anticipation prioritizes preventive actions over reactive ones. Effective systems able to share information in almost real time allow for a good awareness of an aerospace situation. This is essential to minimizing response times, which is critical to reducing the impact of threats and challenges.

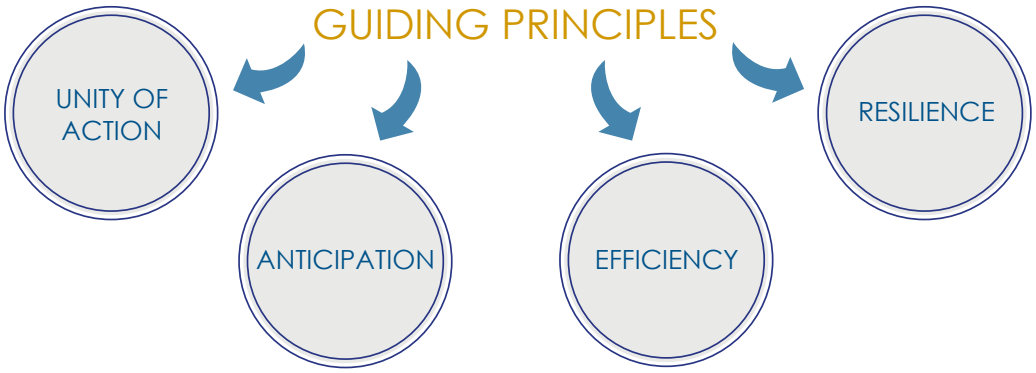
**Efficiency**: Aerospace security requires the use of high-tech multipurpose systems, which have very demanding operational and maintenance needs. These systems are generally highly complex, requiring advance planning, and have high development, procurement, operational, and maintenance costs.

The current—and future—scenario is one of austerity which, together with the social responsibility to obtain maximum performance from the resources available, forces

the State's aerospace action to be geared towards optimizing aerospace security resources. Unity of action, information sharing, and resource integration are all essential to achieving the desired level of efficiency.

**Resilience**: Resilience is a basic characteristic of systems and critical infrastructure in aerospace. Since this is a key sector that enables activity in all other areas, it is foreseeable that it could be threatened from the first moments of any crisis.

The State is required to ensure the availability of those assets considered essential for the nation, improving their protection against threats and challenges. Especially noteworthy is the strengthening required to address cyberthreats, electronic disturbance, and threats to data and communications networks and to command and control systems—all essential assets in the aerospace sector.



## Lines of action and specific measures

The overall objective defined by the 2017 National Security Strategy is translated into five lines of action, to be carried out through a series of specific measures to preserve national security and aerospace.

### Line of Action 1: Promote coordinated action from all public administrations and ministries with responsibilities in matters concerning airspace and outer space, enabling synergies and cross-cutting solutions.

When faced with a security threat or challenge, and possessing knowledge of the aerospace situation, a process must be triggered to assess possible response options. The need to minimize the possible impact requires the existence of chains of command and protocols that minimize reaction times and provide for a flexible response. These mechanisms must strengthen all kinds of ties within the administration, favouring the delegation of responsibilities and the decentralized execution of actions.

Given the high cost, in time and resources, of acquiring aerospace capabilities, it is essential to avoid overlaps between the different ministries through an appropriate distribution of responsibilities and resources. The designation of certain bodies to provide certain services in a centralized manner for the entire country—based on their suitability, experience, or availability—will lead to better overall resource performance. This model would focus on achieving a unity of aerospace action for the entire country, aligning our efforts to make them more sustainable and efficient.

The measures that fall under this line of action stress four main areas: Coordination, Organization, Training, and Culture of Security.

## Coordination

Conduct and improve coordinated action and exchange of relevant information between the different levels of the public administration and with the elements of civil society considered necessary, so that the designated authorities can have access to the necessary information in a timely manner for decision-making in crisis situations.

Specifically:

- Strengthen the coordination mechanisms and foster synergies between the different administrations and bodies involved in aerospace security.
- Make use of all available sources of information, including big data, artificial intelligence, and response impact simulations to anticipate, as much as possible, crisis situations that could occur in aerospace, and to prepare the right responses to them.
- Promote cooperation in the areas of intelligence and criminal investigations regarding risks threatening the aerospace sector.
- Promote coordinated action between national agencies when faced with threats and challenges, establishing protocols for action and developing the necessary capabilities.
- Enhance coordination and exchange of information between the different agencies and bodies with responsibilities in the regulation, production, management, tracking, and operation of unmanned aircraft.
- Establish prevention and response plans amongst the different administrations aimed at addressing the challenge of pandemics and epidemics that could be transmitted by using air transport.

- Increase efficiency by exploiting the synergies in aerospace capabilities between different organizations under the aegis of the administration, as well as collaborations with private enterprises, promoting the most efficient optimization and distribution of resources to make the best use of public spending.

## Organization

In aerospace, it is crucial to develop and maintain response capabilities that are sufficiently flexible and are up to the task of addressing events that could affect national security. These capabilities require four essential elements:

- A unified system of constant observation, surveillance, and tracking providing real-time information on the aerospace situation and potential threats.
- A system that provides comprehensive visibility regarding available response measures to carry out the chosen corrective action.
- A centralized, streamlined chain of command for decision making, based on a regulatory framework that favours cross-cutting, decentralized execution.
- An expert human component which, using its training, experience, and available information, is able to adequately steer the situation and propose response options.

## Training

- Upgrade aspects regarding advanced training in coordinated action in the different crisis, disaster, and breakdown scenarios involving systems associated with aerospace.

- Regularly conduct inter-ministerial and international crisis management exercises, to prepare the crisis management system for different scenarios and evaluate its response, resistance, and resilience.

## Culture

- Strengthen the culture of aerospace security at every relevant level of the public administration by holding periodic coordination meetings, training workshops on security issues, specialized seminars, etc.

- Foster and promote an aerospace security culture throughout society with a transparent, proactive, and participatory information and social communication policy.

- Take advantage of technologies that enable the sharing of and interaction with information, so that communication regarding prevention measures and/or consequences of risks and threats can be carried out accurately, quickly, consistently, and in a coordinated manner.

## Line of action 2: Capacity-building for national bodies and institutions—both public and private—with responsibilities in these areas, to address the different threats and challenges inherent in airspace and outer space.

Measures to strengthen national capabilities in the aerospace sector can be classified into two main groups: legal measures and capacity-building measures. Legal measures seek to establish a clear framework for regulating activities in airspace and outer space, whereas capacity-building measures seek to step up and improve capabilities to achieve aerospace security.

### Legal measures:

- Continue to promote national and international regulation of outer space.
- Given the current lack of definition regarding the upper limit of the sovereignty of national airspace and the foreseeable proliferation of airborne inventions that will operate above controlled airspace, promote the regulation of the layer of airspace between the current controlled airspace and outer space, considering European and international initiatives regarding this issue.
- Update Spain's Criminal Code (1995) and Criminal and Procedural Law on Air Navigation (1964) to define violations of standards regulating the use of airspace and outer space—violations which represent a serious threat to aerospace resources and infrastructure and, consequently, the safety and security of our citizens—as criminal offences.

## Capacity-building measures:

- Steadily strengthen national systems—both civilian and military—for airspace surveillance and control, so that they can incorporate cross-cutting information from other bodies to increase their capabilities for detection, identification, and classification, and their effectiveness and resilience when faced with threats and challenges in aerospace.

- Promote the development of a dual national capacity for surveillance and tracking of outer space, closely connected with and integrated into airspace surveillance, tracking, and control systems.

- Step up and improve the necessary capabilities for coping with the use of air platforms in actions against national security, and promote collaboration and coordination between the national airspace surveillance and control system, the State Security Forces, and Spain's regional and local entities, disseminating and standardizing procedures for detecting possible criminal conduct involving these platforms.

- Develop space intelligence and space resource protection capabilities to keep our essential space services protected against disturbance, electronic warfare, and destruction, disablement, or neutralization.

- Increase the survival capacity of critical aerospace infrastructure, particularly surveillance, tracking, and defence systems, and data and communications networks, through physical and cybernetic protection systems, the satellite collision warning system, and use of redundancies to increase their resilience and guarantee their survival in the event of a threat, major failure, or sudden breakdown.

- Strengthen and consolidate collaboratively the national industrial base of the aerospace sector, promoting Spain's own technological and industrial capacities, and its participation in international programmes—bilateral,

multilateral, or arising from our membership of such organizations as the EU and NATO—that enable us to acquire knowledge and experience, create synergies, share and expand our scope of collaboration, and reduce the investment necessary to acquire these capacities.

- Strengthen the national aerospace industry to obtain greater autonomy and sovereignty, reducing Spain's dependence on third countries.
- Foster the synergies of dual use activities and technologies.
- Promote the security dimension of innovation, basic research, and technological development.
- Detect aerospace threats and challenges through the development of new tools using technological advances in artificial intelligence, big data, etc.
- Promote and introduce advanced technologies in the process of identifying passengers travelling through our airports. Set up databases that are nationally and internationally compatible.
- Activate action protocols for pandemics, led by the competent organizations (principally WHO), and their coordination with national protocols.
- Create and evaluate national protocols for pandemics.
- Complete and incorporate environmental protection measures in aerospace.

## Line of action 3: Continue to pursue risk analysis and assessment of measures to counter cyberattacks, terrorist acts, crimes and other conflicts affecting airport facilities or air transport within or outside Spanish airspace.

### Cyberthreats:

The most troubling characteristics of cyberthreats are their cross-cutting impact, their global nature—due to the lack of geographic frontiers—their easy expansion and spread due to interconnectivity, difficult detection, and the impunity arising from the complexity of identifying their perpetrators. Therefore, it is necessary to address this threat to the aerospace sector with internal capacity-building, intelligence, international cooperation, and legislative measures.

- Strengthen the capacities of prevention, detection, surveillance, and response to cyberattacks, promoting the plans included in the National Cybersecurity Strategy and allocating the resources necessary to implement them.
- Adapt operational and computer systems to the National Security Scheme (*Esquema Nacional de Seguridad*, or ENS) within the public administrations in the realm of aerospace.
- Foster the use of trusted solutions, products, systems, and services, certified for environments and equipment in sensitive networks.
- Raise cybersecurity awareness among the major national actors in the aerospace sector, adopting procedures and good practices such as those regarding the updating of system security.

- Incorporate intelligence on cyberthreats to provide predictive and strategic value as an indispensable complement to physical and logical security measures.

- Use counterintelligence measures to assist in counteracting cyberthreats in aerospace.

- Foster cooperation with other countries and international organizations to establish an international strategic framework for cyberstability in the sphere of aerospace security to enable strategic cooperation (e.g., defensive capacity-building, exchange of good practices, promoting international presence) and tactical cooperation (e.g., exchange between Computer Emergency Response Teams [CERTs], expert training).

- Promote specific international cyberspace laws to establish a common legislative framework, such as the EU Directive on security of network and information systems (NIS Directive), transposed into Spanish legislation by Royal Decree-Law 12/2018.

- Establish a comprehensive cybersecurity policy in aerospace pursuant to the principles established in the National Cybersecurity Strategy:

    - Promote systems architectures that are redundant, resistant, and resilient to cyber-aggression;
    - Manage the obsolescence of aerospace systems;
    - Audit the cybersecurity of the most critical systems;
    - Establish the specific training in cybersecurity for staff that operates and maintains aerospace systems;
    - Organize exercises to evaluate systems and staff.

- Incorporate cybersecurity criteria both in the documents defining the requirements and viability of the processes for obtaining aerospace capabilities, and in the sustainment activities carried out on platforms and critical facilities linked to the sector.

## Terrorism:

In counterterrorism, the rapid exchange of information is essential to address the threat from terrorist organizations faced by the aerospace sector. These groups' immense capacity to adapt to whatever measures are adopted necessitates the existence of specific channels for distributing intelligence on:

- Specific threats to the aerospace sector, both inside and outside of Spain;
- Tactics, techniques, and procedures that are being developed by terrorist groups to circumvent the security measures implemented.

As a complement to these measures, it is essential to increase the security measures involving staff working at or operating in airport facilities and other critical infrastructure associated with air transport, by:

- Determining the security clearance level necessary to gain access to sensitive areas of these facilities and infrastructure;
- Promoting pertinent legislation and determining the procedure for obtaining a security clearance.

## Emerging threats:

- Maintain an adequate level of intelligence on the state of emerging technological developments that could be employed against the nation's aerospace capabilities.

## Challenges:

- Develop and implement a set of technical measures regarding operational continuity and disaster recovery within the framework of sectoral plans for Critical Infrastructure Protection (CIP), both for air transport and for the space sector.

- Increase the capacities of the Spanish Space-Based Surveillance and Tracking System, in coordination with activities carried out under the aegis of the European Space Agency, the European Union, and other departments in Spain's public administrations to include improvements and new functionalities in the area of risk analysis and evaluation of security measures, specifically in:

    - Capabilities for detecting space objects;
    - Processing capabilities, including cataloguing and specific capabilities to meet space security requirements;
    - Capabilities for providing space-based surveillance and tracking services to be able to differentiate between identified objects conducting a "legal registered activity" and those that could have some kind of potentially hostile activity or intention;
    - Analysis capabilities to address the challenges of space weather, asteroids, and comets;
    - Coordination and information exchange with other space security centres or services (secure communications, secure navigation, remote sensing for security);
    - The inclusion of new analysis capabilities to face the threats identified in the event of armed conflict, terrorism, organized crime, or espionage.

- Participate in international monitoring of atmospheric and space weather, and introduce aerospace environmental protection measures.

## Line of action 4: Promoting the implementation of legal provisions concerning the civilian use of remotely piloted aircraft, ensuring the necessary balance between the safety and security of people, facilities and other airspace users, and the technological and economic development of a thriving industry in Spain.

The industry of unmanned aircraft for civilian use has enormous potential, both due to the countless uses that it could have and the economic growth that this activity is expected to generate. To unleash this potential, it is essential to regulate the multiple areas involved in these operations—and this regulation becomes increasingly complicated when it must be made compatible with other regulations affecting the same space.

For certain purposes, unmanned aircraft could be treated like crewed aircraft, and aeronautical laws and regulations could be reused, adapted to these aircraft. Aspects to include here:

- Regulation (EU) 2018/1139 of the European Parliament and of the Council on common rules in the field of civil aviation, establishing the level of security for civil aviation in the EU including unmanned aircraft.

- Royal Decree 1036/2017, which regulates the civilian use of unmanned aircraft in the sovereignty airspace. It is mainly applied to unmanned civil aircraft with a maximum take-off weight of less than 150 Kg for technical or scientific work (specialized air operations in EU terms). The standard sets all the conditions that must be met to authorize these technical works.

Implementation of legal provisions must go hand-in-hand with the operational concept of unmanned aircraft. For example, for operations within general air traffic, unmanned aircraft will have to meet the same standards applicable to crewed aircraft, with any additional guarantees required by the legislation; if the operational concept includes multiple unmanned aircraft in low-level airspace within an urban area (as per the EU's U-Space initiative), traffic management and regulation will be much more complex.

The development of this industry must include measures to address irresponsible, illicit, or terrorist uses of unmanned aircraft. Specifically, it will be necessary to:

- Promote regulatory developments enabling better control, location, and registration of unmanned aircraft.
- Develop capabilities against unmanned aircraft, and laws to regulate their use.
- Promote the creation of centres for surveillance, coordination, and effective control of unmanned aircraft, mainly in U-Space, and establish standards for coordination between these centres and the national airspace surveillance and control system.
- Coordinate and manage security aspects within the airspace surveillance and control system, regulating the scope of action of each national agency with security responsibilities.
- Promote awareness-raising actions regarding the use of unmanned aircraft by private individuals.
- Develop specific legal punitive measures for the unmanned aircraft sector.

## Line of action 5: Support Spain's role at the international level in terms of the commitments and responsibilities assumed in the field of security and safety in airspace and outer space.

Spain has traditionally participated in a wide variety of programmes, forums, committees, and working groups of international aerospace organizations, both civilian and military. The Spanish air defence system ranks among the best in Europe, and is interconnected and integrated with the Atlantic Alliance; likewise, Spain's civil air traffic control system is one of the largest and most complex in Europe, and interconnected with EUROCONTROL. In recent years Spain has been developing a Space-Based Surveillance and Tracking System, as part of its national collaboration with the EU's current space regulation programme, to expand surveillance and tracking of threats and challenges from outer space.

The Atlantic Alliance recognizes that space-based capabilities are essential for operation command and control, and to support decision-making, and therefore form an essential part of defence and deterrence policy. The Brussels summit of Heads of State and of Government in July 2018 agreed to develop a "NATO Space Policy".

Measures to strengthen aerospace security include:

- Promote Spain's investment, active participation, and representation in all international organizations, committees, programmes, forums, initiatives, and working groups of interest in aerospace security.

- Formalize bilateral aerospace security agreements, mainly with neighbouring countries, and multilateral agreements, preferably with the most influential European countries and global space powers, for mutual support in crisis situations.

- Promote international police cooperation on criminal investigations of aerospace issues within their scope of authority as regards threats from organized crime, terrorism, and cybersecurity risks.

- Strengthen mechanisms for information exchange on space surveillance with centres and agencies (civilian and military) from other countries whose coverage complements and completes Spain's own space surveillance system.

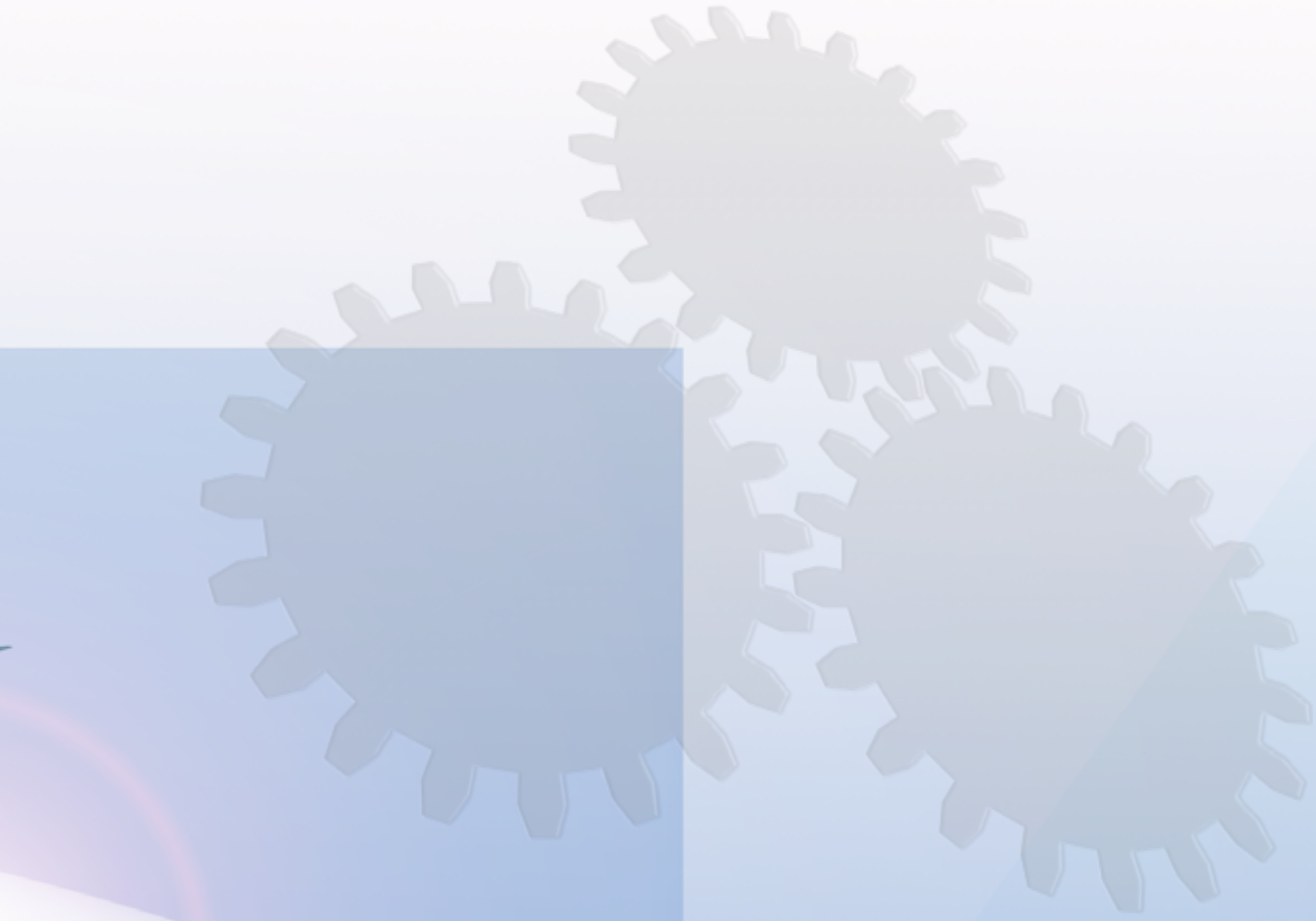
- Ensure interoperability with the aerospace command and control systems of NATO and EU countries, for the proper performance of security and defence duties in our sovereign airspace and airspace of responsibility or national interest.

- Use EU funding mechanisms to strengthen, consolidate, and improve our aerospace industrial base, contributing to the national economy and security.

- Strengthen national and international development of dual-use space capabilities.

- Improve weather forecasting capabilities and contribute to the development of international prevention, warning, and action protocols in the event of adverse weather phenomena, including those originating in outer space, in line with the studies and protection plans created for space weather phenomena.

- Cooperate internationally to mitigate the adverse effects of aviation by improving energy efficiency, using renewable energy and biofuels, and lowering airport noise levels. Promote international coordination to prevent and control the spread of contagious diseases through the international air transport system.



# Chapter 4

## AEROSPACE SECURITY IN THE NATIONAL SECURITY SYSTEM

# Aerospace Security in the National Security System

The comprehensive vision for aerospace security set forth in this strategy—the risks and threats detected that affect the sector, the objectives and lines of action proposed to jointly provide an appropriate response for preserving aerospace security pursuant to the underlying principles of the National Security System—underscores the need to have a clearly defined organizational structure, comprising the following elements, under the aegis of the President of the Government:

A. National Security Council.

B. National Aerospace Security Council.

C. A single Situation Committee for the entire National Security System to manage any crisis situation.

# Aerospace Security Organization

## A. National Security Council

The National Security Council, which operates as a Delegate Commission for the Spanish Government on matters affecting national security, assists the President of the Government in managing National Security Policy.

## B. National Aerospace Security Council

The National Aerospace Security Council provides support for the National Security Council in carrying out its duties, particularly in assisting the President of the Government in directing and coordinating National Security Policy in aerospace security.

### Duties of the National Aerospace Security Council

- Support the National Security Council's decision-making in aerospace security through analysis, study, and proposing initiatives, at the national and international level.
- Support the National Security Council in planning and coordination of national security policy related to aerospace security.
- Strengthen coordination, collaboration, and cooperation between the different levels of the public administration having responsibilities in aerospace security, as well as between the public and private sectors.
- Contribute to drafting proposed legislation regarding aerospace security for the consideration of the National Security Council.
- Evaluate the degree of development and compliance of the National Aerospace Security Strategy, and inform the National Security Council.
- Promote the necessary studies and make proposals for the National Aerospace Security Strategy to be implemented in harmony with national and

international aerospace standards and legislation, and with other strategies having an international scope.

- In aerospace security: assess the risks associated with threats and challenges; analyse possible crisis scenarios and their evolution; design and update response plans; draw up aerospace security guidelines for carrying out crisis management exercises, and evaluating the results of these exercises, in coordination with the bodies and authorities that are directly involved.

- Propose the creation of committees and working groups, standing or temporary, to carry out certain specialized duties and, when appropriate, approve their membership, including the necessary experts from the public and private sectors.

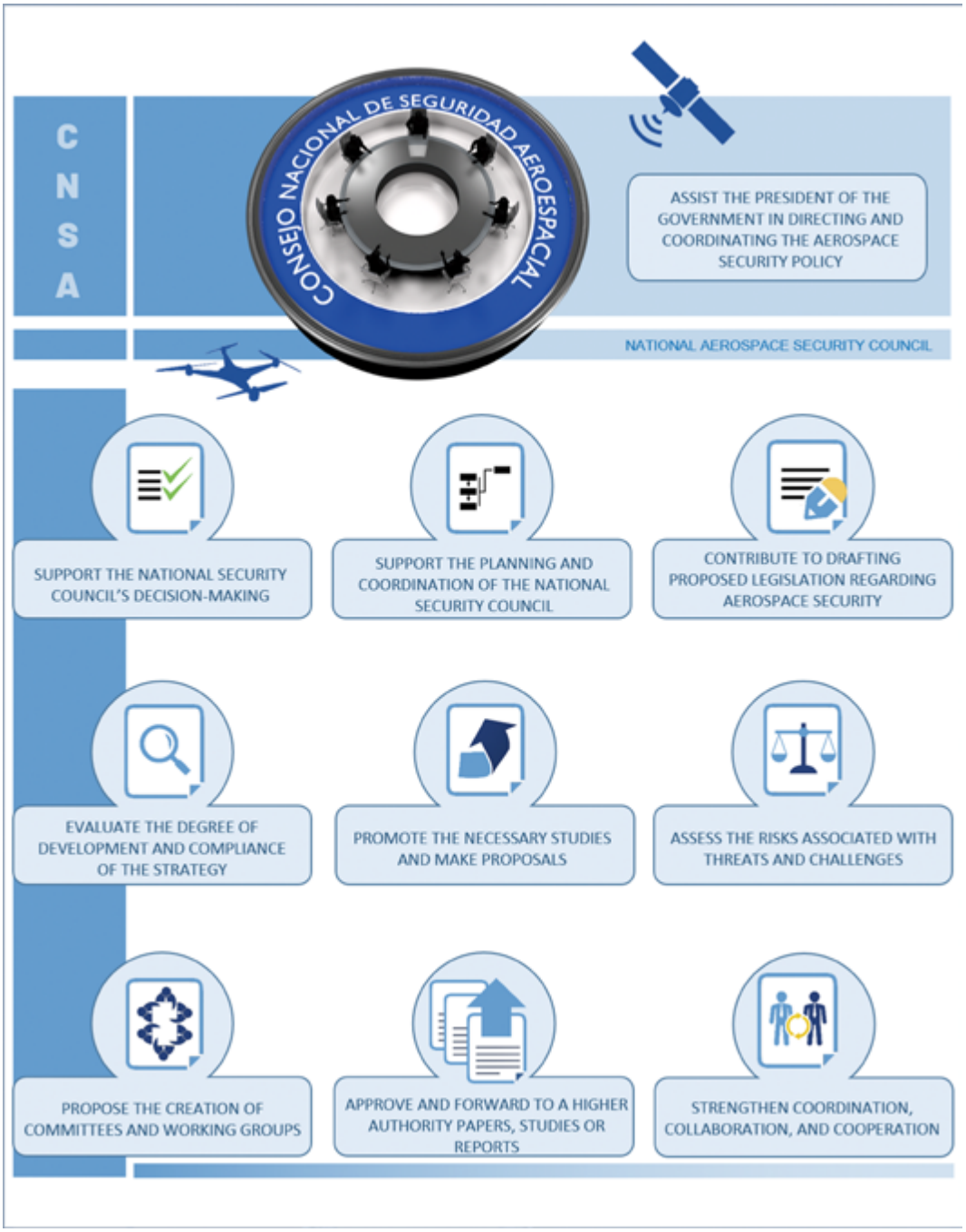
- Approve and, when appropriate, forward to a higher authority the papers, studies or reports of these committees and working groups.

- Any other duties entrusted to it by the National Security Council in the field of aerospace security.

The membership of the National Aerospace Security Council will reflect the wide range of ministries, bodies, and agencies of the public administrations having duties in aerospace security, to coordinate those actions that must be addressed jointly to raise levels of security.

Other relevant actors from the private sectors and specialists whose contribution is considered necessary may participate in the Council's work.

In carrying out its duties, the National Aerospace Security Council receives support from the Department of National Security in its capacity as the Technical Secretariat and standing working body of the National Security Council.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CONSEJO NACIONAL DE SEGURIDAD AEROESPACIAL
ASSIST THE PRESIDENT OF THE GOVERNMENT IN DIRECTING AND COORDINATING THE AEROSPACE SECURITY POLICY
NATIONAL AEROSPACE SECURITY COUNCIL
SUPPORT THE NATIONAL SECURITY COUNCIL'S DECISION-MAKING
SUPPORT THE PLANNING AND COORDINATION OF THE NATIONAL SECURITY COUNCIL
CONTRIBUTE TO DRAFTING PROPOSED LEGISLATION REGARDING AEROSPACE SECURITY
EVALUATE THE DEGREE OF DEVELOPMENT AND COMPLIANCE OF THE STRATEGY
PROMOTE THE NECESSARY STUDIES AND MAKE PROPOSALS
ASSESS THE RISKS ASSOCIATED WITH THREATS AND CHALLENGES
PROPOSE THE CREATION OF COMMITTEES AND WORKING GROUPS
APPROVE AND FORWARD TO A HIGHER AUTHORITY PAPERS, STUDIES OR REPORTS
STRENGTHEN COORDINATION, COLLABORATION, AND COOPERATION

### C. Specialized Situation Committe

The Situation Committee shall be convened to manage crisis situations involving aerospace security which, due to their markedly cross-cutting nature, or to their dimension and potential impact, overwhelm the effective response capacity of the mechanisms in place, always respecting the scope of authority assigned to the different public administrations and with a view to ensuring an immediate, coordinated, and effective response through a single body responsible for the strategic political management of the crisis.

The Situation Committee and the National Aerospace Security Council act in a complementary manner, each within its own scope of authority, but under the same strategic and political management of the National Security Council, presided by the President of the Government.

The Situation Committee is supported by the Department of National Security to ensure its interconnection with the operations centres involved and to provide an appropriate response in crisis situations, facilitating their monitoring and control and the transmission of decisions.

To effectively comply with its duties to support the Situation Committee, the Department of National Security may be additionally staffed with experts from different ministries and other competent bodies, which will constitute the specialized aerospace security Coordination Cell.

## Implementation

The National Aerospace Security Council and the Situation Committee, and the harmonization of their operations with existing bodies, will be implemented steadily through the approval of the necessary regulations and amendment of those in force, with the aim of ensuring that these National Security System components function efficiently and in coordination with each other.


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