EUROPEAN
COMMISSION

Brussels, 10.7.2024
SWD(2024) 173 final

COMMISSION STAFF WORKING DOCUMENT

EVALUATION

Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

on the implementation of the EU Space Programme and on the performance of the European Union Agency for the Space Programme

{COM(2024) 289 final} - {SEC(2024) 202 final}

Table of Contents

1. INTRODUCTION 5

1.1. Methodology 7

2. WHAT WAS THE EXPECTED OUTCOME OF THE INTERVENTION? 10

2.1. Intervention Logic 10

2.2. Description of the intervention, its objectives and performance framework 14

2.2.1. Needs 14

2.2.2. Objectives and performance framework 15

2.2.3. Input 15

2.3. Point(s) of comparison 20

3. HOW HAS THE SITUATION EVOLVED OVER THE EVALUATION PERIOD? 22

3.1. Current state of play 22

3.2. New developments in the period covered by the evaluation 22

4. EVALUATION FINDINGS 27

4.1. To what extent has the Space Programme been successful and why? (Effectiveness, efficiency, coherence) 27

4.1.1. Effectiveness 27

A. Galileo effectiveness 27

B. EGNOS effectiveness 30

C. Copernicus effectiveness 35

D. Space Situational Awareness Effectiveness 38

E. GOVSATCOM Effectiveness 41

F. The Programme in support of the competitiveness of the EU space ecosystem 43

G. General remarks on effectiveness of the programme towards its general objectives 46

4.1.2. Efficiency and Cost Benefit Assessment 51

A. Galileo Efficiency 51

B. Copernicus Efficiency 52

C. Space Situational Awareness Efficiency 53

D. GOVSATCOM Efficiency 54

E. General remarks on Efficiency 55

4.1.3. Coherence 55

A. Coherence of Galileo and EGNOS 56
B. Coherence of Copernicus 57
C. Coherence of SSA 58
D. Coherence of GOVSATCOM 59
E. Coherence and synergies with other EU funding programmes (Horizon Europe, Invest EU) 59
F. Contribution of the Programme to United Nations Sustainable Development Goals .. 65
G. General remarks on coherence 67
4.2. How did the Space Programme make a difference and to whom? (EU Added Value) . 67
A. EU Added Value of Galileo and EGNOS 68
B. EU Added Value of Copernicus 70
C. EU Added Value of Space Situational Awareness 70
D. EU Added Value of GOVSATCOM 71
E. General remarks on EU Added Value 71
4.3. Is the Space Programme still relevant? 72
A. Relevance of Galileo and EGNOS 72
B. Relevance of Copernicus 74
C. Relevance of Space Situational Awareness 76
D. Relevance of GOVSATCOM 78
E. General remarks on relevance 79
5. MAIN FINDINGS CONCERNING THE PERFORMANCE OF EUSPA 81
5.1. Assessment of the implementation of the entrusted tasks to EUSPA 82
5.2. Assessment of the implementation of the EUSPA core tasks 83
Core task 1: Security accreditation 83
Core task 2: Operational security for Galileo & EGNOS 84
Core task 3: Operation of the Galileo Security Monitoring Centre 84
Core task 4: Galileo Public Regulated Service Activities 84
Core task 5: Communication, promotion, and market development 85
Core task 6: Agency management 85
5.3 Independence and autonomy of the Security Accreditation Board 86
5.4. EUSPA's Conflict of Interest Policy 87
6. WHAT ARE THE CONCLUSIONS AND LESSONS LEARNED? 88
6.1 General Conclusions 88
6.2 Lessons learnt 90
ANNEX I: GENERAL INFORMATION 93
ANNEX II. METHODOLOGY AND ANALYTICAL MODELS USED 102

A. Effectiveness 102
a. Galileo Effectiveness 103
b. EGNOS Effectiveness 107
c. Copernicus Effectiveness 111
d. SSA Effectiveness 115
e. GOVSATCOM Effectiveness 115
B. Efficiency 118
a. Benefits assessment of Copernicus 119
b. Benefits assessment of Galileo 122
c. Benefits assessment of SST 125
d. Benefits assessment of SWE 128
e. Benefits assessment of NEO 134
f. Benefits assessment of GOVSATCOM 136
C. Relevance 137
D. Coherence 137
E. EU Added Value 138
ANNEX III. EVALUATION MATRIX 139
A. Effectiveness 141
B. Efficiency 142
C. Relevance 142
D. Coherence 143
E. EU Added Value 144
ANNEX IV. OVERVIEW OF BENEFITS AND COSTS 145
ANNEX V. STAKEHOLDERS CONSULTATION - SYNOPSIS REPORT 154
ANNEX VI: COHERENCE AMONG EU SPACE COMPONENT 158
ANNEX VII. OVERVIEW OF THE PROGRAMME'S ACHIEVEMENTS TOWARDS SDGS GOALS 163

Glossary

Term or acronym	*Meaning or definition*
BCR	Benefit Cost Ratio
C3S	Copernicus Climate Change Service
CAMS	Copernicus Atmosphere Monitoring Service
CLMS	Copernicus Land Monitoring Service
CMEMS	Copernicus Marine Environment Monitoring Service
ECA	European Court of Auditors
ECMWF	European Centre for Medium-Range Weather Forecasts
EEA	European Environment Agency
EGNOS	European Geostationary Navigation Overlay Service
EMSA	European Maritime Surveillance Agency
EMS	Emergency Management Service
ESA	European Space Agency
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUSPA	European Union Agency for the Space Programme
EWSS	Emergency Warning Satellite Service
FFPA	Financial Framework Partnership Agreement
FOC	Full Operational Capability
FRONTEX	European Border and Coast Guard Agency
GSA	European GNSS Agency
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRC	Galileo Reference Centre
GSMC	Galileo Security Monitoring Centre
HAS	High Accuracy Service

IOD/IOV	In orbit demonstration/in orbit validation
KPI	Key Performance Indicators
MFF	Multi-Annual Financial Framework
MOI	Mercator Ocean International
NEO	Near-Earth Objects
OS	Open Service
OSNMA	Open Service Navigation Message Authentication
PRS	Public Regulated Service
R&D	Research and Development
SAB	Security Accreditation Board
SAR	Search and Rescue
SATCEN	European Union Satellite Centre
SBAS	Satellite-based Augmentation Systems
SDA	Space, Defence and Aeronautics
SSA	Space Situational Awareness
SST	Space Surveillance and Tracking
SWD	Staff Working Document
SWE	Space Weather Events

1. INTRODUCTION

The EU Space Programme (the Programme) was established by Regulation (EU) 2021/696 (the Regulation)[1].

The **Programme** encompasses for the first time all EU space activities in one single Regulation, namely the existing space flagships Galileo and the European Geostationary Navigation Overlay Service (EGNOS), Copernicus and new initiatives on space situational awareness (SSA) and satellite communication (GOVSATCOM). Tasks are distributed between the various actors: the Commission, the European Union Agency for the Space Programme (EUSPA), the European Space Agency (ESA) and other entrusted entities[2] that are tasked with activities related to the implementation of the Programme, based on contribution agreements.

The Programme is composed of:

- **Galileo and EGNOS** for positioning, navigation, and timing services. The **Galileo** space infrastructure is based on a constellation of satellites in medium Earth orbit, working in conjunction with a global network ground-based stations and user receivers. **EGNOS** is a satellite-based augmentation system (SBAS) providing users with improved positioning information. EGNOS is composed of a constellation of at least three geostationary telecommunication satellites and a network of ground infrastructures.
- **Copernicus** for Earth observation data and services, which is served by a set of dedicated satellites (the Sentinel families[3]) and contributing missions (existing commercial and public satellites). In addition, Copernicus relies on many environmental measurements collected by data providers external to Copernicus, from ground-based, sea-borne, or air-borne monitoring systems, as well as geospatial reference or ancillary data, collectively referred to as "in situ" data.
- **SSA** to enhance capabilities to monitor, track and identify space objects and debris, increasing the performance and autonomy of capabilities under the Space Surveillance and Tracking (SST) subcomponent, providing Space Weather Events (SWE) services and mapping and networking Member States capacities under the Near-Earth Object (NEO) subcomponent.

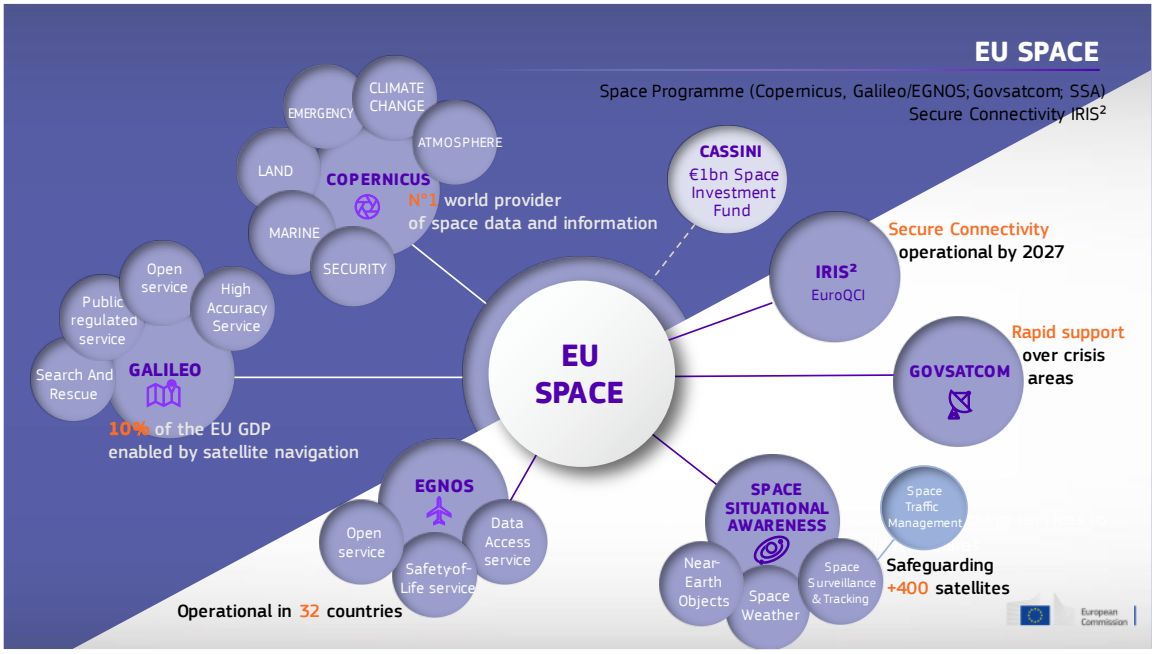
[1] Regulation (EU) 2021/696 of the European Parliament and of the Council of 28 April 2021 establishing the Union Space Programme and the European Union Agency for the Space Programme

[2] European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), European Centre for Medium-Range Weather Forecast (ECMWF), Mercator Ocean International (MOI), The European Maritime Surveillance Agency (EMSA), The European Border and Coast Guard Agency (FRONTEX), The European Environment Agency (EEA), the European Union Satellite Centre (SATCEN).

[3] About Copernicus: Discover our Satellites

- **SST** is a network of ground-based and space-based sensors capable of surveying and tracking space objects, together with processing capabilities aiming to provide data, information and services on space objects that orbit around the Earth.
- **SWE** aims at creating ways to monitor and assess natural changes related to space weather events, such as solar winds, solar flares, or coronal mass ejections. To this end, the EU supports activities that will lead to the establishment of a SWE services.
- **NEO** system is based on syndicating and federating observation and tracking data provided by a large number of European and international sources to monitor the risk of natural space objects approaching the Earth, such as asteroids and comets.

- **GOVSATCOM** to ensure the long-term availability of reliable, secure and cost-effective satellite communication services for EU governmental users. GOVSATCOM will use the capacities and services provided by existing national satcom systems and accredited private operators. The access to these existing infrastructures will be provided through one or several operational Hubs.



The Regulation also sets up **EUSPA**[4] as an evolution of the European GNSS Agency (GSA)[5], with an extended mandate, particularly as regards the management of the exploitation of Galileo and EGNOS, the security accreditation as well as market and downstream applications development for all components. In relation to security in

[4] About EUSPA

[5] Regulation (EU) No 912/2010 Setting Up the European GNSS Agency

particular, the Agency is responsible for the security accreditation tasks for all the Union actions in the space sector through the Security Accreditation Board (SAB).

Article 102 of the Regulation mandated the European Commission to evaluate both the implementation of the Programme and the performance of EUSPA and to present a **Report** by June 2024 to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. The Report is accompanied by this **Staff Working Document (SWD)** detailing the evidence-based assessment, based on the **independent study** "Evaluation of the Performance of the Implementation of the EU Space Programme and of EUSPA" prepared by and external contractor[6].

In a nutshell, the evaluation reviews the performance of the infrastructure, the services provided by the Programme, the users' satisfaction, and the evolution of their needs, as well as EUSPA's performance and policy on conflict of interest.

1.1. Methodology

In accordance with the **Better Regulation toolbox**[7], the evaluation is based on the five evaluation criteria (effectiveness, efficiency, relevance, coherence, and EU added value), for each of the component of the Programme, with dedicated indicators and evaluation questions, in combination with the requirements included in article 102 of the Regulation.

The evaluation covers all 27 EU Member States for the period from 2021, when the first entrusted entities were delegated funds from the Programme to the most recent reporting milestone available in 2023.

As regards **data collection**, the evaluation is based on a broad range of tools, including a desktop literature review of documentation related to the implementation of the Regulation, such as Programme Performance Statements, contribution agreements with entrusted entities, work programmes and annual implementation reports, targeted consultations with the entrusted entities to gather data on the implementation of the components of the Programme. A total of 70 stakeholders were interviewed from 16 organisations, representing the full spectrum of the value chain.

The evaluation also relies on consultations with the Commission services (Inter- Service Group on Space), dedicated meetings with the Space Programme Committee's different configurations and a meeting with representatives of the industry in the framework of the Commission Expert Subgroup on Policies & Programmes relevant to EU Space Defence and Aeronautics Industry (SDA Expert Group)[8], in particular on the procurement aspects.

[6] Mid-Term Evaluation of the Performance of the Implementation of the EU Space Programme and of EUSPA

[7] Better Regulation Toolbox

[8] Register of Commission Expert Groups and Other Similar Entities

In addition, a **Call for Evidence** was published on the "Have your say portal"[9] and it has received responses from the largest and most representative associations in the sector, representing over 150 members from numerous countries (a detailed summary is in Annex V).

The **cost benefit analysis** of the quantitative data, in particular for the efficiency criteria is based on calculation. The efficiency matrix is based on a ratio between the benefits of a Programme component and the budget allocated to it. The benefits of the different components with models and calculations are explained in Section 4 and detailed in Annex II.

Therefore, the results presented in the evaluation are based on solid evidence and robust calculations. More details on the methodology, data gathering, and the calculations are explained in the different Sections of the SWD and in its Annexes. Additional information can be found in the Study.

As the Regulation has entered into force on 28 April 2021, many activities related to the new established components, SSA and GOVSATCOM, started their operational phase only at the end of the evaluation period, therefore it was not possible to carry on a detailed assessment. In other cases, the conclusion of the contribution agreements with certain entrusted entities was longer than expected, with a consequent delay in the implementation of the entrusted tasks.

In addition, since Galileo, EGNOS and Copernicus were launched before the current Multiannual Financial Framework (MFF), it was not always possible to perform a cost benefit assessment or measure the impact for the period 2021- 2023, as it would not be an accurate comparison between costs and benefits. Whereas costs are instantaneous, the benefits from the exploitation of EU space components are the consequence of the investment to develop the infrastructures, including the investments made before the programmes became completely operational. Consequently, they are inherently long-term and continuous, collectively allowing for the continuity of the Union's efforts in their respective domains towards their respective objectives. Also, some of the investments done under this MFF (for all the components) will be measured in the next timeframes. Moreover, the Programme components were launched at different points in time and with different roll-out, which result in non-homogeneous overall timeframes of each component. Consequently, several estimations of the Programme's effectiveness and efficiency are based on longer-time projections, apportioned, where possible, to the reference period of the present evaluation. It would not only be difficult to analyse solely the Programme's performance in the timeframe of 2021-2023, but also unjustified against the Programme's design and objectives. It would also skew the assessment, making it cost-heavy in the expectation of future benefits that have not fully materialised in the period covered by this evaluation. The evaluation also recognises the difficulties in

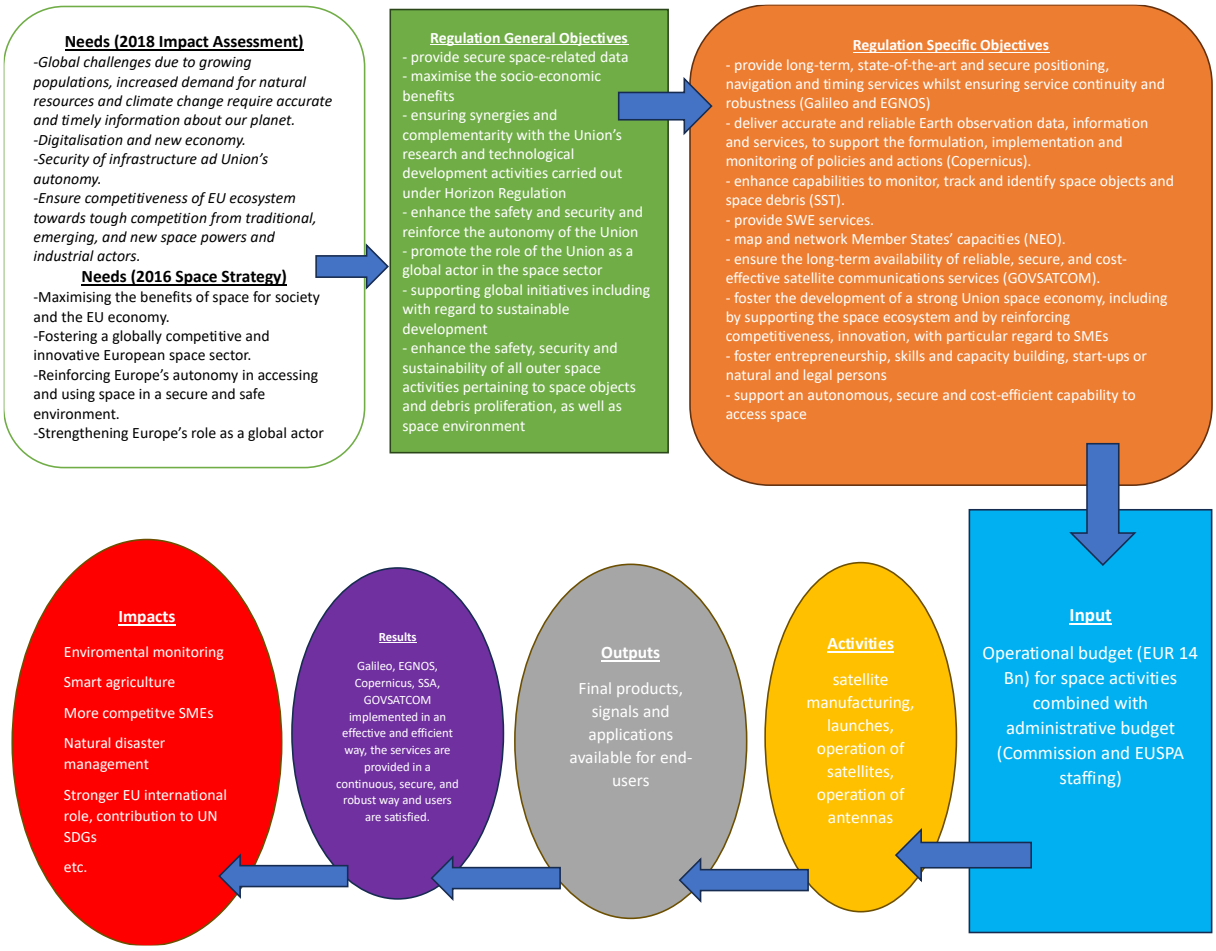
[9] Mid-Term Evaluation of the Space Programme

attributing the benefits to the functioning of the Programme's components, which for most parameters are not isolated in the space and space-based systems. To address the co-existence of various systems and activities, the analysis of efficiency took into account several contribution scenarios.

2. WHAT WAS THE EXPECTED OUTCOME OF THE INTERVENTION?

2.1. Intervention Logic

The intervention logic of the Programme builds upon the legal text of the Regulation, the Impact Assessment accompanying the Commission proposal for the Regulation[10] and the 2016 Space Strategy for Europe[11] (the Space Strategy) mentioned in Section 2.3 (point of comparison). The starting point of the intervention logic consists in the needs justifying the EU intervention. Section 2.2 below provides more detail on the components of the intervention logic, supplementing the present schematic explanation.



[10] SWD/2018/327 on the Impact Assessment Accompanying the Proposal for a Regulation Establishing the Space Programme of the Union and the European Union Agency for the Space Programme

[11] COM(2016) 705 on the Space Strategy for Europe

The general and specific **objectives** of the Regulation are included in article 4. The intervention logic then illustrates how **the financial and human inputs,** hence the budget and the different implementing parties, support the implementation of several **activities** that lead to concrete and measurable **outputs,** based on the Regulation and the tasks entrusted via various Contribution Agreements (see Section 3). The intended **outputs** of the intervention are a synthesis of the work done by the Commission, EUSPA, ESA and the other entrusted entities for the provision of the services and their uptake, and the monitoring and update of the user needs. The Regulation and the contribution agreements also established several Key Performance Indicators (KPIs) toward which assess them. Lastly, the intervention logic considers **external factors** (described in Session 3) that must be taken into account in the evaluation.

In addition to providing an understanding of the Regulation, the intervention logic serves as a basis to assess whether the intended objectives of the intervention have been achieved and identify any shortcomings in the causal chain.

While the Commission is the overall responsible of the implementation of the Programme, the Regulation, under Title IV **'Governance of the Programme'** (Articles from 26 to 32), provides for a clear distribution of roles, responsibilities and tasks among several implementing entities, as described in Section 2.

The governance – understood as the mechanism whereby the investing organisation (the Commission) exerts financial and technical control over the deployment of the Programme and the realisation of the objectives towards the implementing actors (entrusted entities) - is not a self-standing objective, but rather a tool for the implementation of the Programme. In this respect, the governance is defined through the Financial Framework Partnership Agreement (FFPA) setting up the framework conditions to entrust tasks through several contribution agreements to the different entrusted entities, thus defining roles and responsibilities of each entity, budget allocation, activities, objectives, expected results and target, when applicable.

Moreover, while assessing the Programme, the evaluation covers the performance of all the entrusted entities in the implementation of their tasks, including EUSPA delegated tasks, while its core tasks' implementation is assessed in Section 5 (Performance of EUSPA). In the Section 4.1 (Effectiveness), the contribution of each entrusted entity is clearly identified.

As explained later in Section 3, the **market and users uptake** of EU space data and services, is assessed as part of the EUSPA's performance, while a more comprehensive

SWD on EU Space Programme User Uptake Status[12] and a Strategy on Space Data Economy[13] are under preparation.

Finally, the Regulation brings under a single legal framework different EU space former programmes and initiatives (now called components), but given the difference of management, governance, users and output of the different components, the evaluation tackles each component separately, while providing an overall assessment of the impact of the Programme.

Needs identified in the Impact Assessment	- Global challenges due to growing populations, increased demand for natural resources and climate change require accurate and timely information about our planet which only space-based solutions can provide. - Digitalisation and new economy. - Security of infrastructure ad Union's autonomy. - Ensure competitiveness of EU ecosystem towards tough competition from traditional, emerging, and new space powers and industrial actors. - Specific problems, lesson learnt, and recommendations are identified for each component.
Needs identified in the Space Strategy (2016)	- Maximising the benefits of space for society and the EU economy. - Fostering a globally competitive and innovative European space sector. - Reinforcing Europe's autonomy in accessing and using space in a secure and safe environment. - Strengthening Europe's role as a global actor and promoting international cooperation.
Objectives (Art. 4 of the Regulation)	1. Provision of space-based data information and services - To provide long-term, state-of-the-art and secure positioning, navigation and timing services whilst ensuring service continuity and robustness (Galileo and EGNOS) - To deliver accurate and reliable Earth observation data, information and services integrating other data sources, supplied on a long-term sustainable basis, to support the formulation, implementation and monitoring of the Union and its Member States' policies and actions based on user requirements (Copernicus). - To enhance capabilities to monitor, track and identify space objects and space debris with the aim of further increasing the performance and autonomy of capabilities (SST). - To provide SWE services. - To map and network Member States' capacities (NEO). - To ensure the long-term availability of reliable, secure, and cost-effective satellite communications services

[12] EU Space Users Needs - EU Agency for the Space Programme

[13] Strategy on Space Data Economy

	(GOVSATCOM). 2. Fostering the EU upstream and downstream space sector - Supporting the space ecosystem and by reinforcing competitiveness, innovation, entrepreneurship, skills and capacity, with particular regard to SMEs and start-ups - Promote the uptake of EU space data and services. - Enhance EU autonomy, in particular in terms of technology - To support an autonomous, secure, and cost-efficient capability to access space, taking into account the essential security interests of the Union. - Promote the Union as a global actor in the space. - Enhance the safety, security, and sustainability of space activities.
Inputs	1. Financial: EU budget for the Space Programme 2. Human: Commission, EUSPA, ESA, entrusted entities and Member States resources, knowledge, and expertise
Activities	Defined in the Regulation for each component (Article 44 to 69) and for horizontal activities in Article 6 and entrusted through contribution agreements to entrusted entities (e.g., satellite manufacturing, launches, operation of satellites, operation of antennas).
Outputs	Each component provides several space-based data and services in a reliable, uninterrupted, and accurate way. Horizontal activities on competitiveness and SME's participation (e.g., CASSINI initiative).
Users, stakeholders, and beneficiaries	1. Users: Core and non-core users of the different components, as defined in the Regulation 2. Stakeholders: industry, academia, research centre, NGO, etc 3. Beneficiaries: citizens, industries, academia, etc
Results	The Programme components are implemented in an effective and efficient way, the services are provided in a continuous, secure, and robust way and users are satisfied.
Impact	The Programme has enabled better monitoring and management of natural resources, as well as improved environmental protection and disaster response. Copernicus provides valuable data for environmental monitoring, climate change research, and natural disaster response, aiding in the protection of ecosystems and the mitigation of environmental risks. The number of Galileo users is growing with more than 3.9 billion devices in use by 2023. Users of Galileo and EGNOS includes users in agriculture, aviation and drones, consumer solutions, emergency management, fisheries, forestry, maritime, rail, public transport, and automotive sectors and others. Creation of new markets and opportunities for a wide range of enterprises, in particular small and medium enterprises (SMEs). EU international role on space is reinforced, including the contribution to the United Nations Sustainable Development Goals (UN SDGs).
External Factors	- Brexit - Covid - Russia's invasion of Ukraine

	- Disruption of global supply chains - Shortage of launch services - Economic recession - High levels of inflation

2.2. Description of the intervention, its objectives and performance framework

2.2.1. Needs

The EU has been developing its own space initiatives and programmes since the 1990s and is one of the world leaders in space. To ensure continuity to the services provided since several decades, and in order to keep and develop its capabilities in an increasingly uncertain geopolitical environment and to preserve Europe's leadership, competitiveness, sustainability and autonomy, investing in space remains a priority.

The EU space policy and the Programme are critical for the strategic autonomy of the EU and its Member States and to support the **EU's political priorities**, in particular the European Green Deal, the Digital Transition, the EU's resilience, and the EU role in the global dimension. The Programme enables solutions to tackle **global challenges** such as sustainability and climate change, safety and security, natural disasters and mobility and strengthens the EU's role on the international scene as a global space power. With an evolving geopolitical context and new competition (and possible threats) from third countries, the Union's autonomy of action becomes even more critical, in all areas that are key for security and defence, in particular in space. In addition, it effectively provides cutting-edge data and services for areas like Artificial intelligence, autonomous vehicles and smart solutions, enhance security through critical infrastructure monitoring and provide key data to prevent, prepare for and respond to disasters. The Programme plays a crucial role in addressing cross-cutting policy topics by fostering **innovation, resilience and competitiveness** of EU companies.

The political commitments enshrined in the **2016 Space Strategy for Europe** were reflected in the subsequent **Impact Assessment** (IA) accompanying the Commission proposal for the Space Regulation that recognized the benefits of navigation and Earth observation programs such as Galileo, EGNOS, and Copernicus, as well as the EU SST initiative, requiring continuity of space-based services.

The **IA** identified global challenges such as increased demand for natural resources due to growing populations and climate change. These challenges require accurate and timely information about the planet, which can be provided by space-based solutions. Space serves as a crucial public investment in addressing priorities like sustainable resource management, climate change mitigation, emergency response support through Earth observation (Copernicus), and enabling smart transport systems and precision agriculture through Global Navigation Satellite Systems (EGNOS and Galileo). The IA also emphasized the importance of secure satellite communications for public security actors

and protecting vital space infrastructure against space debris and space weather events through a Space Situational Awareness program.

In terms of competitiveness, the European space industry is facing tough competition from traditional, emerging and new space powers and industrial actors. Moreover, the business environment is shifting focus from infrastructure to applications and services. This puts the European industry under pressure (from launchers to satellites to downstream service providers). These economic and business shifts constitute a major driver of change for the sector which calls for the need for EU-level intervention in order to accompany this transition and allows a smooth and balanced transformation of the sector.

2.2.2. Objectives and performance framework

The Regulation defines for the Programme general and specific objectives. In order to measure the progress towards these objectives, the Regulation also defines indicators. The progress against the indicators is tracked through the **Programme Performance Statements**[14] which are published every year. Further technical and budgetary indicators have been defined by the Commission in contribution agreements with entrusted entities and are also tracked through internal annual reporting.

As **general objectives**, the Programme provides, maintains, and promotes the use of EU space data and services to support the EU's political priorities. It also fosters the development of European space industry, enhances the security of the EU and its Member States, reinforces autonomy in areas of strategic importance and promotes the role of the EU as a strong global space actor.

The general objectives are further translated into specific ones: to provide positioning, navigation and timing services; to deliver Earth observation data, information and services; to monitor, track and identify space objects and space debris; to provide space weather services and to map and network Member States' capacities; to ensure satellite communications services for governmental users; to support an autonomous access space; to foster the development of a strong Union space economy.

2.2.3. Input

The Programme has a total budget of EUR 14.88 billion for the period from January 1, 2021, to December 31, 2027. This budget is allocated as follows: EUR 9.017 billion for Galileo and EGNOS, EUR 5.421 billion for Copernicus, and EUR 0.442 billion for SSA and GOVSATCOM each. Its implementation is constantly monitored and reported.

[14] Programme Performance Statement

The Programme is implemented by the Commission, EUSPA, ESA and other entrusted entities referred to in the Regulation. The **Commission** has overall responsibility for the Programme, managing and overseeing the implementation of all activities on behalf of the EU.

EUSPA is in charge of the security of the Programme that includes security accreditation of all components of the Programme, through the Security Accreditation Board (SAB). EUSPA is also responsible for the operational security of Galileo and EGNOS, which is provided through the Galileo Security Monitoring Centre, (GSMC) and for the provision and delivery of the Galileo Public Regulated Service (PRS) for governmental users. Another key part of work of EUSPA is communications, market development and promotion of Galileo and EGNOS, and of the data, information and services offered by Copernicus without prejudice of activities performed by entrusted entities and the Commission.

In line with Article 28.4 of the Regulation, the Commission, EUSPA and ESA signed in June 2021 a FFPA defining the roles, responsibilities, and obligations of the Commission, EUSPA and ESA with regard to each of the Programme's components and necessary coordination and control mechanisms. This Framework Agreement was followed by three contribution agreements entrusting specific tasks and budget to EUSPA and ESA.

In case of **Galileo and EGNOS** the Commission has delegated the operational management of the programme to EUSPA, which oversees how Galileo and EGNOS infrastructure is used and ensures that services are delivered as planned and without interruption. Galileo's and EGNOS design, deployment, evolutions of the system and the technical development of infrastructure are entrusted to ESA.

For the implementation of **Copernicus**, the tasks entrusted to ESA include coordinating the space component and its evolution, designing, developing, and constructing the Copernicus space infrastructure, including its operations and related procurement, and where appropriate, providing access to third-party data. EUSPA is entrusted to support the development of downstream and integrated applications based on Copernicus. The Commission also signed contribution agreements with following entrusted entities: EUMETSAT, EEA, MOI, ECMWF, EMSA, FRONTEX.

For the **SSA component**, EUSPA was entrusted to support the Commission as far as project management and technical matters are concerned, in particular in preparation of the operational users' management/coordination, while ESA is with tasks in the area of space weather and NEOs such as mapping Member States' capabilities for detecting and monitoring NEOs, establishing and maintaining a European NEO catalogue or elaborating user needs and service quality criteria regarding the space weather.

Regarding **GOVSATCOM**, EUSPA has been entrusted with the procurement and the setting-up of the secure operational ground segments (GOVSATCOM Hubs), in addition to other tasks related to support for the definition of technical requirements, downstream

activities and for security related activities. ESA has been entrusted with a set of system studies and upstream research and development activities for satellite communication key technological building blocks.

2.3.4 Activities

The activities linked to each component are defined in several Articles of the Regulation (Articles 44 to 69 and Article 6 for horizontal activities in support of the space ecosystem). Different tasks are entrusted to the various implementing actors (EUSPA, ESA, entrusted entities) through several contribution agreements, as listed in section 3.

The Regulation also includes several actions implemented by a wide range of entities and tools (Commission, EUSPA, ESA, European Investment Fund, and others) to boost a competitive and innovative EU space ecosystem and build synergies with other EU programmes, such as the **In Orbit Demonstration/In Orbit Validation (IOD/IOV**) service[15] or the **Cassini Space Entrepreneurship initiative (Cassini)**[16], that are covered by the evaluation.

2.2.5 Outputs

Each component of the Programme delivers or will deliver several space-based services, with unique features and application.

Global Navigation Satellite Systems (Galileo and EGNOS)

- Galileo Open Service (OS), free of charge for positioning, navigation, and timing.
- Galileo High Accuracy Service (HAS) for added-value high precision services (in a different frequency band then the OS).
- Galileo Public Regulated Service (PRS) restricted to government-authorised users, for sensitive applications that require a high level of service continuity and resilience.
- Galileo contribution to the Search and Rescue (SAR) system to quickly locate and help people in distress.
- Galileo Emergency Warning Satellite Service (EWSS) to alert the population in case of a looming disaster (fire, storm, floods, tsunamis, volcano, industrial etc).
- Galileo Open Service Navigation Message Authentication (OSNMA) to deliver authenticated data, assuring users that the received Galileo navigation message is coming from the system itself and has not been modified. EGNOS Safety-Of-Life service for aviation (free of charge) including an integrity message alerting users to any failure in Global Positioning System (GPS) or Galileo signals.

[15] In-Orbit Demonstration and Validation (IOD/IOV)

[16] Space Entrepreneurship Initiative - CASSINI

- EGNOS data access service, free of charge, providing EGNOS information through terrestrial means.

Earth Observation (Copernicus)

- Copernicus Services, providing information in order to satisfy public sector needs and those arising from the Union's international commitments:
    - Copernicus Atmosphere Monitoring Service (CAMS)
    - Copernicus Marine Environment Monitoring Service (CMEMS)
    - Copernicus Land Monitoring Service (CLMS)
    - Copernicus Climate Change Service (C3S)
    - Copernicus Emergency Management Service (Copernicus EMS)
    - Service for Security applications
- Copernicus data:
    - are available and accessible to any citizen, and any organisation around the world mainly on a free, full, and open basis through different digital platforms (Copernicus Open Access Hub, Data Store, EUMETCast, Copernicus Space Component Data Access, DIAS.)

Space Situational Awareness (SSA)

- SST services[17]:
    - Collision Avoidance - Provides risk assessment of collision between spacecraft or between spacecraft and space debris and generates collision avoidance alerts.
    - Re-entry Analysis - Provides risk assessment of uncontrolled re-entry of man-made space objects into the Earth's atmosphere and generates related information.
    - Fragmentation Analysis - Provides detection and characterisation of in-orbit fragmentations, break-ups, or collisions.
- SWE service
    - election of one Space Weather Service
- NEO services
    - Establishing and maintaining a European NEO catalogue

Governmental Satellites Communication (GOVSATCOM)

To provide governmental satellite communication to identified institutional users.

2.2.6 Users, Stakeholders, and Beneficiaries

[17] SST services are provided upon request to all EU Member States, the European Council, the European Commission, the European Union's External Action Service, public and private spacecraft owners and operators, and public authorities concerned with civil protection across the European Union.

The Programme's **main users** can be divided into two categories - public authorities and decision makers fall into the first category, while commercial and private users and others, such as researchers and nongovernmental organisations fall into the second. The Regulation defines also explicitly users of Copernicus, SST and GOVSATCOM components. **Copernicus users** are split between Copernicus core users (the Union institutions and bodies, as well as European, national, or regional public bodies within the EU or Copernicus Participating States) and Other Copernicus users (research and education organizations, commercial and private bodies, charities, non-governmental organizations, and international organizations that benefit from Copernicus data and information). **SST** users are divided between EU core users: Member States, the EEAS, the Commission, the Council, the Agency as well as public and private spacecraft owners and operators established in the Union and EU SST non-core users: other public and private entities established in the Union, and international users. A **GOVSATCOM user** is a public authority, an entity entrusted with public authority, an international organization, or a natural or legal person responsible for overseeing and managing security-critical missions, operations, and infrastructures.

The **stakeholders** of the Programme are the numerous actors contributing to the Programme or who benefit from space-based services including industries, researchers, commercial users, NGOs, and decision-makers. Ultimately, the Programme serves a broad a non-measurable **number of beneficiaries, as EU citizens and industries,** e.g., people using navigation applications on their mobile phone without even know that the service is provided thanks to Galileo.

2.2.7 Results &Impact

The data and the services provided by the Programme are a public good, freely accessible to all. Results and impact are assessed in the evaluation of the Programme towards the better regulation criteria: effectiveness and efficiency of the Programme aim to assess the results of the Programme, while the coherence, EU added value and relevance will serve to evaluate the impact.

Galileo has surpassed all other constellation in terms of precision worldwide. Accuracy in above targets (on average three times better than the). The overall availability of Galileo is close to the final target value (above 99%). Galileo users' numbers increased over 3.9 billion a high satisfaction (82.35%).

For EGNOS the performance of the service has gradually improving. It was slightly under target for external reasons (harsh space weather and closure of thrid-country sites). For EGNSO the aviation sector is the largest main user, covering more than 65% of instrument runways, and above 27% of the airplane fleet by end of 2023.

Copernicus has provided data and services with reliability and continuity above targets (on average above 94.5%) for many applications, from environmental monitoring and disaster management to climate change adaptation and sustainable urban planning with high satisfaction for users (above 85%).

The results and impacts of the rest of the Space Programme are difficult to highlight as long as the components are not operational, with the exception of SST (a sub-component of SSA). SST has steadily increased the number of sensors (up to 40 including radars, telescopes and laser ranging stations). Its user numbers also increased (above 200 organisations) with more than 400 satellites registered to the collision avoidance service.

2.2.8 External Factors

In recent years, various factors such as the COVID19 pandemics and geopolitical events, such as Russian invasion in Ukraine or Brexit have caused significant changes in global trade patterns. These events have led to many unforeseen changes, as tensions and shifts in trade agreements, a limited availability of energy sources, technologies and raw materials, and impacts on the economy (e.g. raise of inflation). As a result, the EU industries, including the ones in the space sector, have been greatly affected, hampering their ability to deliver as planned. For a detailed description of these external factors see Section 3.2.

2.3. Point(s) of comparison

The **Commission's Programme Performance Statements** for the Space Programme detail every year the baseline, annual implementation, and long term (2027) targets of the KPIs annexed to the Regulation and linked with the Specific objectives of the Programme. It clarifies the source of information and identifies the methodology; therefore it provides a clear overview on the implementation of the Programme and its components for the period 2021-2027.

Given the differences among the Programme's components and their complex implementation, the Regulation identifies several KPIs for each component with a few transversal KPIs, which are then monitored in the Programme Performance Statement.

The main KPIs contained in the Programme Performance Statements are further detailed by technical and management KPIs defined in the FFPA and in the contribution agreements (78 KPIs for Copernicus, 43 for Galileo and ENGOS, 7 for SSA, 6 for GOVSATCOM, 18 for Cassini) for which however no point of comparison is available. These are collected through regular implementation reports and serve to evaluate the implementation of the Programme and the performance of the entrusted entities. More information is available in Annex II.

The effectiveness part of the evaluation takes into account the main KPIs of the Programme Performance Statement where a point of comparison is available. For SWE, NEO and GOVSATCOM where the main KPIs listed in the Programme Performance Statements do exceptionally not provide for a point of comparison given that these Programme's components are not yet available, the analysis is based on the technical and management KPIs provided in the FFPA and in the contribution agreements which allow

to track progress towards the establishment of services for SWE, NEO and GOVSATCOM.

3. HOW HAS THE SITUATION EVOLVED OVER THE EVALUATION PERIOD?

3.1. Current state of play

The Commission has the responsibility for the overall implementation of the Programme, while it delegated different tasks to nine entrusted entities, through contribution agreements: EUSPA, ESA, EUMETSAT, ECMWF, MOI, EMSA, FRONTEX, EEA, SATCEN[18]. All of them have performed the tasks assigned within the budget allocated.

The implementation of the contribution agreements allows the provisions of a wide range of services and data to reach the objectives of the Programme and satisfy the users' needs.

For Galileo, EGNOS, Copernicus and SST some operational services have been provided to the users seamlessly, bridging with the previous MFF, while new features will be provided under this MFF. The NEO, SWE and GOVSATCOM services are under preparation.

As regards **EUSPA**, in accordance with Article 29 of the Regulation, its tasks were significantly expanded as compared to the previous MFF. The Agency was originally dealing mostly with satellite navigation, while now EUSPA essentially became the "operational arm" of the EU for the implementation of the EU Space Programme. Its core and entrusted tasks now range from managing the full exploitation and operational security of Galileo and EGNOS, the security accreditation of all components of the Programme (Galileo, EGNOS, Copernicus, GOVSATCOM and SSA), to undertaking communication, promotion and market development as well as downstream-related activities without prejudice to the activities performed by other entrusted entities and the Commission.

3.2. New developments in the period covered by the evaluation

Several developments arose during the evaluation period, all having an impact on the implementation of the Programme: Brexit, the COVID-19 pandemic, Russian invasion to Ukraine and geopolitical context of increasing power competition and intensification of threats to both to the EU and the Member States. The Programme has proven to be resilient to these as reported in the table below, while a detailed analysis is provided in the effectiveness section.

[18] The Agreement was signed in July 2023 and implementation of tasks by SATCEN was not assessed since there were no results available immediately.

External factor	Affected component	Ongoing	Comment
Brexit	Copernicus	No	Relocation of one Copernicus data centre from UK to Italy. Uncertainty regarding Copernicus budget
COVID	EGNOS	No	Slowed down deployment, (reduced system accuracy as consequence), see details in Section 4.1.1.B
Russian invasion to Ukraine	Galileo	Yes	Launcher crisis, see details in Section 4.1.1.A
Chipset shortage	Galileo	No	Slowing down the manufacturing of second generation satellites, however, not critical as long as the first generation launches are completed

The **COVID-19** outbreak in early 2020 and the high infection rate and death toll led to large scale lockdowns that effectively closed many sectors of the economy for long periods of time and stopped trade of goods, drastically **straining the global supply chains,** including in a space sector where many beneficiaries were unable e.g., to procure hardware or perform testing.

It also contributed to high levels of **inflation** due to both price increase in different sectors such as in the energy. The application of current EU procurement rules in adjusting to changing economic conditions and prices over the course of multi-year contracts could have negative impact on the European space industry.

The **Russian invasion of Ukraine** further contributed to the disruptions in space global supply chains. In addition, **launch services** for Galileo satellites with Soyuz from the French Guyana space port (Kourou) have been suspended, further to unilateral withdrawal of Roscosmos (subcontracted by Arianespace). This situation led, together with some industrial delay, to the temporary unavailability of qualified European launcher to deploy Galileo satellites in the planned timeframe. In order to secure the continuity of the Galileo constellation, the Commission had to exceptionally resort to alternative launch provider (SpaceX) securing two launches of four first generation Galileo satellites in 2024. The entry into service of Ariane 6 is expected restore the autonomous access to space for Galileo.

The rapid evolvement of the international system with geopolitical shifts like regional conflicts, terrorism, cyber threats, growing migration pressures and destabilisation strategies featuring cyber warfare and disinformation has been affecting the EU more systematically. The adoption of the Regulation and the establishment of a dedicated EU GOVSATCOM and a SSA components constituted a first step towards improved

resilience. After the entry into force of the Regulation new initiatives have been adopted in order to further strengthen the resilience and autonomy of the EU in the space domain (e.g. IRIS^2).

Regarding GOVSATCOM, several recent studies[19] concluded that the Union's current satellite communication assets cannot meet new needs of the governmental users regardless the latest technical progress that has allowed non-geostationary-orbit communications constellations to gradually offer high-speed and low-latency connectivity services. As the necessary frequency filings have been currently available within the EU, this has presented an opportunity to address the evolving needs of governmental users by developing and deploying additional infrastructure. Therefore, building on GOVSATCOM, on 15 February 2022, the Commission presented a proposal for a Regulation establishing the **Union secure connectivity programme for 2023-2027 IRIS^2,** that was adopted on 15 March 2023[20].

In the current geopolitical context of increasing power competition and intensification of threats, EU leaders identified space as a strategic domain in the Strategic Compass[21] and called for an **EU Space Strategy for Security and Defence**[22]. The Strategy aims at protecting the EU's space assets, defend its interests, deter hostile activities in space, and strengthen its strategic posture and autonomy.

In light of an increasingly congested space, there is a compelling need to act in order to maintain space as a resource for future generations. Space Traffic Management (STM) therefore aims at keeping space operations safe, space orbits usable, and space accessible for decades to come while ensuring and further fostering the competitiveness of the EU industry. Following up the already existing SSA activities, **the EU approach to Space Traffic Management**[23] aims at enhancing capabilities, norms and engagement while preserving EU interests in line with the respective competencies of the Union and its Member States.

On the 13th of September 2023, the President of the Commission presented Commission priorities for 2024, that include an initiative for an **EU Space Law**[24]**,** to provide a

[19] Notably the European Networking for satellite Telecommunication Roadmap for the governmental Users requiring Secure, inTeroperable, InnovativE and standardiseD services (ENTRUSTED), a research project funded under the EU Horizon 2020 Research and Innovation Programme as well as the "Building Blocks Towards a Secure Space Connectivity System" study (DEFIS/2020/OP/008).

[20] Regulation (EU) 2023/588 Establishing the Union Secure Connectivity Programme for the Period 2023-2027

[21] Strategic Compass for Security and Defence

[22] JOIN(2023) on European Union Space Strategy for Security and Defence

[23] JOIN/2022/4 on An EU Approach for Space Traffic Management

[24] State of the Union 2023

common framework for security, safety, and sustainability in space addressing the growth in space activities and the rapid emergence of New Space.

Brexit had only a minimal impact on the implementation of the Programme. The delay in the decision to associate the United Kingdom to the Copernicus component created uncertainty regarding the possible allocation of certain financial resources for the Programme. In the case of Copernicus, the migration of some operations from the UK to Italy due to Brexit led to some delays, however with no impacts on the services.

Despite the work carried out to promote the adoption of EU Space data and services by the market, the **European Court of Auditors (ECA)** published in 2021 a Special Report[25] that pointed out the missing of a single comprehensive strategy to support **the uptake of the EU Space data and services**. According to the report, there is a need to precise the objectives described in the 2016 Space Strategy by setting clear goals and priorities for the maximisation of benefits and to support the uptake of the different components and to add KPIs to measure performance.

The Report was followed by Council Conclusions on "EU space programmes Galileo and Copernicus: services launched, but the uptake needs a further boost"[26] . The Conclusions welcomed the recommendations recalling the importance of the user uptake to EU space-based services and acknowledging that the ECA assessment covered the period before the entry into force of the Programme. In fact, the scope of the audit is a period starting from 2014 to mid-2020 and that during this period, the key effort of the Commission was to put in place the necessary space and ground infrastructure under different legal frameworks. The Programme, for the first time, provides a common framework for all space data and services. It puts more emphasis than the previous regulations on the downstream sector, the market uptake and the exploitation of EU space data and services and continues to recognise the role of EUSPA for promoting the market uptake of EU space data and services, enlarging it to all the components of the Programme.

The ECA proposed four recommendations, which the Commission accepted, whereby the Commission is working towards delivering on them:

1. By 2023, to develop a comprehensive strategy for supporting the uptake of EU space services.
2. By 2024, to develop a conceptual framework for estimating the benefits of the EU space programmes and improve performance measurement,
3. By 2024, to ensure full readiness of Galileo and better targeted action on uptake of the EU space services,
4. By 2024, to ensure a better use the regulatory framework to support the uptake of EU space services.

[25] Special Report: EU Space Programmes Galileo and Copernicus

[26] Council conclusions on Special Report No 07/2021 from the European Court of Auditors

Following ECA's recommendations, the Commission is preparing a Staff Working Document on **EU Space Programme User Uptake Status** to present an analysis of the state of the play of the user uptake of Galileo, EGNOS and Copernicus, as the basis and first step to develop a **Strategy for Space Data Economy** by 2024, as included in the letter of intent[27] sent by the President of the Commission to the European Parliament and the Council. In addition, the Commission with the support of EUSPA, finalised a conceptual framework to measure the EU Space programme benefits.

[27] State of the Union 2023 – Letter of intent

4. EVALUATION FINDINGS

4.1. To what extent has the Space Programme been successful and why? (Effectiveness, efficiency, coherence)

Since the infrastructure, governance, services, and users of the Programme are not homogenous, the evaluation assesses each component separately, while the final conclusions and lesson learnt will tackle the Programme as a whole.

The sub-sections below (A and following) detail only the main indicators as per the Programme Performance Statement in order to have a clear and straightforward indication on the achievements of the objectives of the Programme, measured as per the indicators identified in the Regulation. The most important ones are:

- accuracy of the data and services (excellent for Galileo, EGNOS)
- continuity of the data and services (excellent for Galileo, good for EGNOS)
- number of users (very high for Galileo, EGNOS and Copernicus)
- the satisfaction of users (excellent for Galileo, EGNOS and Copernicus).

The trend is positive for all indicators as detailed in section 4.1.1. More indicators and their evolution are available in Annex II. For NEO, SWE and GOVSATCOM there are no operational services, therefore we report on the implementation of the component based on the performance of the entrusted entities, based on the methodology and evaluation matrix described in Annex II and III.

4.1.1. Effectiveness

A. Galileo effectiveness

The objective of Galileo and EGNOS is to provide long-term, state-of-the-art, and secure positioning, navigation, and timing services. These services aim to offer high precision, reliability, and availability to meet the needs of various users across numerous sectors, while ensuring service continuity and robustness.

Overall, the evaluation demonstrates that Galileo is delivering excellent performance and the services progress towards Full Operational Capability (FOC). Its success is visible against the Programme Performance Statement values from 2021 and 2022.

The achieved accuracy of navigation and timing services are already significantly better than the commitment. The primary goal for the future is to ensure that the level achieved is maintained in a stable manner.

Indicator 1: Accuracy of navigation and timing services provided by Galileo

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
Galileo horizontal accuracy										
2021	Milestones									2027
1.8m				4m						4 m
	Actual Progress									Final
	1.8m	1.3m	1.3m							
Galileo vertical accuracy										
2021	Milestones									2027
2.8m				8m						8m
	Actual Progress									Final
	2.8m	2.3m	2.3m							

The indicator "accuracy" refers to the proximity of the receiver's indicated position, as determined by the navigation system, to the actual location. The level of accuracy needed may vary between services or applications (for a typical example maritime navigation can be achieved with lower accuracy than for the other means of transport). The overall **availability Galileo services** almost meets the final target value, and the goal for the future is to ensure that the availability is maintained and stable.

Indicator 2: Availability of services provided by Galileo

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
Galileo availability										
2021	Milestones									2027
99.5%				99.5%						99.5%
	Actual Progress									Final
	99.5%	99.9%	99.2%							

The indicator ’availability’ drops down from 100% as soon as an interruption is recorded.

The main factor influencing accuracy and availability is the number of Galileo satellites in service. By 2027, the full constellation will be deployed with sufficient ’spare’ satellites in orbit, thus guaranteeing the achievement of the targets.

Galileo services were first declared in December 2016 with the OS, followed by the SAR Service. In addition, **new** unique **services** are being developed and delivered. This is the case for the **HAS** where initial service was declared on 24 January 2023 and is already providing a few decimetres accuracy worldwide. Finally, other new services are planned to be declared in the coming months and years, like Galileo’s OSNMA and EWSS.

The implementation of **PRS** is currently in progress and is proceeding according to the established schedule, expected in 2024. Further efforts however are needed to ensure its roll-out and full functionality. To mitigate inherent risks, the Commission has put in place a risk management task force with EUSPA, involving ESA and all industrial actors to monitor progress and oversee the execution of the workplan.

These developments pave the way towards robust position, velocity, and time information for Galileo users and in support of the **EWSS** that will alert the population in case of a looming disaster (fire, storm, floods, tsunamis, volcano, industrial etc).

However, despite the efforts, FOC cannot be fully achieved. In fact, following Russia’s invasion to Ukraine in February 2022, Roscosmos, a subcontractor of Arianespace, unilaterally suspended the collaboration with European partners and stopped operating

Soyuz launchers from the French Guiana space port in Kourou, leading to a temporary unavailability launcher vehicle for Galileo satellites. This has no immediate consequence on the continuity and quality of the Galileo services, however as some satellites are reaching design end of life, there is a potential risk to the service provision. To ensure the service continuity and robustness, the Commission had to exceptionally resort to use a different service provider to contract four of the first-generation Galileo satellites in 2024 as described in Section 3.2.

The **EU user satisfaction** with respect to Galileo is on an upwards trend and is expected to increase as shown below:

EU user satisfaction with respect to Galileo

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
EU user satisfaction with respect to Galileo services										
2021	Milestones									2027
80%					85%					90%
	Actual Progress									Final
	80%	82%	83%							

The **share of Galileo enabled receivers** (the most common receivers are mobile phones which incorporate Galileo chipsets) in the worldwide and the EU Global Navigation Satellite Systems receivers market is growing steadily and is expected to remain so:

Share of Galileo enabled receivers in the worldwide and the EU Global Navigation Satellite Systems receivers market

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
Share of Galileo enabled receivers worldwide										
	Milestones									2027
64%					68%					70
	Actual Progress									Final
	64%	65%	67%							

The **number of users of Galileo is growing**, with 82.35%[28]of users satisfied with the Galileo performance. Users of Galileo are from the **agriculture, drones, consumer solutions, emergency management, fisheries, forestry, maritime, rail, public transport and automotive sectors** (more details can be found in the EUSPA Market Report[29]). The User Consultation Platform regularly collects users' needs and requirements in view of new services or improvement of existing ones[30].

The largest number of Galileo users are in consumer solutions. 3.9 billion Galileo-enabled smartphones had been sold worldwide by February 2023, while the number of Galileo receivers is higher. The second largest application area for Global Navigation Satellite System (GNSS) is road and automotive, where Galileo penetration is very high, with every car bought in Europe after 2019 having Galileo in their eCall emergency call system. In SAR, major manufacturers offer Galileo-enabled SAR beacons since 2018 and

[28] Galileo User Satisfaction Survey Report 2021

[29] EUSPA EO and GNSS Market Report 2022

[30] Reports on User Needs and Requirements

integrate Return Link Service since 2021. Further information on users is available in Section 4.1.3 (Coherence).

As seen before, **Galileo services** are provided by ensuring the access to the users of Galileo service with minimized number of incidents that are dealt quickly, with no consequences. As regards **the security of Galileo**, there are no issues to report. However, there are still areas for improvement, such as implementing cyber requirements, coordinating accreditation inputs, and defining and implementing PRS downstream activities. For the **roll out of upcoming Galileo services**, there are no expected delays as EUSPA can still provide the services at the expected level even without having all the planned satellites of the constellation operational. Regarding **the development and deployment of Galileo infrastructure**, some delays in the component were reported, notably in the space segment. As the delays are related to the external factors like the launch crisis, EUSPA has however limited control to mitigate these kinds of delays.

Based on the results showed above, it can be established that the implementation of Galileo has been broadly effective between 2021 and 2023, considering the global economic and political situation.

B. EGNOS effectiveness

The main objective related of EGNOS is to provide reliable, secure, and state-of-the-art positioning and navigation, and timing services, ensuring continuity and robustness.

Overall EGNOS is demonstrating strong performance and making good progress in its services as visible against the Programme Performance Statement values from 2021 and 2022:

Indicator 1: Accuracy of navigation and timing services provided by EGNOS

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
EGNOS horizontal accuracy										
2021	Milestones									2027
2 m				1.5m						1.5 m
	Actual Progress									Final
	1m	1.2m	1.3m							
EGNOS vertical accuracy										
2021	Milestones									2027
3 m				2.5m						2.5 m
	Actual Progress									Final
	1.5m	1.7m	1.8m							

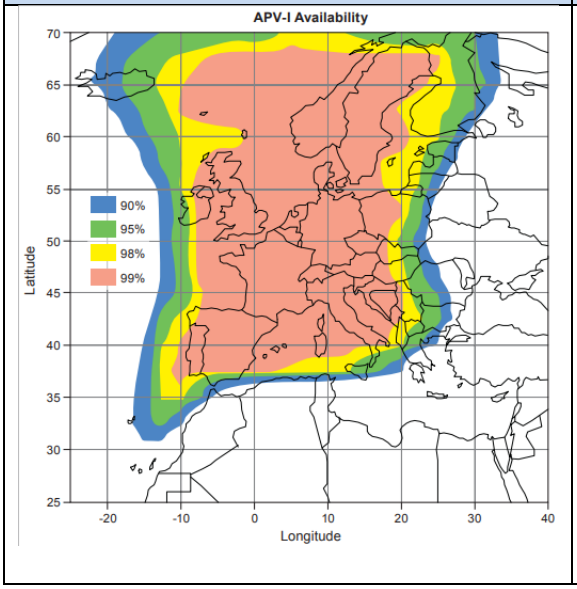
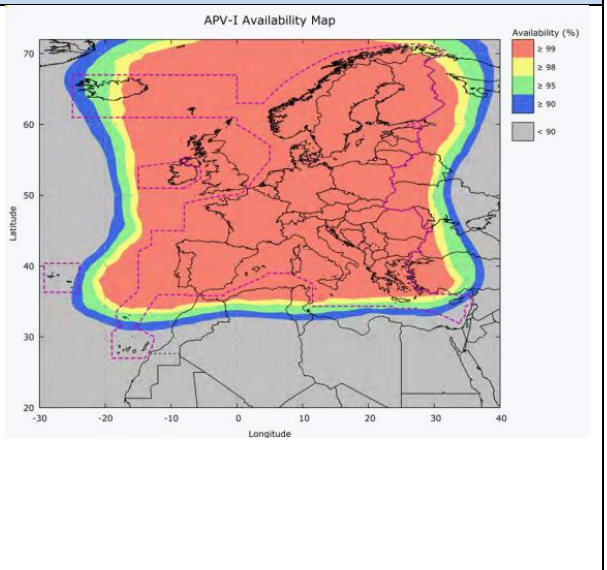
Accuracy is better than expected and already better than the 2027 target. However, some decrease was experienced in the last years, due to space weather (i.e., the increase of the solar activity), which has caused some service performance degradation. Also, the deployment of the system evolution to the updated version EGNOS V3 was slightly postponed due to industry delays, security requirements imposed during contract implementation and the COVID restrictions. However, an EGNOS evolution deployed in November 2023 largely mitigates the observed performance issues related to space weather. In addition, the service has been temporarily impacted at Europe's South East's borders due to the closure of two sites in Egypt, which was necessary to improve the

resilience of the system. The EGNOS **availability and continuity** between 2021 and 2023 is presented in the table below. Although slightly under target, it is expected that the release of EGNOS V.3 will bring the component back within the targets by 2027:

Indicator 2: Availability and continuity of services provided by EGNOS

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
EGNOS availability - APV-I										
2021	Milestones									2027
97%	97.0%	97.0%	97.0%	99%						99%.
	Actual Progress									Final
	97%.	97.4%	84%							
EGNOS continuity - APV-I										
2021	Milestones									2027
98%	98%	97%	90%		98%					98%
	Actual Progress									Final
	98%	97%	89%							
EGNOS availability - LPV-200										
2021	Milestones									
95	95%	95%	95%	95%						95%
	Actual Progress									Final
	95%	95%	80%							
EGNOS continuity - LPV-200										
2021	Milestones									
93%	93%	90%	85%		85%					93%
	Actual Progress									Final
	93%	89%	83%							
Legenda	EGNOS: APV-I = Approach procedure with vertical guidance, category 1. LPV-200= Localizer Performance with Vertical guidance to a decision altitude of 200ft. EGNOS availability - APV-I - is measured as the percentage of EU territories with APV-I availability more than 99% of the time. EGNOS availability - LPV-200- is measured as the percentage of EU territories with LPV-200 availability more than 99% of the time. EGNOS continuity – APV-I – is measured as the percentage of EU territories with APV-I continuity risk better than 5*10-4/15 seconds. EGNOS continuity - LPV-200 - is measured as the percentage of EU territories with LPV-200 continuity risk better than 5*10-4/15 seconds.									

The performance of the service in terms of **coverage** is gradually improving since the EGNOS Safety-of-Life (SoL) service was first declared in 2011.

EGNOS Safety of Life Service Definition Document v1 (March 2011)	EGNOS Safety of Life Service Definition Document v3.5 (November 2023)
	

The **geographical coverage** compliance of EGNOS **will likely be reduced** in the coming years where there will be the solar peak of cycle 25 (2023-2026) and then an

improvement is expected for compliance similar to the target in 2027 as per the table below:

Indicator 3: EGNOS services geographical coverage

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2021	Milestones									2027
97%	97%	97%	97%	97%						99%
	Actual Progress									Final
	97%	97%	84%							

The number of airports where EGNOS procedures are published **is steadily increasing with 497 airports and 935 approaches by the end of 2023** (this corresponds to around 70% of all the EU instrument approaches).

Since the Performance Based Navigation Regulation[31] mandates implementation of EGNOS approach procedures to all EU instrument approaches by 2024, the rates of 70% by end of 2023 show satisfactory progress for the implementation of EGNOS procedures. The Commission together with EASA are closely monitoring the full compliance to the Regulation, including infringement procedures if required.

Overview of the airports with existing (green) or planned (yellow) procedures[1]:



The trend is positive, and it is expected that by the end of this MFF all the EU instrument runway ends will have EGNOS as per the Programme Performance Statement:

[31] Commission Implementing Regulation (EU) 2018/ 1048

Indicator 4: Number of EGNOS procedures published (both APV-I and LPV-200)

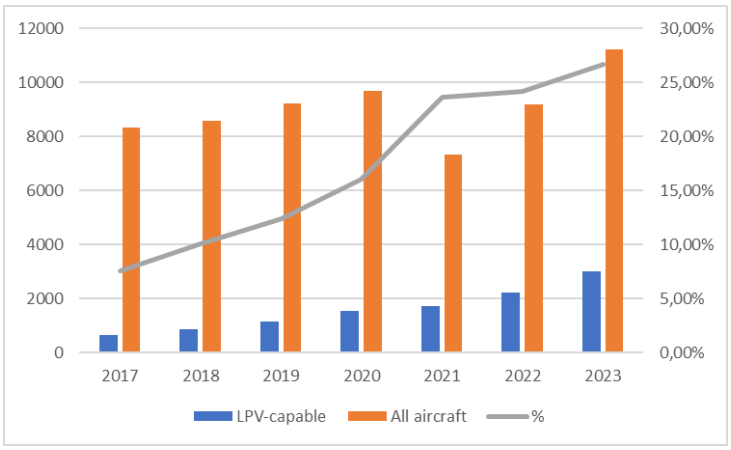
Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2020	Milestones									2027
690				900						1 150
	Actual Progress									Final
	769	870	935							

For **EGNOS receivers**, the market share **is already stabilised**:

Indicator 6: Share of EGNOS enabled receivers in the worldwide and the Satellite Based Augmentation System receivers market

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
Share of EGNOS enabled receivers worldwide										
	Milestones									2027
63	63.0%	63.0%	63.0%		64					65
	Actual Progress									Final
	63%	62.4%	62%							

In terms of EGNOS fleet equipage, around 27% of the fleet was equipped by end of 2023 (according to information provided by operators in their flight plans to Eurocontrol). This follows **the increase from the past years** in the number of aircrafts equipped with EGNOS.



	LPV-capable	All aircraft	%
2017	632	8323	7,59%
2018	863	8585	10,05%
2019	1142	9201	12,41%
2020	1548	9670	16,01%
2021	1730	7337	23,58%
2022	2213	9172	24,13%
2023	2997	11232	26,68%

(February each year, except June 2023, latest data)

EGNOS equipage evolution. Source: EUROCONTROL PRISME Network Business Intelligence

In **maritime**, EGNOS supports robust and safe navigation, with a penetration in receivers' models **above 90%** (recreational and regulated) by end of 2023, benefitting from EGNOS increased accuracy. The introduction of receivers reached 100% by 2023 in merchant vessels satellite navigation equipment (SOLAS-Safety of Life at Sea) and 89% in models for recreational vessels (non-SOLAS).

The Programme is developing a specific EGNOS maritime service for merchant vessels (based on SBAS L1 and compliant with International Maritime Organisation Resolution

A.1046[32]) to contribute to the safety of navigation. The corresponding standard for user receivers is IEC 61108-7[33].

Agriculture is a mature EGNOS user for guidance applications for basic-value crop cultivation (e.g., cereals) where 10-30cm pass-to-pass accuracy is adequate. In 2022, 93% of GNSS receivers in agriculture are EGNOS enabled. For European tractors **it is estimated that more than 97% of new tractors sold are EGNOS enabled**[34]. The use of EGNOS across a wide range of applications (e.g., farm machinery guidance, automatic steering, as well as variable rate technology and asset management) allows the farmers to better monitor their harvest yields and perform effective in-field data collection, allowing them to increase their productiveness and to lower input costs whilst at the same time minimise the environmental impact of agriculture.

EGNOS is also being used in surveying/geomatics applications. Data gathered by EUSPA[35] since 2019 estimates that in 2023 ~98% of all new mapping and Geographic Information System grade receivers are equipped with EGNOS. EGNOS provides sub-metre level accuracy removing the need for complex and costly equipment and is able to fulfil the accuracy requirements for users such as small and medium municipalities, forestry and park management, etc.

Overall **user satisfaction** is high. The trend is expected to be positive as the availability of the services will increase:

Indicator 5:EU user satisfaction with respect to EGNOS services

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
EU user satisfaction with respect to EGNOS services										
2021	Milestones									2027
85%	85%	85%	85%		87%					90%
	Actual Progress									Final
	85%	86%	89%							

EGNOS is implemented through delegated tasks to EUSPA. **The implementation of tasks** was evaluated across the following activities: EGNOS service provision, security of the EGNOS component, development of new services, development and deployment of EGNOS infrastructure and support to Commission in international activities.

As regards the **provision of services**, EUSPA is on track, although some targets are not met due to limitation in EGNOS V2. Some delays were observed in the implementation of tasks related to **the security of EGNOS** mainly because of the delay of the production

[32] Resolution A.1046(27), Worldwide Radionavigation System

[33] Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 7: Satellite Based Augmentation Systems - Receiver Equipment - Performance requirements and method of testing.

[34] 2023 EUSPA market report

[35] Egnos Fact Sheet

of EUSPA documentation both for EGNOS V2 and V3. Regarding the **development of new services,** they are linked with the implementation of EGNOS V3, therefore the service is planned to be delivered beyond 2027. Most targets are on schedule regarding the deployment of **the hardware of EGNOS**. However, a postponement is expected for EGNOS V3 and its services, due to issues with site procurement and industry delays, that have been mitigated by EUSPA.

C. Copernicus effectiveness

Copernicus aims at providing precise and dependable Earth observation data, information, and services by integrating various data sources on a sustainable basis and to support the development, implementation, and monitoring of policies and actions of the Union and its Member States, in accordance with user requirements.

All targets as per Programme Performance Statement have been achieved:

Indicator 1: Number of EU users of Copernicus Services, Copernicus data, and Data and Information Access Systems (DIAS) providing, where possible, information such as the type of user, geographical distribution and sector of activity

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2021	Milestones									2029
400 000					1 000 000					1 200 000
	Actual Progress									Final
	857 273	946 453	1 200 000							

Indicator 2: Where applicable, number of activations of Copernicus Services requested and/or served

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2021	Milestones									2029
76					300					500
	Actual Progress									Final
	76	946	232							

Amount of data generated by the Sentinels

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2021	Milestones									2029
35.000.000 data products corresponding to more than 330 million Gigabytes					85 million data products					125 million data products
	Actual Progress									Final
	45 million data products		66 million data							

Targets have been largely exceeded for **reliability, availability, and continuity** for Copernicus and are, on average >94.5%[36] and also for **volume of data generated** from the Sentinels. The number of users of data, products, or services within Copernicus is either growing or is steady with user satisfaction greater than 85% across all services and above 94% for a majority of services. As shown above, the number of registered users increased from 385 000 users 2020 to 638 000 in 2022, with the amount of Sentinel data generated being 6 800 Terabyte in 2022.

The main factors influencing the indicators above are the number of satellites in service. By 2027 it is expected to have a comprehensive constellation of satellites and instruments plus one ‘expansion’, a satellite dedicated to CO2 emissions monitoring.

[36] For example, Sentinel-2 and Sentinel 5P reached 100%

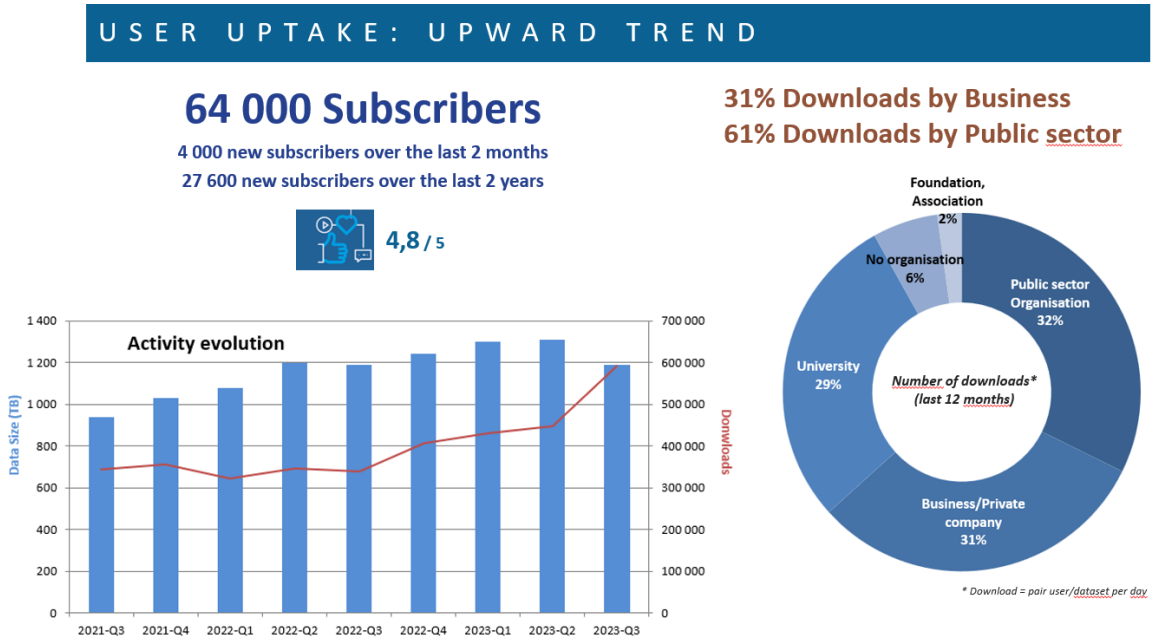


Figure: Copernicus's user uptake trend

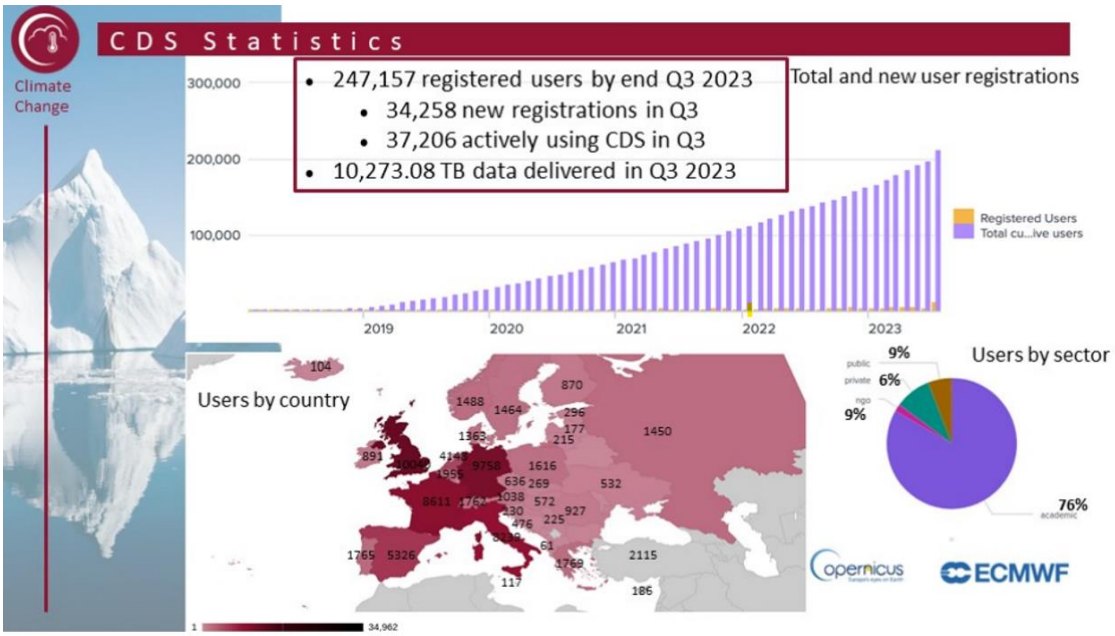


Figure: Users from Climate Change service

Additionally, new unique and specific products as for example the leaf area index (normal and high resolution) are being developed and delivered for all Copernicus services as expected. New products based on policy requests are implemented by the Copernicus services as fast as possible, but always requires a development and ramp-up phase. According with the Programme Performance Statement, in 2022 there was a slight decrease, but this is mainly due to the fact that several entrusted entities were releasing products based on funding from the previous MFF which are not covered by this evaluation:

Indicator 5: Information products delivered in the portfolio of each Copernicus Service

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2021	Milestones									2029
88%					96%					100%
	Actual Progress									Final
		56%								

The number of information products vary from service to service and can be delivered in real time, as a forecast or over a pre-fined series of time (e.g the temperature of the ocean).

The benefits of Copernicus are increasingly being recognised by the public and private sectors. The Programme effectively started implementing dedicated users related activities to expand the use of Copernicus in business and commercial applications (entrusted to EUSPA). This is reflected by the high involvement of industry at the User Consultation Platform (see Section 4.3 on relevance) and the participation of numerous start-ups and SMEs in the different Cassini initiatives with Copernicus based solutions. The **implementation of the entrusted tasks** for Copernicus is split between eight entrusted entities. Each entrusted entity was evaluated across multiple interventions that are linked to the above-mentioned Copernicus objectives, both on the deployment and management of the infrastructure and the provision of services[37].

ESA was in charge of developing and operating the space component, procuring launches, managing Sentinels and Contributing Missions data, and ensuring continuous and available data access for all Sentinel data. ESA successfully carried out most of the entrusted tasks without delays, in particular in the intervention areas of data access and distribution and user uptake. Related to data acquisition, one activity was delayed due to the external factors: the loss of one sentinel (Sentinel-1B[38]), plus the unavailability of the launcher for its replacement (Sentinel-1C). This has not led to any critical consequences as the service is provided by a third satellite (Sentinel-1A), still operational, however data is not available with the same latency. The return into operations of the VegaC launcher will ensure the nominal deployment of satellites for Copernicus.

EUSPA has been entrusted the implementation of activities related to the user uptake of data, market development, and capacity building, extension of the European GNSS User Consultation Platform to Other Copernicus users, and analysis of trends in user needs and requirements. While most of the tasks were implemented on track, the kick-off of a project on Copernicus demonstrators was delayed due to a high number of proposals, with no impact the overall implementation.

The implementation of the entrusted tasks by **other entrusted entities** (EUMETSAT, EEA, MOI, ECMWF, EMSA) is, overall, very well aligned with the contribution agreements, and despite a few delays due to external political factors such as late signing

[37] Section 3.1.3 of the supporting Study

[38] Sentinel-1B had been launched on 25 April 2016 and malfunctioned in orbit on 23 December 2021

of the contribution agreement, there were no serious impacts on the overall implementation, timeline, or budget of the Copernicus.

D. Space Situational Awareness Effectiveness

The specific objectives of **SSA** is to enhance capabilities to monitor, track and identify space objects and space debris with the aim of further increasing the performance and autonomy of capabilities under this sub-component at Union level, to provide SWE services and to map and network Member States' capacities under the NEO sub-component. Its performance was evaluated through KPIs, i.e., the number of users and the availability of services, which were not applicable for all the SSA segments since some services are not operational yet.

Among three SSA subcomponents comprising, **SST** is the most advanced one, since established during the previous MFF. SST capability has three main functions: sensor, processing, and service provision.

Funds from the previous MFF were used for SST in 2021 and 2022, therefore KPIs are reported only for 2023.

Indicator 1: Number of EU users of Collision Avoidance Services

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
	Milestones									n.a.
0			40							
	Actual Progress									Final
	n.a.	n.a.	40							

Indicator 2: Number of EU users of Re-entry

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
	Milestones									n.a.
0			149							
	Actual Progress									Final
	n.a.	n.a.	154							

Indicator 3: Number of EU users of Fragmentation Services

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
	Milestones									n.a.
0			146							
	Actual Progress									Final
	n.a.	n.a.	150							

Indicator 4: Availability of services - Front Desk Portal availability

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
	Milestones									100%
0%			95%							
	Actual Progress									Final
	n.a.	n.a.	99,9%						100%	

Indicator 5: Availability of services - EU SST Database Availability

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
	Milestones									100%
0%			95%							
	Actual Progress									Final
	n.a.	n.a.	99,9%						100%	

For information, under the previous MFF funding, the KPIs were:

2021		
	Number of users	Number of organisations

Collision avoidance	78	35
Fragmentation	193	105
Re-entry	205	111
2022		
	Number of users	Number of organisations
Collision avoidance	88	42
Fragmentation	271	143
Re-entry	298	176

The network **has added a new sensor every year** (from 38 sensors in 2021 to 40 sensors today[39]) including radars, telescopes and laser ranging stations. **SST services** is performing very well with increased number of registered organisations and satellites. There are 402 registered satellites distributed as follows in different orbits: 156 in Low Earth Orbit, 58 in Mid Earth Orbit, in 188 Geostationary Earth Orbit[40].

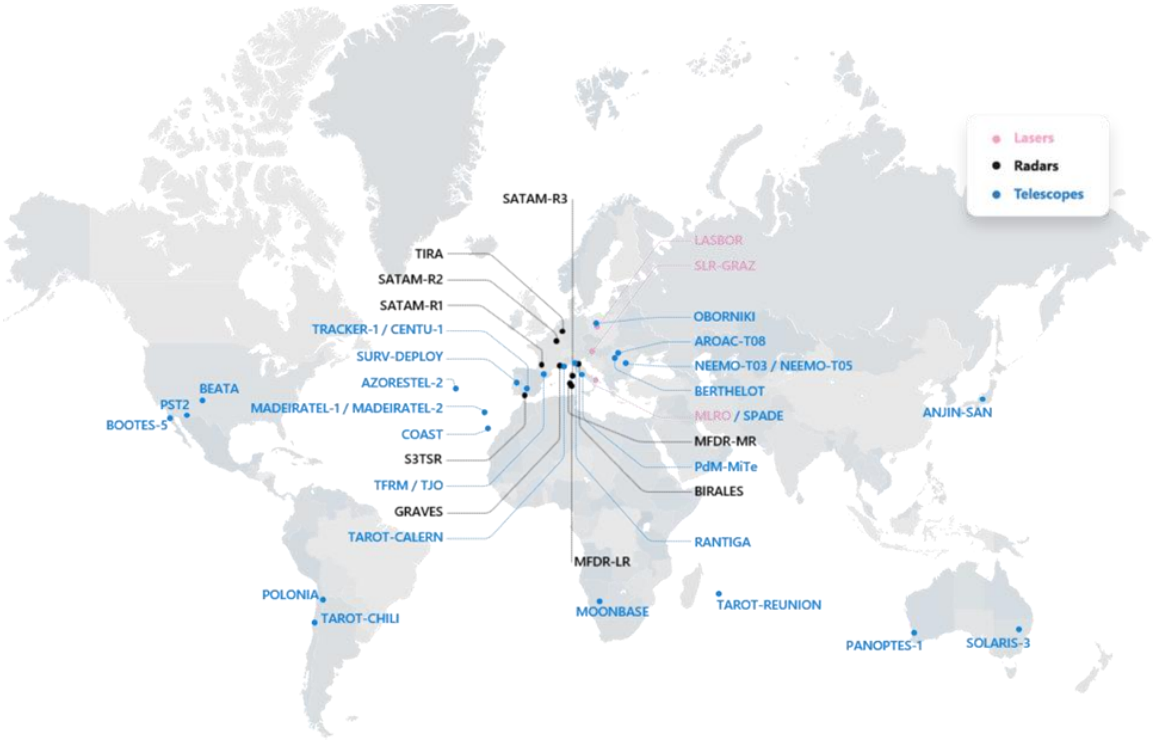
As regards the users, there is a total number of 191 registered organizations mainly operating at national or international scope with a strong focus on national entities and in particular on the industry sector (out of 191 registered users, 83 are from the industry sector)[41].

While the owners and/or operators are overall evenly distributed across all EU Member States (1 to 4 operators and/or owners for each country), France, Spain, and Germany each have twice as many.

[39] Number updated in July 2022.

[40] EU SST - About Us

[41] EU SST - About Us



EU SST Sensors Network (July 2022)[42]

The **EU SST Partnership Agreement**[43] officially entered into force on 11 November 2022, forming the SST Partnership of 15 EU Member States[44]. With this Partnership, EU SST builds on the results achieved by the previous consortium of seven Member States and ensures continuity of activities and service provision. Considering that an SST system is a network of ground-based and space-based sensors capable of surveying and tracking space objects, together with processing capabilities aiming to provide data, information and services on space objects orbiting around the Earth, the larger number of participating Member States, substantially increase SST observation and data processing capacities.

The responsibility to manage and operate the **SST Front Desk**[45] was transferred on 1 July 2023 from SATCEN to EUSPA's GSMC in Madrid, following a Commission's Decision of 3 June 2022. As the establishment of the new EU SST Partnership took longer than expected due to the expansion of EU Member States from 7 to 15, the transfer of the Front Desk was slightly delayed. However, the continuity of the SST service was ensured by SATCEN, which worked together with EUSPA for a smooth transition.

[42] EU SST Sensors Network (July 2022)

[43] New EU SST Partnership of 15 Member States

[44] Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Italy, Latvia, the Netherlands, Poland, Portugal, Romania, Spain and Sweden

[45] EUSPA, the new EU SST Front Desk

As regards for **SWE and NEO**, the tasks to fulfil are as follows:

- Mapping of Member States' capabilities for detecting and monitoring NEOs.
- Promotion of the networking of Member States facilities and research centres.
- Establishing and maintaining a European NEO catalogue.
- Development and provision of rapid expert response service in relation to new NEOs.
- Elaboration of user needs and service quality criteria.
- Pre-selection of space weather service for operational framework.
- Preparation of invitation for tender, publication, evaluation, and contract placement.

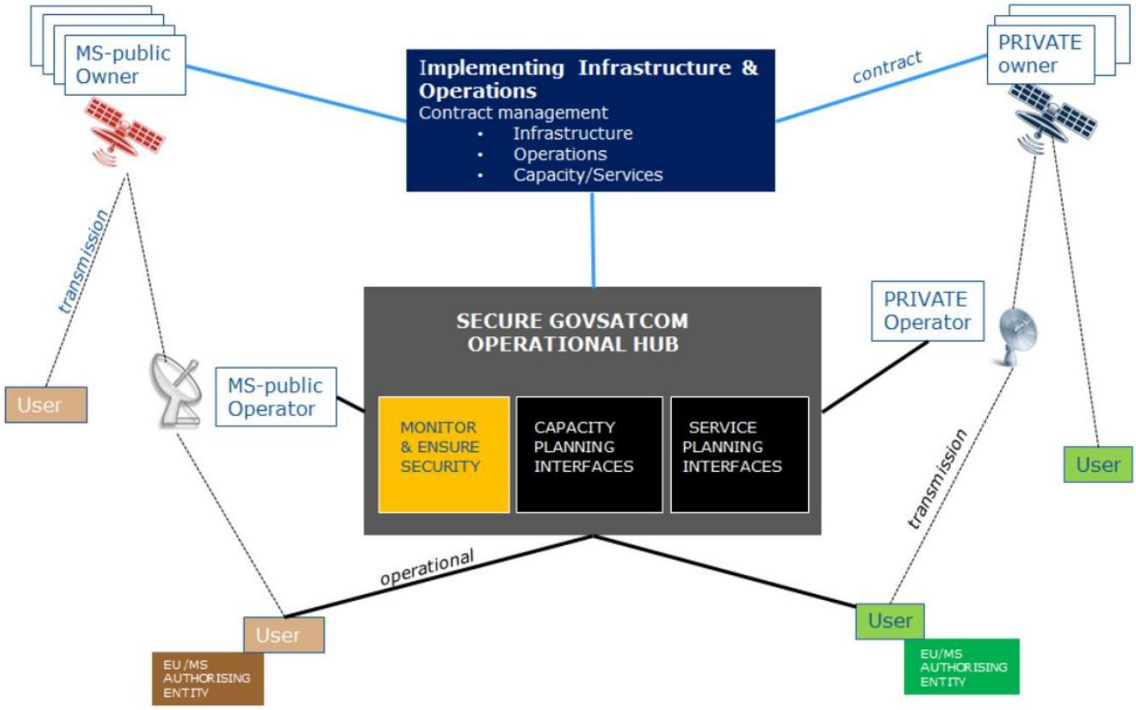
Since the services for NEO and SWE are not yet operational, the completion of Indicators as per the Programme Performance Statement is not applicable.

For the SWE sub-component, there were some initial issues related to setting up the implementation process of the new sub-component. This led to a delay in a study to be commissioned, but the approach to mitigate effects was put in place and therefore not expected to have a cascading effect on other tasks.

As for NEO sub-component, a first version of a map of Member States' capabilities for detecting and monitoring NEOs with a full list of institutions and assets was compiled by the ESA. This map will be finalised taking into consideration several Member States' feedback.

E. GOVSATCOM Effectiveness

GOVSATCOM' s objective is to ensure the long-term availability of reliable, secure, and cost-effective satellite communications services for GOVSATCOM users. The Regulation provides that the GOVSATCOM should be implemented in step-by-step approach. In the period of the evaluation the main objective was to prepare the implementation of the GOVSATCOM component.



Visual representation of GOVSATCOM functioning (source: 2018 Impact Assessment)

The GOVSATCOM indicators of the Programme Performance Statement cannot be measured since the services are not yet operational.

For GOVSATCOM several tasks have been split by contribution agreements between ESA and EUSPA. As for other components, a set of specific KPIs and criteria have been defined in the contribution agreements to assess if the targets set have been met and to what extent.

The result of the assessment is based on the Annual Implementation Reports submitted by ESA and EUSPA and interviews with three representatives from ESA and four representatives from EUSPA. All activities have been performed on timely, the detailed list is provided in Annex II.

Preparatory activities for service provision have been implemented effectively. They focused on the procurement of the **GOVSATCOM hub**[46] **operations** and the determination of its location and the mapping of the availability of satcom resources hub. Despite the initial delays caused by the setup of the procurement process and the definition of the procurement conditions, EUSPA, together with the Commission managed to mitigate this risk and the activities are currently running smoothly. The innovation partnership contract has been awarded for the GOVSATCOM Hub in December 2023. This allows for the preparation of the Initial Service provision.

[46] The GOVSATCOM Hub is in charge of monitoring and ensuring the overall capacity and service planning as well as the security of the overall system.

F. The Programme in support of the competitiveness of the EU space ecosystem

The Programme has been a key contributor to the EU competitiveness on several fronts. Firstly, it has provided the EU with strategic autonomy in space, reducing the dependence on non-European space programmes and enhancing the EU's ability to operate independently in space-related activities (see Section 4.3 on relevance). The Programme has been also playing a significant role in driving innovation and technological advancement within the EU. This has not only bolstered the EU's technological capabilities but has also supported European companies as leaders in the global space industry. Beyond the upstream industry, the EU's space assets underpin the well-functioning and competitiveness of a wide range of economic sectors, from agriculture to fisheries, finance, emergency response, urban planning and others.

On top of the objectives per component, the Programme has a specific objective in Article 4.2(f) of the Regulation "to foster the development of strong Union, space economy including by supporting space ecosystem and by reinforcing the competitiveness, innovation, entrepreneurship, skills and capacity building in all Member States and Union, with particular regard to small and medium-sized enterprises and start-ups or legal and natural persons from the Union active or wishing to become active in that sector."

The indicators provided in the Regulation for the evaluation of this specific objective are: 1. Number and location of space hubs in the Union and 2. Share of SMEs established in the Union as a proportion of the total value of the contracts relating to the Programme.

As regards the indicator on the "number and location of **space hubs in the Union**", it is well on target as per the Programme Performance Statement. The baseline was set out on the basis of an ad-hoc study[47]. To be noted, the number of European Digital Innovation Hubs is counted under this indicator instead of Space hubs given the overlap with the wider ICT and digital industrial ecosystem. From the original 38 hubs, we can count today 398[48]:

Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
Year: 2021	*Milestone*									Year: 2027
38	38	45	45							38
	Actual Progress									
	38	45	398							

Concerning **SMEs**, in 2020, around 1800 SMEs were involved in ESA and EU space projects, generating a combined annual turnover of EUR 3.9 billion, and employing

[47] Mapping, Analysis and Characterization of Space Hubs in the EU, PwC, June 2019

[48] European Digital Innovation Hubs Network – EDIH Catalogue

approximately 33 000 individuals.[49] As an example, between 2021 and mid-2023, SMEs participation in Copernicus significantly increased, accounting for 18.5% of the value of the contracts. This marks a notable rise from the 10% participation observed during the period of 2014-2020. The European Association of Remote Sensing Companies (EARSC) reported in 2023 that the overall European Earth Observation (EO) industry is comprised of 772 companies and around 14 000 employees. The sector is highly dominated by SMEs, with approximately 96% of companies having less than 50 employees and 66% of them with less than 10. Furthermore, a competitive EO downstream sector has emerged dominated by SMEs. In fact, they do not require a large upfront investment in resources (human or material) and become operational very quickly.

The Dynamic Purchasing System was a new method of purchasing complementary data to complement the one from the Sentinels. The system was designed to allow easy entrance of start-ups and SMEs into the tendering process and proved to be a success (also by shortening the length of the tendering): Aerospacelab from Belgium, Prométhée from France and EnduroSat from Bulgaria supply multispectral images; Kuva Space Oy from Finland supply hyperspectral images; Constellr and OroraTech from Germany and Aistech from Spain provide thermal infrared data; Satlantis from Spain and Absolut Sensing from France provide data on atmospheric composition.

In addition, **CASSINI** is the European Commission's initiative to support entrepreneurs, start-ups and SMEs in the space industry, including New Space, during 2021-2027. The initiative is open to all areas of the Programme, and covers both upstream (nanosats, launchers and downstream - products/services enabled by space data, etc.). CASSINI includes a EUR 1 billion EU seeds and growth fund, hackathons and mentoring, prizes, a business accelerator, partnering and matchmaking. Thanks to CASSINI over 700 SMEs were provided support by the end of Q2 2023, with nearly 40 of them receiving venture investments totalling EUR 300 million (see Section 4.1.3 Coherence).

Albeit it is not a part of the Programme but contributing to the space ecosystem, EUSPA Horizon Europe calls[50] show that 96 out of the total 292 participants were SMEs, constituting approximately 33% of the total participation. From budget perspective, a substantial budget of EUR 25.42 million out of a total budget of EUR 75.85 million was granted to SMEs. This substantial investment highlights the recognition and support given to SMEs, underlining their pivotal role in driving innovation and competitiveness within the EO and GNSS market sectors.

[49] ESA Business Boosts Small Space Companies

[50] HORIZON-EUSPA-2021-SPACE (covering the period 2021-2022) and HORIZON-EUSPA-2022-SPACE (encompassing 2022-2023)

Regarding the **development of the EU space ecosystem**, the European **upstream** segment reported EUR 8.2 billion in sales[51], constituting 17.5% of the global market for upstream activities. Europe represents the 4th space power that produced 11% of global spacecrafts, where in first place were the Unites States, followed by China, then Russia[52]. A third of the world's satellites is estimated to be manufactured on the European continent, with around EUR 9.5 billion of satellite exports registered over the last ten years or so and a flourishing global commercial satellite market. The European space industrial supply chain employs around 59 707 persons including supporting personnel on site with more than 1 000 companies active in the upstream segment[53]. This industry is highly competitive in the global stage, as demonstrated by its positive contribution to the European trade balance. Exports of cutting-edge satellite systems, launch services, and equipment and subsystems created an average net surplus of EUR 1 billion per year in 2011-2020.

Concerning an autonomous access to space and the EU launchers manufacturing industry, the Commission purchased in 2022 six launch services with VegaC from Arianespace covering all the Copernicus needs for this MFF, with the aim of providing long term visibility and sustainability for the industry. However, after one successful test flight (=maiden flight), the VegaC launcher failed during a launch for a commercial customer and was grounded (it is expected to resume Copernicus launches in autumn 2024).

On the **downstream** side, according to EUSPA's stakeholder consultations, EUSPA is monitoring **400-500 new startups and SMEs** that are leveraging Galileo and Copernicus data for their business. The market size for Earth observation and satellite navigation is globally reported in the regular EUSPA Market Reports. These values can be used to calculate Europe's market share for the downstream space activities. According to EUSPA`s EO and GNSS Market report, issue 2, it has been estimated that for the **Earth Observation**, Europe (defined as EU27, plus Norway, Switzerland and the United Kingdom), together with the United States, has remained a dominant player in the commercial EO downstream market, accounting together for a market share of more than 85%, with each being responsible for over 40%. In this supply point-of-view analysis[1] downstream EO industry is organised into three categories: data acquisition and distribution, data processing, and analysis, insights & decision support. The first two categories are led by North American companies measured in market share, with Europe in second place, while in the third category of analysis, insights & decision support Europe leads with over 50% of the global market share, followed by North America with nearly a quarter. As regards **GNSS**, revenues from GNSS downstream market in Europe

[51] Eurospace Facts & Figures

[52] Ibid.

[53] Ibid.

have been estimated at the level of almost 25% in 2021. To complete the overview, the US maintains the largest portion of the market (over 30%), and by contrast, Japan, China and South Korea combined account for 30% of the global market. The downstream GNSS industry is split into three categories: components and receivers' manufacturers, system integrators, and added-value service providers.

Efforts have been directed towards supporting **skills** development, as the demand for space-qualified jobs has created a competitive tension in the workforce market leading to growth in workforce costs, which, combined with other factors, has a certain impact on the competitiveness of European space sector on a global scene. In order to encourage skills development, a Pact for Skills under the European Skills Agenda aims at supporting public and private organisations through the green transition and the digital transition. SPACE4GEO[54], the recently established large-scale skills partnership dedicated to space data, services, and applications, building on the Erasmus+ EO4GEO Blueprint project, focuses on promoting the up-skilling and re-skilling of the workforce, while attracting new talent. A new blueprint called SpaceSUITE[55], funded under Erasmus+ Alliances for innovation, is being developed under SPACE4GEO. In the Joint Communication on a European Union Space Strategy for Security and Defence, the Commission also recognised the need for up-skilling and re-skilling activities to meet industry demand, fill the future skills gap and increase women's participation, focusing in particular on space for security and defence. A number of ongoing projects funded by Horizon Europe, such as ASTRAIOS, E-KNOT or GENIUS and Erasmus+, such as the European universities alliance UNIVERSEH[56] support this objective. As a transnational alliance of universities from all across Europe, UNIVERSEH is working on the first pan-European high-level teaching and research programme for space. Additionally, the former Copernicus Academy with over 200 members is evolving into the **EU Space Academy** and the Commission is working with EUSPA to develop EU Space Academy Learning Platform, a free on-line course to improve skills and expertise in various fields.

G. General remarks on effectiveness of the programme towards its general objectives

The evaluation underlined that the Programme proceeds effectively towards its objectives, with services provision and user satisfaction often higher that the expected

[54] SPACE4GEO is a Large-scale Skills Partnership for the downstream segment of space economy dedicated to data, services and applications promoted under the Pact for Skills initiative

[55] SpaceSUITE - SPACE downstream Skills development and User uptake through Innovative curricula in Training and Education" (2024) develops a program and innovative platform with the aim to supply the required skills and curricula to achieve the goals of the EU in the aerospace and defence ecosystem.

[56] The UNIVERSEH European universities alliance has the goal to develop new joint interdisciplinary and cross-sectoral curricula and to become an entrepreneurial university, developing new common entrepreneurship courses adapted to European space sector.

targets, as shown in the table below. In addition, it also shows that the Programme provides a wide range of benefits in different sectors and to the European Union as a whole, (more in section 4.1.3 on Coherence and in Section 4.2 on Relevance) as well as to the competitiveness of the EU space ecosystem. Concerning SMEs, the Programme has supported the growth of SMEs and startups in the space industry, creating a more diverse and competitive landscape within the EU. The Programme has facilitated collaboration and partnerships between SMEs and larger companies and other stakeholders in the space sector, allowing them to access expertise, knowledge, and resources that they may not have been able to access independently. In addition, SMEs have been able to access funding, resources, and technological support to develop and implement innovative space-related projects (e.g., thanks to the Cassini initiative).

Most of the tasks the Commission assigned to the entrusted entities were carried out on time. In fact, the various entrusted entities among the components have managed to keep the timeline and generally meet ambitious performance goals.

General objectives (Art.4.1)	**Specific objectives (Art.4.2)**	**Completion of the objectives**
- provide or contribute to the provision of high-quality and up-to-date and, where appropriate, secure space-related data, information and services without interruption and wherever possible at global level, meeting existing and future needs and able to support the Union's political priorities and related evidence-based and independent decision making, inter alia for climate change, transport and security;	- provide long-term, state-of-the-art and secure positioning, navigation and timing services whilst ensuring service continuity and robustness (Galileo and EGNOS)	Galileo and EGNOS have provided reliable and secure positioning and navigation, and timing services, ensuring continuity and robustness as described in in sub-sections A and B above
	- deliver accurate and reliable Earth observation data, information and services integrating other data sources, supplied on a long-term sustainable basis, to support the formulation, implementation and monitoring of the Union and its Member States' policies and actions	Copernicus has provided precise Earth observation data, information, and services by integrating various data sources on a sustainable basis. It has also supported the development, implementation, and monitoring of policies and actions of the Union and its Member States, in accordance with user requirements as described

	based on user requirements (Copernicus).	in subsection C above
	- enhance capabilities to monitor, track and identify space objects and space debris with the aim of further increasing the performance and autonomy of capabilities (SST)	SST is providing all services (collision avoidance, re-entry analysis, fragmentation analysis) as described in subsection D above
	- provide SWE services. - map and network Member States' capacities (NEO).	Important advancements were made towards making the SWE and NEO operational as described in subsection D above
	- ensure the long-term availability of reliable, secure, and cost-effective satellite communications services (GOVSATCOM).	GOVSATCOM services are not yet available but important advancements were made towards making the component operational, as described in subsection E above
- maximise the socio-economic benefits, in particular by fostering the development of innovative and competitive European upstream and downstream sectors, including SMEs and start-ups, thereby enabling growth and job creation in the Union and promoting the widest possible uptake and use of the data, information and services provided by the Programme's components both within and outside the Union	- to foster the development of a strong Union space economy, including by supporting the space ecosystem and by reinforcing competitiveness, innovation, with particular regard to SMEs	SMEs were successfully supported as described in sub-section F above
	H. to foster entrepreneurship, skills and capacity building, start-ups or natural and legal persons	Skills building actions were successfully performed as described in sub-section F above.

- ensuring synergies and complementarity with the Union's research and technological development activities carried out under Regulation (EU) 2021/695	No specific objective defined by the Regulation	Research for the next generation of Galileo chipsets is funded simultaneously by the Space Programme and Horizon Europe Calls in Horizon Europe were launched to ensure synergy with the components of the Programme (e.g. timing, drones, applications including clean energy, natural hazard mitigation, sustainability & smart mobility, biodiversity)
- enhance the safety and security of the Union and its Member States and reinforce the autonomy of the Union, in particular in terms of technology	- support an autonomous, secure and cost-efficient capability to access space, taking into account the essential security interests of the Union	Contracts with Arianespace as described in subsection F above, however, no launches[57] have actually taken place due to external factors.
- promote the role of the Union as a global actor in the space sector, encourage international cooperation, reinforce European space diplomacy including by fostering the principles of reciprocity and fair competition, and to strengthen its role in tackling global challenges, supporting global initiatives including with regard to sustainable development and raising awareness of	No specific objective defined by the Regulation	Promoting the role of the EU as global actor since most data and services are available to world-wide users: - Copernicus has become the top Earth observation programme in the world - Galileo and EGNOS have established the EU as a strong and credible interlocutor in the field of transportation in relation with third-countries. - very important

[57] Without counting the launch of Sentinel 6A in 2021 which was paid by NASA, and the Galileo L11 launch which was paid with funds from the previous MFF

space as a common heritage of humankind		contribution of Copernicus and Galileo to UN SGDs as shown in Annex VII
- enhance the safety, security and sustainability of all outer space activities pertaining to space objects and debris proliferation, as well as space environment, by implementing appropriate measures, including development and deployment of technologies for spacecraft disposal at the end of operational lifetime and for space debris disposal	No specific objective defined by the Regulation	No action was taken under the Space Programme. However, Horizon 2020 has already financed several projects on this topic (e.g. REDSHIFT, ADR1EN, TeSeR, COMPASS, PULSAR)

The majority of the deviations are due to external causes. For instance, the unavailability of launchers impacted some of the Galileo and Copernicus activities, or unexpected space weather conditions affected EGNOS's performance.

The high inflation and the chips shortage had an impact on the industry commitments. Limited flexibility of the EU procurement rules to adapt to external economic conditions and volatility of prices during multi-year contracts, has challenged the ability of industry to deliver on their contractual commitments, causing procurement delays. The impact of inflation on industry capacity to respect the contracts and the complexity in their implementation have been repeatedly raised by industry (e.g., Eurospace manifesto for an increased flexibility towards inflation[58]). Both the feedback in the Call for Evidence and from the meetings with industry representatives of the SDA Expert Group identified specific constrains in the procurement process (detailed in Annex V), such as changes in requirements during the execution phase, reliance on technologies at a low maturity level, overspecification, policy measures promoting smaller and newer companies etc. The Members of SDA Expert Group would also welcome the establishing of a system through which the Commission could report to the industry on the statistics related to its space procurement processes.

[58] Eurospace Position Paper, September 2022

4.1.2. Efficiency and Cost Benefit Assessment

The evaluation aims to assess if the costs incurred are justified and proportionate to the benefits achieved, answering the question on the extent to which the intervention has been cost effective. The evaluation takes into consideration both the investment and spending into the deployment of the infrastructure and the provision of the services, and the wider socio-economic benefits resulting from their utilisation and exploitation.

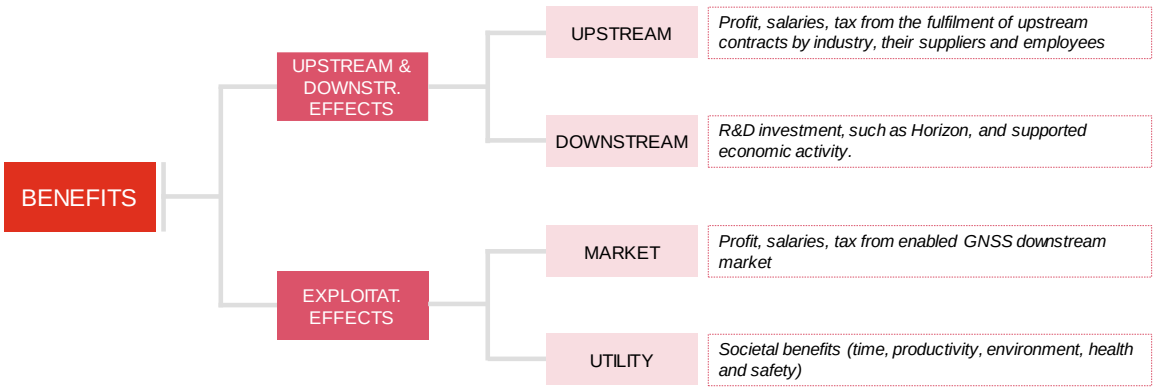
Since the EU space components' development has started before the current MFF, it is not possible to perform an accurate **cost benefit assessment** only for the **period 2021-2023**. This is because the benefits stemming from the exploitation of EU space components are the consequence of long-lasting investment started before 2021. Putting in balance only costs of the years 2021-2023 with all the Programme benefits would provide exceptionally high, i.e., unrealistic results. It is not possible, or not justified for the quality of the analysis, to extract a portion of the benefits limited to a few years.

In addition, the SWD cannot show a single temporal scope limited from 2021 to 2023 for all components because there are mature services offered by Galileo and Copernicus (which are also characterised by high cost incurred in previous MFFs) and no services offered for others, e.g., NEO, GOVSATCOM (with minor or no cost in previous MFFs).

In addition, it should be highlighted that the benefits shown have not been measured directly for the purpose of the SWD, but they are macro-economic estimations derived from previous studies. Whereas that does not abide fully the evaluation methodology, no other approach appeared to yield better results as striving to provide estimates for a very delimited period for a programme of such a long time span and outreach, would not provide a meaningful assessment in any dimension (either costs or benefits). Based on the evolution of the KPIs, it is therefore assumed that the projected benefits materialise respectively.

A. Galileo Efficiency

In order to prove efficiency, it is first necessary to identify benefits. There are several types of benefits:the benefits of activity in the upstream & downstream, or benefits from the exploitation of the services. This can be shown as below:



It is not possible to count benefits only from the period 2021-2023 for Galileo and EGNOS. They have started to provide benefits long before 2021 and at the same time rely on high infrastructure investments which started more than 10 years ago. Between 2021-2023 the infrastructure investments were minimal since constellations were mature and the ratios with benefits would give disproportionate results. Also, the benefits time-frame does not match with Copernicus since they rely on different satellites or stations with completely different lifetimes and they have started at different times in the past.

The benefits due to exploitation of EGNSS have been estimated to be EUR 352.402 billion (see Annex II.B.b for the detailed calculation), while the cost was EUR 13.20 billion. Even with the most pessimistic scenario the benefits massively outweigh the costs. This is because of the extremely wide-reaching use cases of GNSS: Safety Critical and Liability Critical Transport, Terrestrial Vehicles monitoring & Automation, Drones, Critical Infrastructure, High Precision Professional Applications.

B. Copernicus Efficiency

Copernicus development also has started before the current MFF. For its benefits, the period 2008-2027 has been considered, from the availability of the first services (derived from third-party satellite data) until the maturity of the component (first generation) with CO2 monitoring missions.

The figure below presents the spending on Copernicus and the socio-economic benefits resulting from Copernicus. The benefits apply to the following sectors:

- Air quality and pollution monitoring and forecasting
- Border control
- Climate modelling
- Coastal area monitoring
- Control of IUU fishing activities
- Crops monitoring
- Fire detection and monitoring
- Floods monitoring and forecasting
- Forestry management and protection
- Ground elevation and ground motion monitoring
- Ice monitoring to support navigation
- Law enforcement
- Marine resources management
- Maritime navigation
- Maritime safety - Search & rescue
- Oil and gas infrastructure management
- Offshore infrastructure management (wind-powered)
- Oil Pollution monitoring
- Solar energy monitoring and forecasting

- Urban monitoring
- Water resources management
- Wetlands monitoring

The models and calculations used are explained in Annex II.B.a.

As shown in the table below, the **benefit cost ratio (BCR)** over the period 2008-2027 varies between the three different scenarios of the Copernicus benefits projection. In a **neutral scenario** the BCR of Copernicus is 3.7. This means that the downstream socio-economic benefits experienced by the Copernicus end-users and beneficiaries largely outweigh the costs and spending that went into Copernicus over the same period by 270%. In a **pessimistic scenario** the benefit cost ratio goes to 2.5 and in an **optimistic scenario** it goes to 5.3 indicating the downstream benefits will outweigh the costs by 150% to 430%.

Table: Cost benefit ratio over the timeframe 2008 – 2027

Costs (billion EUR)	Benefits (billion EUR)			Benefit cost ratio (billion EUR)		
	Pessimistic	**Neutral**	Optimistic	Pessimistic	**Neutral**	Optimistic
13.3	32.6	**49.1**	71	2.5	**3.7**	5.3

C. Space Situational Awareness Efficiency

In the scope of this cost-benefit assessment, the cost considered are all the costs that have accumulated from the beginning of the component, including the investments made before the programme became operational, and planned until the end of this MFF.

On the benefit side, the analysis also accounts for all the benefits accumulated since the beginning of the Programme in 2014, and 2027 (when all its services will be operational), for the purpose of keeping the consistency with the cost's timeframe. While the benefits for SST subcomponent were assessed up to 2035 with the assumption that they be enabled thanks to the current Programme. This assessment is therefore very conservative and shows that the actual benefits can be more important. The benefits provided by the SSA apply to the following sectors/activities:

- Delays in launch
- Disruption of power grid networks leading to short power loss or longer blackout
- Disruption to communication
- Disruption to GNSS signals
- Failures of equipment
- Human health risks
- Impact on the potential emergence of a commercial market for SST services
- Impact on the risk of losing all the space assets (Kessler effect)

- Increased economic return of the EU NEO service value chain
- Malfunction in avionics
- Orbit Injection Anomalies
- Preventing infrastructure damages
- Preventing injuries
- Preventing Land damage
- Reduced lifespan of specific services/satellites
- Reduced loss of revenues for spacecraft owners and operators
- Reduction of fragmentation
- Risk of complete loss/lack of functioning of satellite
- Safety of people
- Saving lives
- Temporary disruption/loss of service
- Waste of propellant due to defueling

An estimation per sector/activity in euros is provided in more detail per sector in Annex II.B.b.

The BCR of SSA for the period of 2014 – 2027 is 5.92:

Costs	**Benefits**	**Benefits cost ratio**
EUR 260.5 million	**EUR 1.5 billion**	**5.92**

This means that the downstream socio-economic benefits experienced by the SSA end-users and beneficiaries over the timeframe 2014-2020 **largely outweigh the costs** and spending that went into SSA over the same period nearly six times.

Furthermore, the investments in the SSA component also generate many benefits that were only assessed qualitatively and could not be included in the cost-benefit assessment. These benefits correspond to thousands of lives saved; to a better positioning of the EU in the international stage; to reducing EU dependence on other countries; to important knowledge creation, etc. All these benefits increase the usefulness of the SSA component and show that the investments in this component are justified.

D. GOVSATCOM Efficiency

The GOVSATCOM Impact Assessment recognised that during the first ten years of operations, the cost for the infrastructure would be significant, whereas the benefits will only occur at the later stage (ca. 15 years after the investments are made). The same assessment showed the correlation between the EU investment in GOVSATCOM and growth (Gross Value Added (GVA). GVA was estimated to increase between EUR 2.7 billion and EUR 5 billion (compared to the total EU economy of about EUR 14.6 billion), and to generate up to 8 000 jobs.

The expected benefits of GOVSATCOM services utilisation could not be quantified at this point because the infrastructure has not yet been deployed and declared operational. However, the evaluation estimates that over the period 2025 - 2027, the potential economic losses due to cyber-attacks only on transportation sector is EUR 554.3 million. The budget allocated to (=total cost of) GOVSATCOM is EUR 180 million. This means that if GOVSTACOM contributed to reducing 32 % of the economic losses from this one single use case, then the cost would be equivalent to the benefits for end users.

Beside the forecast of the quantitative benefit, the IA identifies various qualitative benefits such as enhanced security thanks to the access and information assurance for all users, in particular for Member States without national assets; defragmentation of benefits for users; more predictable and stable EU markets for industry.

E. General remarks on Efficiency

Despite a challenging environment and the complexity in the quantification of benefits, due also to the fact that each component has different timeframe, maturity, users and output, it can be concluded the Programme is **efficiently** carried out and provides significant value for money. The benefits brought at European and global level by the Programme's long-standing components outweigh the costs that were directly and indirectly sustained for their development. For the more recent components, a quantitative assessment was not yet possible but using proxy data (e.g., cyberattacks in the transport sector) indicates the enormous potential once the components are fully operational.

4.1.3. Coherence

Coherence assessment was done taking into consideration:

- The synergies among the services provided by Copernicus, Galileo, EGNOS and GOVSATCOM.
- Their coherence and enabling role to other EU policies and actions.
- Their coherence with international policies.
- The synergies with other EU funding programmes (Horizon Europe, Invest EU).

Copernicus, Galileo, EGNOS and GOVSATCOM provide different data and services, that can be used simultaneously to offer information and applications to draft, implement and monitor EU policies and activities (e.g., precision agriculture or enabling applications for energy sector and raw materials policies), as well as to support the green and digital transition or the robustness of EU resilience. Overlaps are not possible, since each component provides a specific service (navigation and positioning, Earth Observation, satellite communication), as described in Section 2, while the benefit can be maximised combined them, when possible.

This section presents several, non-exhaustive examples of how EU space data and services are referenced in numerous EU legislations, used for their implementation, and linked to international policy.

In addition, it provides a few examples of blending operations with other EU funding programmes (e.g., Cassini and IOD/IOV). While research and innovation activities financed by Horizon Europe are not covered in this evaluation, the document include an example of Horizon Europe's support for the research and innovation needs of the Space Programme.

This chapter also outlines how the Programme contributes to the Sustainable Development Goals (SDGs).

A. Coherence of Galileo and EGNOS

By providing improved positioning and timing information, Galileo and EGNOS are **instrumental in supporting various EU policies**. It aligns with the **EU Single European Sky** initiative, particularly through its support for Performance-Based Navigation and EGNOS, enhancing the efficiency and unity of European airspace management. For **maritime safety**, Galileo's OSNMA supports the Integrated Maritime Policy and EU Maritime Safety Strategy, promoting safer waters. Galileo also contributed to advancing the EU Green Deal Initiative for **Sustainable and Smart Mobility**, particularly in the European Rail Traffic Management System. Within the "Europe on the Move" package, Galileo's OSNMA and HAS ensure GNSS authenticity verification and decimetre accuracy, along with the future Galileo Emergency Warning, thus playing key roles in enhancing road segment safety and regulations.

Furthermore, Galileo contributes to the objectives of **EU Common Agricultural Policy** increasing the efficiency of the farming sector and supporting the functioning of the Integrated Administration and Control System. Satellite navigation can enhance the environmental and climate performance of agriculture by enabling precise dosing tailored to crop needs, resulting in decreased consumption of both fuels and agricultural inputs like mineral fertilisers and pesticides.

For the **energy** sector, Galileo and EGNOS are instrumental by providing precise timing and synchronisation for Phasor Measurement Units that play a critical role in enhancing the reliability of power systems by measuring voltage and timestamping these measurements. This contribution of Galileo and EGNOS addresses challenges in energy security, particularly related to the energy market disruption caused by Russia's brutal invasion of Ukraine, and supports the REPowerEU plan, leading to the transformation of Europe's energy system and reducing dependence on Russian fossil fuels.

Together with **Copernicus**, Galileo plays an increasingly important role in the raw materials sector and contributes to the broader objectives of the **EU Action Plan for Critical Raw Materials**, particularly in applications like mining machinery control and mining vehicle tracking and asset management.

Galileo also **demonstrates synergies with other space components** across multiple fields. In terms of **disaster management** Galileo, Copernicus and GOVSATCOM can be used to in synergies. For example, in case of an earthquake, Copernicus can monitor the consequences on earth providing information on damage assessment, Galileo and EGNOS will be able to broadcast emergency messages to personal receivers, while GOVSATCOM will ensure secure communication for governmental users (e.g., civil protection).

B. Coherence of Copernicus

In terms of **coherence**, the six Copernicus services[59] can be utilized by authorities, companies, citizens including policy makers, as well as the global scientific community. They support a variety of applications in many non-space domains, potentially impacting businesses and organisations in their day-to-day activities and operations.

At the same time coherence **between different Copernicus services** is ensured by supporting various segments and applications with data and products. Four **Copernicus Thematic Hubs** (Coastal, Health, Energy and Arctic) have been launched to combine information and products for specific thematic areas, aiming to facilitate access, improve coordination, and promote collaboration.

All Copernicus services provide key information on our path to **climate neutrality** and **resilience**. The Copernicus Climate Change Service provides unique climate information about the past, present, and future to support adaptation and mitigation strategies. It provides interactive access to many climate indices from the service in support of climate change adaptation and forecasting. The annually published "**European State of the Climate**" provides updates on key climate indicators for policy makers and businesses for a more resilient society.

The Copernicus services play a crucial role in monitoring and preserving **terrestrial and marine ecosystems and biodiversity** at both global and European scales. These services support the EU Biodiversity Strategy and upcoming Nature Restoration Law by systematically monitoring biophysical parameters and identifying threats to biodiversity. Copernicus data is essential for the implementation of various EU directives, such as Natura 2000, the Birds and Habitats directives, the Water Framework Directive, and the Marine Strategy Framework Directive, among others.

Copernicus helps supplying clean, affordable, and secure **energy** by offering valuable data on renewable energy sources, enabling effective management of solar, wind, and wave energy locations, and directly supporting the REPowerEU Plan in response to global energy market disruptions caused by Russia's invasion of Ukraine. Multispectral

[59] Copernicus Services

and future hyperspectral analysis from Copernicus Sentinels can in the future help identify and locate raw materials on Earth's surface.

Copernicus also plays an important role in promoting sustainable and smart **mobility** when its services provide essential data for improving maritime transportation, air travel efficiency, railway track management, and road transport energy savings. Additionally, these services assist in monitoring air pollutant emissions and support new emission regulations for aviation.

As of 2023, with the introduction of the Area Monitoring System in the **Common Agricultural Policy** (CAP), the use of Copernicus products in Member States for monitoring purposes has been continuous and fundamental. The mandatory Area Monitoring System provides farmers with timely alerts and supports national authorities in decision-making for Common Agricultural Policy aid eligibility. Moreover, Copernicus Land Monitoring Service indicators benefit agriculture by providing valuable input for crop monitoring and yield forecasts. Copernicus data also supports "smart farming" applications and precision agriculture and assist in fisheries control activities.

The Copernicus services significantly contribute to various **global initiatives**: its Land Service provides support to international initiatives such as the United Nations Environment Programme, Food and Agriculture Organization, World Bank, UN-REDD and United Nations 2030 Agenda for Sustainable Development. Copernicus Atmosphere and Climate Service supports international coordination frameworks such as the Integrated Global Greenhouse Gas Information System and the Committee on Earth Observation Satellites. It also aids in national inventory reporting under the United Nations Framework Convention on Climate Change, United Nations Kyoto Protocol, and United Nations Paris Agreement, and produces essential climate variables for the International Global Climate Observing System program.

C. Coherence of SSA

The **SST sub-component** plays a crucial role in preventing damages to EU Space infrastructure, which is vital for the continuity of services provided by all components. Additionally, the **Space Weather** sub-component aligns well with other satellite-based activities, as some navigation and Earth observation satellites currently host Space Weather instruments to measure radiation around the satellites. This is essential for managing potential interference with satellite electronics, electrostatic charging, and damage to onboard materials or space ground infrastructure. This is the case in particular for satellite navigation constellations including Galileo that is positioned at relatively high altitude and is less protected by the geomagnetic field than other orbit regimes, like low orbit.

At the same time, SST services are also complementary to wider European initiatives such as research activities related to the protection of space-based infrastructure carried out under EU framework programmes for research and innovation, a Digital Agenda for

Europe initiative as well as security-related initiatives such as EU Space Strategy for Security and Defence.

On the more global scale, The United Nations Committee on the Peaceful Uses of Outer Space endorsed recommendations for creating an international response to the **Near-Earth Objects** threat. These recommendations focus on sharing information, raising awareness, and establishing emergency response protocols to mitigate the risks associated with Near-Earth Objects. Two objectives of the NEO subcomponent align with these recommendations: building a European Catalogue of Near-Earth Objects and developing a rapid expert response service for new Near-Earth Objects, including potential ground impactors and fast-response space missions.

D. Coherence of GOVSATCOM

The GOVSTACOM component is coherent with EU policies and priorities, it aligns with the EU Digital Europe Programme). In fact, the GOVSATCOM component supports the further development of EuroQCI initiative (a secure quantum communication infrastructure for the EU), addressing emerging challenges in computing capabilities and security threats to communication networks.

The GOVSATCOM services are relevant for the implementation of several EU policy priorities, including the EU maritime security strategy, telecommunications policies, humanitarian aid, border management etc. whose efficacity is expected to be boosted by the component.

GOVSATCOM is also complementary to, and well aligned with the objectives of the new Union Secure Connectivity Programme IRIS², which emphasizes the importance of satellite communication as a strategic asset for governments and civil society alike.

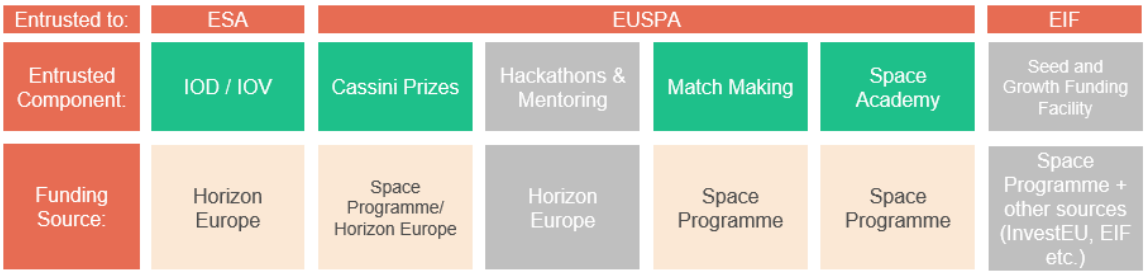
E. Coherence and synergies with other EU funding programmes (Horizon Europe, Invest EU)

a) Research and development activities in support of the EU Space programme

Research and development activities are an essential component for the development of the Programme. Upstream (mission evolution, technology, infrastructure) and downstream segments (applications, user technology) are addressed in a complementary way both under the Programme and under Horizon Europe that is instrumental to finance the future generations of EU Space infrastructure and ensure the uptake of the services provided. For example, EUSPA has continued implementing the downstream research and development (R&D) actions funded through Horizon Europe, as well as the Fundamental Elements envelope under the EU Space programme dedicated to chipset and receivers.

b) Horizontal Actions to support the EU space ecosystem: the example of IOD/IOV and the Cassini initiative

The In Orbit Demonstration/In Orbit Validation (IOD/IOV) initiative and the Cassini Space Entrepreneurship initiative (Cassini) are horizontal actions to support an innovative and competitive EU space ecosystem, promote the growing of SMEs and start-ups, and encourage the uptake of space-based services and applications. They are implemented by different actors, and financed by different EU funding programmes, ensuring effectiveness, coherence and the EU added value.



In Orbit Demonstration/In Orbit Validation (IOD/IOV)

IOD/IOV allows academia, research organisations, start-ups, SMEs, and larger industrial companies to effectively test new technologies in space, reducing the time to market. At the same time, the initiative stimulates new European launchers systems and solutions through open competition for the procurement of launch services. IOD/IOV is funded by Horizon 2020 and Horizon Europe, but it has been included in this evaluation to show its effectiveness, EU added value and to prove the coherence of the Space Programme with Research and Innovation activities.

The actions are partially entrusted to ESA, in particular to prepare the calls for expression of interest, the implementation of IOD/IOV projects and the procurement of launch services and management of the related procurements and interfaces with industry.

The IOD/IOV initiative kicked off in 2018 under Horizon 2020, when the Commission published the first call for expression of interest for experiments. It attracted more than 50 proposals from various European entities, from SMEs to large companies, universities, and research organisations. Retained applications offered a range of innovations in the field of Earth observation, positioning navigation and timing, satellite communication and space science. In September 2020, the first selected IOD/IOV experiment, was successfully launched. The three new missions launched in October 2023[60] are part of this selection. In the years 2021- 2023, two calls were launched for IOD/ IOV that received a total of 62 applications, the majority of which (41 applications) coming from SMEs, and the rest from Midcaps, LSIs (Less-significant institutions) and Universities. 31 of these applications (50%) were retained for pre-selection. Currently, two parallel calls for expression of interest are open until March 2026[61] to gather experiments that could be considered for IOD/IOV actions that cover aggregation launch services and operations.

IOD/IOV targets (KPIs) have been reached with the exceptions of the ones related to launch services. Some delay in developing new contracts for launch services is not impacting the implementation of the IOD/IOV missions so far because the new batch of experiments is not completely ready for launch. In addition, in comparison with its previous edition, IOD/IOV under the current MFF already succeeded in reaching more SMEs and from a larger number of Member States.

Cassini Space Entrepreneurs initiative (Cassini)

Cassini is the Commission's initiative to support entrepreneurs, start-ups and SMEs in the space industry in the EU, via different types of actions. Cassini is a horizontal initiative, including activities included in the Programme and exploiting synergies and

[60] Press Release: EU Launches Three New Missions

[61] *Ibid.*

coherence among the EU programmes, getting funding from multiple sources – the EU Space Programme (blending for equity investments under InvestEU and matchmaking), Horizon Europe (for business development, competitions, inducement prizes and In-Orbit Demonstration & Validation) and a matching contribution from InvestEU for blending operation. The Programme is contributing to following initiatives under CASSINI:

- **CASSINI Challenges (MyEUSpace Competition)** is aiming at supporting startups in the development of their ideas and concepts into final products. The budget for MyEUSpace competition is in total EUR 1 million per year of which EUR 750 000 is from GALILEO and EUR 250 000 is from Copernicus.
- **CASSINI Space Academy** provides online training for start-ups (budget of around EUR 300 000 – EUR 400 000 per year).
- **CASSINI Business Accelerator** was set up in 2023 to provide business development advice and growth acceleration to Europe-based start-up space-based companies that achieve high revenue growth and attract significant external investments. This initiative aligns with the commercialization goals of the Programme and Horizon Europe, while also leveraging synergies with the InvestEU program and ensuring complementarity with other business incubation programs such as ESA-BIC. CASSINI Business Accelerator is run in direct management by the European Commission and will have a mid-term review by the end of 2024.
- **CASSINI Matchmaking:** The action consists of the organisation of a series of matchmaking events for start-ups and SMEs to create broader professional networks. The events include investor matchmaking to prepare companies for investment and connect them with potential investors, as well as industrial partnering to facilitate connections with large companies for product testbeds, customers, and partnerships. In 2021, the Commission directly managed the Matchmaking action, but management will be delegated to EUSPA in 2024, with collaboration between EUSPA and the Commission in 2022-2023.
- The Programme is also contributing funds to the **CASSINI Seed and Growth Funding Facility** through the InvestEU blending operation. The facility aims to establish funds and support existing ones that seek to invest in the space sector, with the primary goal of preventing European space companies from seeking foreign investment and relocating abroad.

The impact can be summarised as per the table below:

#	Impacts	KPIs	Value for 2022	Value for 2023	Comments and outcome
1	Outreach and Increase awareness of space programmes and attracting companies to develop space-based solutions	1.1 Increase in the number of applicants	233 applicants	245 applicants	
		1.1.1 Applicants for ideas	146	92	Positive trend in attracting more actors and focusing more on higher maturity solutions
		1.1.2 Applicants for prototypes	87	95	
		1.1.3 Applicants for products	NA	58	
		1.2 Diversification and maximization of (EU) Countries represented	24 EU countries + Norway + Switzerland	25 EU MS + Norway + Switzerland + Iceland	
2	Supporting and enabling the European industry (at all the stages of development and maturity) to build solutions utilizing EU SP	2.1 Number of teams receiving support and size of financial support given	43 teams (EUR 1 m)	30 teams (EUR 1 m)	
		2.1.1 Awarded ideas	23 (EUR 10 000 each + additional EUR 25 000 to one final winner)	15 (EUR 10 000 each)	Total funding level to industry sustained, more financial support is given per company (except for ideas) which enables more progress and results per company. This observed trend also meets EUSPA's objective of increasing focus on higher maturity products and near-market products.
		2.1.2 Awarded prototypes	20 (EUR 15 000 each + additional EUR 50 000 to one final winner)	10 (EUR 30 000 each)	
		2.1.3 Awarded products	NA (0)	5 (EUR 100 000 each)	

					All companies from 2022 awards have survived and are being tracked. However, for 2023 it is not possible to make these assumptions yet since they have just been awarded.
		2.2 User satisfaction	A survey was conducted post award with lots of useful qualitative appreciation and suggestions for improvements. Suggestions for example related to the application process were implemented in the following edition.		Positive engagement of stakeholders in feedback activity and active implementation of EUSPA to these activities
		2.3 Number of trainings and attendees on how to use and access Copernicus data	All the participants	All of the participants	In general around 20 requests per month are supported however it is done via the EUSPA core team, not utilizing this initiative budget
3	Enable the development of European based products and services that utilize data from the EU Space Programmes	3.1 Number of Prototypes supported into viable business opportunities	20 Prototypes supported into viable business opportunities	28 Prototypes supported into viable business opportunities	More advancements were achieved in 2023 in turning prototypes to final products, and final products to viable business opportunities. This also materialized because the 2023 edition focused on more mature concepts and provided more funding to the users, therefore better results were
		3.2 Number of final products and viable business propositions supported	5	15	

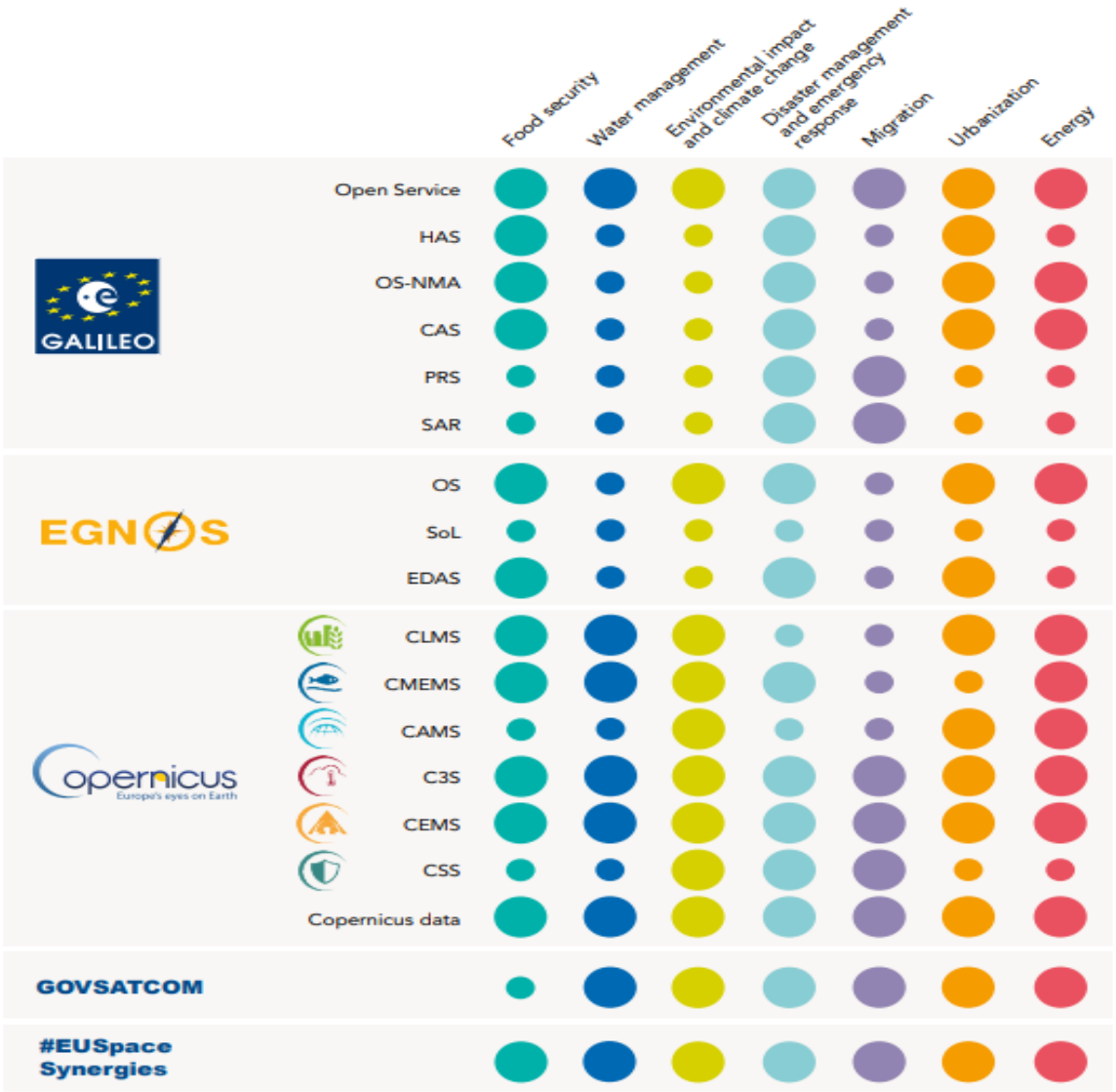
					achieved even though, in absolute number, less awards were given.
		3.3 Number of products or companies that was supported in scale – up	NA	NA	NA – it is too early to assess today this KPI, but it will be done in later years

The evaluation shows the increase of participation to Cassini activities with a high grade of satisfaction of the participants. It demonstrates that Cassini has successfully and increasingly brought together the space companies' ecosystem with the VC and private financing ecosystem and enabled space start-ups and SMEs to network and promote their business ideas. In conclusion, Cassini has effectively supported the development of a Venture Capital community in the EU that would invest in space companies, supported SMEs and Start-ups to adopt Copernicus and Galileo/EGNOS data and services in their solutions and businesses and helped them build their prototypes and advance their product maturity.

F. Contribution of the Programme to United Nations Sustainable Development Goals

The Programme had a very significant contribution to the United Nations Sustainable Development Goals (UN SDGs) as acknowledged in two studies by the United Nations Office for Outer Space Affairs[62]. The contribution can be summarised as follows:

[62] UNOOSA: Eu Space Supporting A World Of 8 Billion People, UNOOSA: European Global Navigation Satellite System and Copernicus



The Copernicus component provides essential tools to report on SDG indicators and supports effective monitoring of progress and compliance with the international agreements. This includes assisting in strategies related to conventions such as the Ramsar Convention on Wetlands and the United Nations Framework Convention on Climate Change. Furthermore, the Program's EO data, particularly from Copernicus CLMS, aids in monitoring crop conditions and providing early warnings on failing crops, benefiting organizations like 'Action Against Hunger' and the 'Centre de Suivi Ecologique de Dakar'.

Galileo and EGNOS contribute to several SDGs by providing precise positioning, tracking, and geolocation services including SDG 2 (Zero Hunger) by enabling precision agriculture, which can lead to reduced resource consumption and increased food production. Additionally, Galileo and EGNOS play a crucial role in disaster response and management, supporting SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) by enhancing emergency response, infrastructure resilience, and climate monitoring.

The exhibition "Space for our Planet - People and Space Solutions: Together for Change"[63] is based on a digital platform highlighting how the Programme can provide innovative solutions to achieve the 17 SDGs. It shows real life testimonies from scientists and users across the world. The exhibition in physical format has been travelling for about 3 years around the world. A more detailed description of the Programme's achievements towards SDGs goals is available in Annex VII.

G. General remarks on coherence

Copernicus is strongly coherent with Galileo across several market segments, on the downstream applications side. Sectors such as agriculture and urban planning are two of the key segments where combined applications are being developed, however there are several other segments that benefit from these synergies (more examples are given in Annex VI). SSA and GOVSATCOM are coherent with the overall Copernicus component with SST ensuring prevention of damages to the space infrastructure, including the one of Copernicus and GOVSATCOM supporting with secure communication capabilities. This aligns seamlessly with the Copernicus CEMS, as GOVSATCOM can augment the existing service by delivering secure communication solutions during disaster management activities. Finally, IOD/IOV and Cassini initiatives shows the coherence with other funding programmes, boosting synergies and enhancing EU growth and innovations.

4.2. How did the Space Programme make a difference and to whom? (EU Added Value)

The purpose of this chapter is to assess the additional benefits realised by the Programme and its components when compared to what Member States could achieve individually or what could be achieved at international level. It offers a qualitative assessment, considering the perspectives of users, Member States, and the overall international perception.

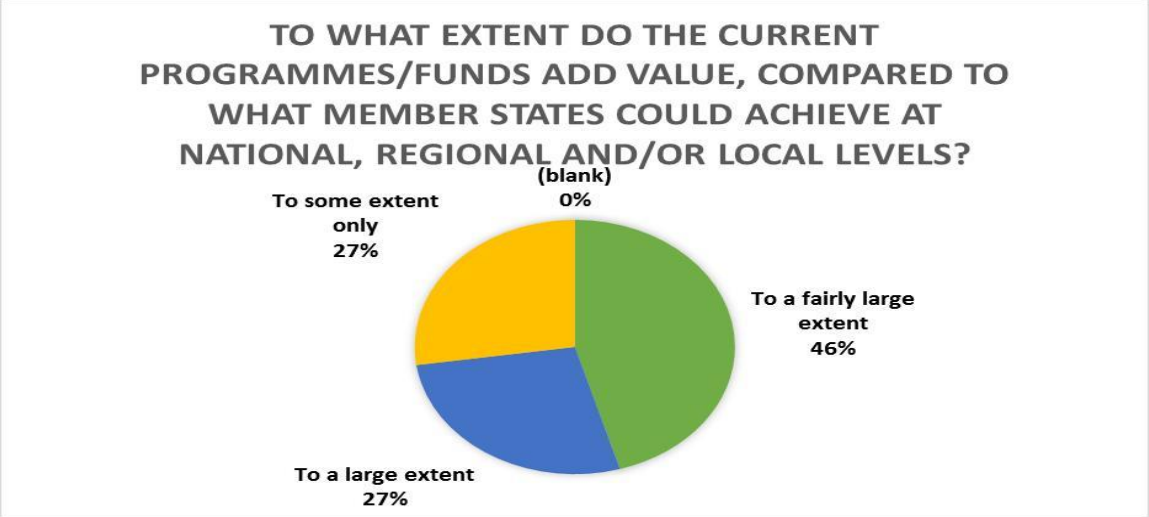
As mentioned before, EU space initiatives and programmes started in the nineties of the past century. In the meantime, several studies, impact assessment, regulations and evaluations and has been conducted to prove the EU added value. A public consultation was launched in the beginning of January 2018 within the framework of the preparation for the next MFF and the main findings are the following:

1. A single country cannot achieve significant results alone or afford a large space programme. The Galileo/EGNOS and Copernicus programmes have created world-class strategic infrastructures that no Member State would have been able to create on their own. Space matters are requiring a high level of investment to achieve results and bring the necessary independence of Europe.

[63] Space Solutions for a Sustainable World

2. Ensuring space capacity for Europe means fostering collaboration between Member States in the industrial sector. Bringing together several nations, competences, skills add value to any of these endeavours for the benefit of European society. Transboundary infrastructures clearly provide EU value added.
3. The EU has a key role to play in supporting the sector and allows it to continue to innovate and develop new services for citizens, also supporting the competitiveness of the space industry at large including satellite operators.
4. Downstream, the data, signals and services create far more valuable information and knowledge.
5. The Galileo/EGNOS and Copernicus programmes allow Member States to specialise in specific upstream technology.
6. Infrastructures are of strategic importance, require multiannual financial security (because of the high investment and maintenance cost) and continuity.
7. Pooling and sharing of national space capabilities would also allow Member States without own capabilities to develop their services based on satellite systems at a national level, with a positive industrial fallout that otherwise they would not have. Moreover, the development and use of common and shared spatial systems favours the achievement of other EU objectives, common to all Member States; a significant example could be border control and maritime surveillance with satellite systems, or the development of trans-European transport networks.

When asked to qualify the extent to which the current Galileo/EGNOS and Copernicus programmes provide EU added value, more than two thirds of respondents considered this to be the case, while about a minority of one quarter of the respondents considered this to be the case to some extent only:



A. EU Added Value of Galileo and EGNOS

Galileo and EGNOS have been operational already long before the current MFF. Its value added has been already detailed in the IA of the Regulation (page 16 and following).

The EU added value of the Galileo and EGNOS was assessed as high. According to stakeholders, stopping or withdrawing the existing EU intervention would have such severe consequences for Galileo and EGNOS that the entire programme would be jeopardised. Ending EU intervention would entail a considerable waste of public funding and would impact the outcome of efforts supported by private investments. Stopping or withdrawing EU intervention would severely damage the image of the EU, as such a decision would reflect badly on the Union’s reputation for leading programmes as complex and challenging as Galileo and EGNOS.

The added value of the European GNSS lies not only in ensuring Europe’s independence with regard to a critical technology but also in securing important macro-economic benefits for the European Union, catalysing the development of new services and products based on GNSS and generating technological spin-offs beneficial for research, development and innovation.

The implementation at EU level of Galileo and EGNOS has brought a high added value compared to what could have been achieved by the Member States at national, regional or local level. The size and complexity of the programmes require implementation at EU level, as no viable alternative exists to ensure an appropriate return on investment.

As demonstrated earlier in the text Galileo provides state of the art services that allow Europe to be independent, if necessary, on positioning, navigation, and timing services. Unlike GPS, Galileo is a civil service, under civilian control with dual applications for civil and security sensitive operations, that reduces the risk of disruption due to conflict. Moreover, Galileo's independence extends to the network layer, since even with a disruption of the terrestrial network, Galileo would be still available.

It is unlikely that a single Member State could independently gather the budget required for Galileo/EGNOS and manage such a complex system. The shared effort and resources of the EU enable Galileo/EGNOS to operate smoothly and efficiently. Additionally, pooling expertise from the broad EU's industrial base more than relying on national expertise, allows for faster and better service provision. Furthermore, EUSPA is a single-entry point to collect user needs and offering funding schemes to support the development of new ideas, technologies, and solutions, avoiding overlaps and fragmentations, enabling economy of scale, and enhancing synergies.

Galileo/EGNOS provides high precision and interoperability with the US GPS and WAAS and offer significant technological value to the EU. Strategically, it grants the EU independence, ensuring network continuity, and delivering global coverage. Additionally, a national-level initiative would be costly and challenging to manage, while the EU's shared resources, expertise, and funding mechanisms foster efficiency and innovation.

B. EU Added Value of Copernicus

Copernicus has been operational since the previous MFF. Its value added has been already detailed in the Impact Assessment of the Regulation (page 15). “EU action is providing considerable added value above what could be achieved at national level.”

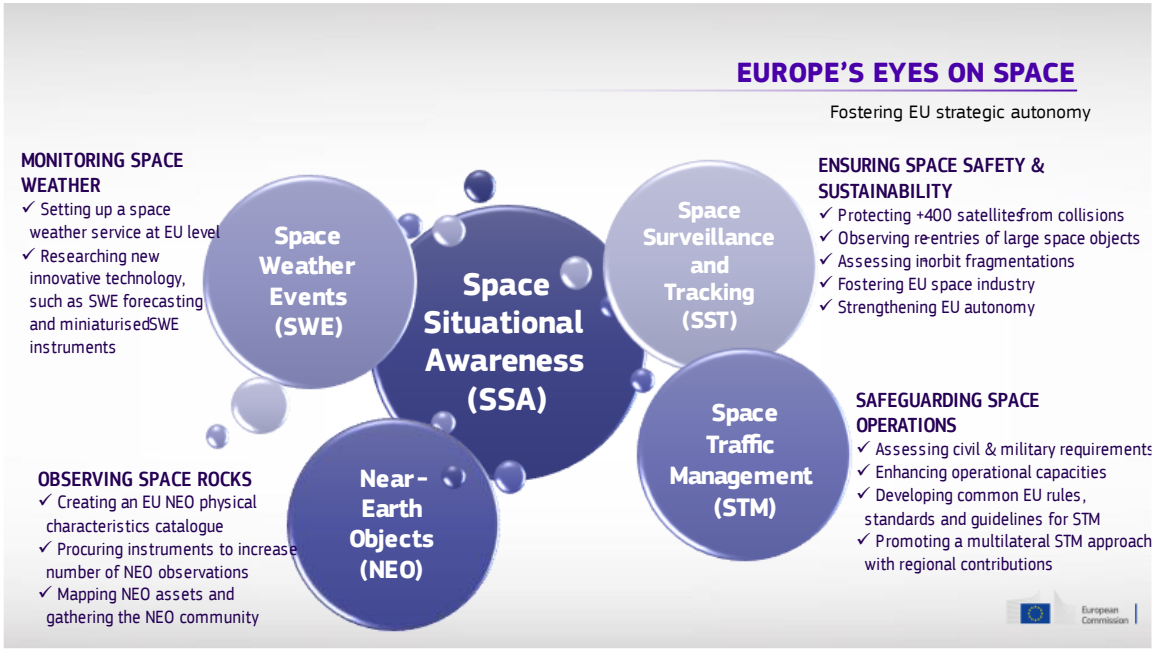
Copernicus has significantly enhanced the EU's visibility and leadership in providing high-quality, free and open Earth Observation data at a global level in key areas such as climate change and disaster management. It offers a one-stop shop portal for a wide array of data, products, and services of consistent high quality.

Moreover, by providing strategic insights, it serves international objectives at a global scale, for example the Paris Agreement objective and the United Nations Sustainable Development Goals, Copernicus enables in many cases the EU and its Member States to remain non-dependent on third countries. By supporting several third countries with remote sensing information, Copernicus not only strengthens the EU’s international relations but also opens up diplomatic routes and gives the EU strategic and political relevance at global stage. and . This aligns with the Global Gateway strategy, through which EU builds solid international partnerships in support of green and digital transition, bringing reciprocal benefits and reinforcing Europe’s role as a global actor.

Developing and managing a programme of this scale would be extremely challenging at a national level, both in terms of financial resources and operational capacity. Additionally, given the various needs across the EU that demand a collective response, it is essential to pool resources and collaborate to address these shared challenges. An important advantage of Copernicus is its ability to support national and EU decision makers, providing high quality an independent data and information, as well as for the monitoring of the implementation of EU and national policies.

C. EU Added Value of Space Situational Awareness

The SSA component brings significant value to the EU, since is providing services for the security and safety of the EU and its Member States, pooling resources and capabilities from different Member States. SST presents capabilities that is beyond the capabilities of most Member States due to high costs. In fact, some Member States do not have a proper SST mechanism in place, or it they have limited capabilities. Similarly, for NEO and SWE, a variety of instruments and substantial resources are necessary, making it unfeasible for individual Member States to tackle. Implementing an initiative at EU level also enhances its efficiency by preventing duplication of assets across Member States. Moreover, operating at the Union level allows for a strong international presence, where the EU can stand alongside major players such as the United States.



D. EU Added Value of GOVSATCOM

GOVSATCOM strengthens the EU's resilience and ensures all security stakeholders an access to satellite communication that meets EU-standardized minimum-security levels, leading to enhanced security and operational efficiency, reduced administrative complexities, and notable economic advantages. This approach particularly benefits Member States without nationally owned satcom infrastructures, allowing them to pool and share resources during crisis or emergency situations. Additionally, Member States with national satcom capacities benefit from expanded coverage in terms of geography, capacity, and services, creating EU added value.

One of the main reasons for action at EU level is the cost effectiveness, as well as the possibility to offer an additional level of security for satcom services thanks the GOVSATCOM Hub infrastructure that will be put in place by pooling and sharing services by governmental providers.

Moreover, an initiative at EU level permits to aggregate the demand and to negotiate favourable financial conditions for users. This system is expected to benefit operators because the aggregation of demand will result in large volumes and long-term contracts which ultimately will also be reducing the administrative burden associated with managing multiple short-term ad-hoc contracts with numerous clients.

E. General remarks on EU Added Value

Galileo and EGNOS enables EU independence from dual-use systems such as GPS, while serving the industry with high performance and free space data and services. The same is valid for Copernicus that offers a free, open and reliable service that results in leadership and visibility for the EU, thus fostering scenarios of collaboration and enhance its soft power. Similarly, GOVSATCOM will ensure security communication for critical

governmental applications, while SSA will protect EU citizens and infrastructure with an effort that can only be done jointly at EU level. The Programme strengthens the European position in the global landscape, and also plays a paramount role in the internal market. The role of the Programme at global stage has been acknowledge also in the Call for Evidence, encouraging to further expand and strengthen its engagement into international relations. In addition, more and more regulations are drafted with the support of space assets: examples span from healthcare, aviation, maritime safety, disaster resilience, agriculture, green mobility, and energy security.

4.3. Is the Space Programme still relevant?

The relevance of the Programme is verified through **user needs satisfaction**, namely in how far the space services are still addressing them and their evolutions.

Article 102 of the Regulation requires the analysis *of "the evolution of needs of the users of the Programme", the evolution of data and services offered by the competitors (for Galileo, EGNOS and Copernicus), the evolution of available capacities for sharing and pooling (for SSA and GOVSATCOM), the need for changing pricing policy and the need for additional space or ground infrastructure to address the user needs".*

User needs are constantly monitored during the implementation of the Programme, through different tools and fora. Users are different, depending on the components and the services offered, therefore their needs are collected and addressed by the entity entrusted to their implementation. Nevertheless, as highlighted before, many applications depend simultaneously on Galileo and Copernicus services and some convergence is taking place at user level. For example, the **User Consultation Platform (UCP)**[64] led by EUSPA, was established to cover only GNSS users, but with the entry into force of the Regulation, has been extended also to Earth Observation users.

A. Relevance of Galileo and EGNOS

Evolution of the needs and of additional infrastructure

As described above, **EUSPA** runs a **User Consultation Platform (UPC)** to identify and understand the evolving needs of the users' communities and prepares since 2010 a GNSS Market Report; now the **EO and GNSS Market Report**. This platform supports EUSPA interventions to take into account the needs and requirements of end users, ensuring that space services provided by the Agency are driven by these needs. It follows up with annual public **reports**[65] on several sectors.

Galileo and EGNOS are used for many applications in different fields. Some sectors rely heavily on it for **positioning**, such as the transportation sector, emergency, or raw

[64] EUSPA Releases User Consultation Platform 2022 Reports

[65] Ibid.

materials. Some instead need accurate **timing**, such as the energy, finance, or telecommunication infrastructure. Each sector or even application has **critical performances** to meet, and they vary among the applications. In fact, in safety critical and liability critical applications (e.g., for the aviation sector), the main performance requirements are related to **accuracy and integrity** of the signal, which must be precise and reliable. The relevant user needs are generally met by current generation of Galileo and EGNOS, however two new user needs were identified thanks to the regular monitoring and consultations, that allowed the Commission and the entrusted entities to promptly react. In fact, there are needs – particularly from the transport sector – that cannot be met by the current generation of Galileo or EGNOS. Therefore, it is in the interest of the EU to deploy and enter into service Galileo Second Generation and EGNOS V3 as soon as possible to allow the user community to leverage the service. The first is the need for emerging safety critical use cases in transport applications, such as precision port approaches in maritime. The second gap is the need for a dedicated EGNOS service in rail, similar to the one in aviation. While these requirements exceed that of the current system, they are being addressed in a stepwise approach with a target for full services with EGNOS V3.

Pricing policy and competitors

Galileo services should remain free in the future. Services were originally conceived to be offered at a fee, but this approach has been discarded subject to further analyses. In particular, the following reasons support the free provision of services:

- Historic reasons: satellite navigation services have been provided freely, starting with GPS. Any changes to the Galileo services provided for free would have a negative effect on public authorities (who are captive users and have limited budgets) and in general on other users too (private or commercial, who are not captive and would become dependent of non-EU free service providers).
- Socio-economic benefits: In the case of added-value services specifically offered by Galileo (e.g., High Accuracy and Authentication), it was estimated that the social benefits of allowing free use of the services were higher than in the fee-based scenario. From the economic perspective, value creation by the private sector derived from the free availability of such features, overcame the potential losses by a commercial exploitation of the services.
- Operational constraints: finally, operational constraints to put in place a fee-based scheme, including potential user access control, were a deterrent for the implementation of fee-based schemes. The new architecture would be costly to implement and maintain.
- Finally, it is difficult to argue that live saving services such as the Galileo SAR Service or the future EWSS should be available only via fee.

Galileo is one of four GNSS available. GPS and Glonass are older systems, while Galileo and Beidou are newer and similar to each other. Of the four systems, Galileo has more differentiating features that sets it apart (e.g., HAS, PRS, Authenticated Service). While

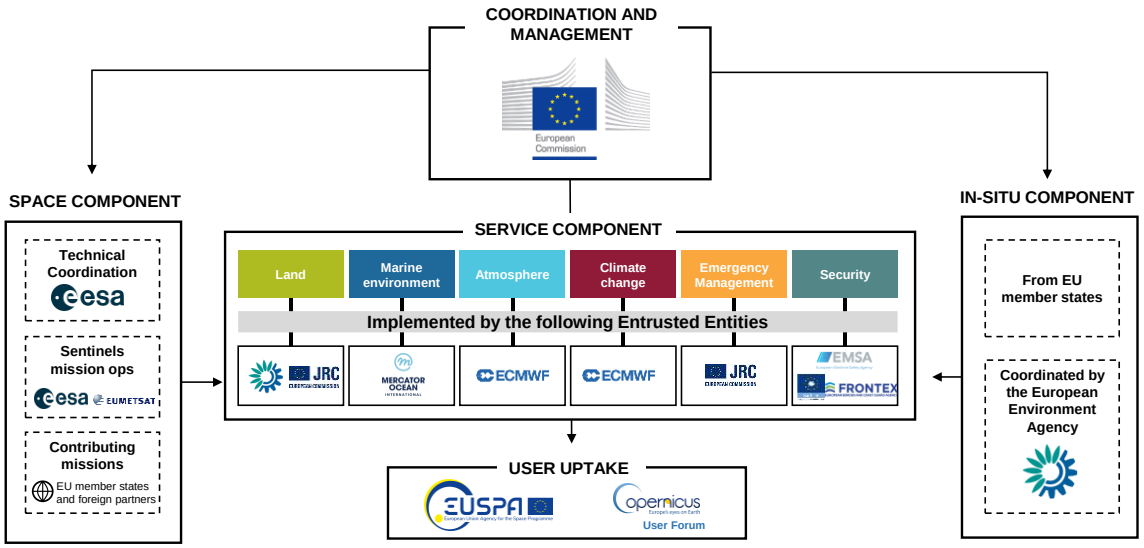
they provide similar services and target the same users, the four systems cannot be said to be in competition. On the contrary, more satellites in orbit would be beneficial to the civilian end user, so the systems can be said to be complementary.

The SBAS are also not competitive since they target different geographic areas. They are fully interoperable and therefore complementary as the wider the coverage of SBAS, the more benefit there is to the end user.

B. Relevance of Copernicus

Evolution of the needs and of additional infrastructure

The **Copernicus User Forum** provides inputs to the Commission regarding the definition and validation of user requirements, and it is responsible for the coordination of the Copernicus programme with its public sector users (Copernicus core users). In April 2021 the Commission established the **Knowledge Centre on Earth Observation (KCEO)** that brings together 15 different DGs having and interest in using Earth Observation data and services from Copernicus in their policymaking, with the aim to incentivise the uptake of Earth Observation in the EU policies. Assessments of initial needs and requirements have been undertaken or are ongoing for areas such as biodiversity, urban climate adaptation, and compliance assurance. Furthermore, each entrusted entity, including ESA, collects needs and requirements from the user community it interacts directly with, through user support desk, workshops, surveys, and events, to provide actionable recommendations to guide the evolution of the service.



Since 2020, the **User Consultation Platform** run by EUSPA includes Earth observation, bringing together the users' community to share their experiences and needs, and discuss market trends in various domains. Following two previous issues of the **Copernicus Market Report** [66] prepared by the Commission, in 2022 EUSPA issued the first **EO and**

[66] Copernicus – Market information

GNSS market Report[67] to presents an overview of the entire downstream space application market, main trends, market size and revenues. It further provides a global industry overview and main trends, as well as a general description of what Copernicus and EGNSS encompass. Finally, it showcases how EO and GNSS play a role across general policy and market trends.

Regarding the user needs collection and implementation, the entire process is continuous and exhaustive, taking into account inputs from multiple sources and following a bottom-up approach, placing the user at the centre of the programme to provide a more holistic view of user needs.

At a high level, out of the ~40 applications that were assessed during the evaluation, around half the applications were identified to still have at least one gap in user needs. However, nearly 90% of these gaps are planned to be addressed or are under consideration. Therefore, it can be deduced that over 90% of identified user needs are either being met or planned to be met through the current and planned Copernicus missions[68].

Pricing policy and competitors

The pricing policy post-2020 has already been extensively analysed in a separate study[69] that confirmed that the free, full, and open data policy of Copernicus is the most suitable pricing policy for the following reasons:

1. Socio-economic benefits brought by Copernicus to end users and beneficiaries of its data and services, when monetized, largely outweigh the costs of the component by 3.7 times, even with the data and services being open and freely available.
2. Copernicus provides public services used by citizens and governments across the globe (e.g., to fight climate change, protect the ecosystems, as well as to prevent and manage natural disasters).
3. Stimulation of the industry: Copernicus aims to stimulate the industry to develop products and added value services based on Copernicus data that are public or commercially viable.
4. International obligations: In accordance with the UN Resolution 41/65 on the Principles Relating to Remote Sensing of the Earth from Outer Space Remote

[67] EUSPA - EO & GNSS Market Report

[68] CHIME (Copernicus Hyperspectral Imaging Mission for the Environment), CIMR (Copernicus Imaging Microwave Radiometer), CO2M (Copernicus Anthropogenic Carbon Dioxide Monitoring), CRISTAL (Copernicus Polar Ice and Snow Topography Altimeter), LSTM (Copernicus Land Surface Temperature Monitoring), ROSE-L (Copernicus L-band Synthetic Aperture Radar).

[69] Study on the Copernicus Data Policy Post-2020

sensing activities shall be carried out for the benefit and in the interests of all countries.

Worldwide, even if the US does not have one comprehensive programme such as Copernicus, the Landsat Program[70], which provides land observations, and National Oceanic and Atmospheric Administration (NOAA) satellites[71], providing environmental observations could be considered as a competitor in terms of the data provided. However, Copernicus is the only one to offer radar imagery with good resolution[72] and with comparable annual budgets[73]. Landsat and NOAA are considered complementary to Copernicus rather than competitors and help provide better insights for all user communities, when combined.

In comparison with other providers, the United States Landsat and the National Oceanic and Atmospheric Administration have an open and free data policy, allowing industry and academia to produce benefits for the society at low cost and high efficiency.

C. Relevance of Space Situational Awareness

Evolution of the user needs and need for additional infrastructure

For **SST**, the user needs have been gathered by Sat Cen and this work is today continued by EUSPA. Preliminary results show roughly 100 user needs collected through feedback campaigns, meetings (physical or virtual) and with EUSPA's UCP stakeholder consultation. Overall, around 80% of the identified needs are currently being covered with the service. For the remaining 20% either it is not possible to fulfil them because of the current system technical constraints (impossible to detect extremely small objects) or of a lack of budget (and vice-versa). The current SST component is based on an aggregation of the resources available at EU level, combining Member States capabilities, and it allows to use available assets under defined conditions with the EU budget covering the part of the operational and research costs. The expected evolution is an overall growth in the capacities, both from institutional (Member States) and commercial side.

[70] The Landsat Program is run jointly by NASA and the USGS and provides space-based data essential for making informed decisions about Earth's resources and environment. The program has been active since 1972, however, data has only been freely available to users since 2008 due to a policy change

[71] The National Oceanic and Atmospheric Administration is a scientific and regulatory agency based in Washington, D.C. The agency is charged with forecasting weather, monitoring oceanic and atmospheric conditions, charting the seas, protecting of marine mammals and managing fishing in the exclusive U.S. economic zone. As of today, NOAA owns or operates a total of 17 satellites

[72] 15m multispectral resolution from Landsat, 5m radar resolution from Copernicus, 10m multispectral resolution for Copernicus

[73] US had USD 1.6 billion in 2022 while Copernicus had EUR 2.1 billion in contract value between 2021 and 2022

Regarding the future, the user needs are expected to evolve, to adapt to the current trends of increasing of space debris and of large constellations**,** and the potential intensification of aggressive or unfriendly actions in space. With the anticipated development of an EU Approach **Space Traffic Management (STM)**, the EU SST capabilities are expected to be enhanced to effectively tackle the challenges associated with STM, along with STM regulatory aspects and operational aspects.

For **NEO and SWE**, the services are not yet operational. Therefore, the methodology was slightly different as it was not feasible to make direct comparisons between the service and the user needs, and the focus was placed on examining the link between user needs and service definition. For **SWE**, the exact number of services is not determined yet however, at least one service is foreseen, considering the current budget allocated to the SWE sub-component.

For **NEO**, no user need assessment has been done yet. The topics chosen are identified in the Regulation to strike a balance between the interest for the community and the budget allocated to the component.

Pricing policy

Space Situational Awareness sub-components provides (SST) or will provide (SWE, NOE) services free of charge, as they are expected to be public services or used by public authorities for the safety of EU, national and commercial infrastructures (space and ground) infrastructures.

For **SST** pricing: SST was designed in order to protect Galileo and Copernicus satellites. With the EU as main user, charging does not make sense. For other users implementing a pricing mechanism could pose great challenges given that SST relies 99% on information from third-parties radars and telescopes to deliver its services. On top, SST provided by the EU is considered as a public service providing key information to ensure that space as a global commons is kept as far as possible free from new debris created through collisions of satellites with existing debris or other satellites. Also, on the US side SST data are provided free to stakeholders. Whilst the US is currently working on an evolution of the system, it intends to continue offering basic services for free.

For **SWE** pricing: Meteorological-like services are primarily designed as public services. Customized services could be added for various sectors such as transportation or defence, tailoring the service to specific needs within these sectors. However, for now, and due to the objectives of SWE future service – mitigate the risks associated with extreme space weather events and safeguard systems and technologies in orbit and on Earth - charging is not possible.

For **NEO** pricing: The user base is very limited, and these users are almost exclusively relying on public budgets for their functioning (with no margin to payments or subscriptions).

D. Relevance of GOVSATCOM

Evolution of the needs and infrastructure and need of additional infrastructure

Regarding GOVSATCOM, a large survey led by EUSPA was done within the **ENTRUSTED**[74] project aimed at identifying user needs and use cases that permitted to build the baseline. EUSPA is now maintaining up to date knowledge of these requirements.

However, due to the particularly sensitive nature of the GOVSATCOM component, the results of this survey are classified. For this reason, this section will focus on a high-level assessment mainly describing the process used in gathering the necessary inputs. The **High-level Civil Military User Needs for Governmental Satellite Communications**[75] (2017) served as a baseline for the ENTRUSTED work and for the creation of a user representatives' network which actively participated in the survey, the largest survey conducted in this area with approximately 140 respondents.

Even though the precise results are classified, overall, it is concluded publicly that GOVSATCOM will meet a substantial percentage of the user requirements. However, the survey and the Impact Assessment accompanying the proposal for the IRIS^2 Regulation identified gaps, particularly as regards low latency. In fact, there are no EU Low Earth Orbit and Medium Earth Orbit operational or planned capabilities that could meet the current evolving governmental user needs. Therefore, the available satcom resources of EU GOVSATCOM need to be complemented with new capabilities meeting these needs. To cater for such situation, the Programme includes provision for a decision on a second phase of the GOVSATCOM implementation which involves the development of additional bespoke space infrastructure or capacities through one or more public-private partnerships. In 2023, the co-legislators have agreed to establish the Union Secure Connectivity Programme (IRIS^2) with the adoption of the IRIS^2 Regulation. The services offered by IRIS^2 will complement those offered by GOVSATCOM.

Approximately EUR 220 million were reallocated from the Space Programme to finance IRIS^2, resulting into descoping or cancellation of certain activities under the Space Programme. Consequently, the budget available to purchase capacities to provide GOVSATCOM services (pooling of resources financed by the Programme) has been reduced, thereby limiting the volume of services offered to governmental users. Additionally, Space Weather and Near-Earth Object activities have been affected, resulting in the postponement of initially planned services in these areas.

It is however important to note that synergies were fostered to limit the potential overall cost impact of implementing IRIS^2. Amongst others, we could mention that:

[74] ENTRUSTRED Project

[75] Study on High-level Civil Military User Needs for Governmental Satellite Communications

- The provision of EU satellite communication services for governmental users is based on the development of a ground infrastructure (GOVSATCOM Hub) that pool together different existing and future satellite systems and share the resources among governmental users. The underlying satcom capacity and services will be provided by Member States' national assets and by security-accredited commercial satcom providers. The governmental services of IRIS² will also be provided through the GOVSATCOM Hub. Hence, the GOVSATCOM Hub is an essential element of the IRIS² service provision, where users will be able to select from a wide catalogue of services.

- Furthermore, the contract for the development of ground infrastructure for the GOVSATCOM Hub also includes the development of the Security Monitoring facility that will ensure the security of IRIS².

- Finally, efforts to promote the adoption of services within the governmental market are shared between IRIS² and GOSATCOM, as they target the same user communities, such as border guards, police, military, civil protection, the maritime and diplomatic communities within Member States, as well as within EU institutions and agencies.

Pricing policy

The GOVSATCOM pricing policy has been defined in implementing act[76], approved in May 2023, and will consist in a system of tokens, tailored to the needs of each participant, to facilitate the sharing and prioritization. The system will be completed by a pay-on-demand part for additional demands. This pricing policy guarantees to provide secure connectivity to users at no cost but remains flexible enough to be adapted to the needs of each use through the additional pay-on-demand part.

E. General remarks on relevance

The Programme serves a wide variety of **needs of different users**. Users' requirements change and evolve constantly, and the evaluation found that the entrusted entities continuously track, collect, and meet user needs. Only a small percentage of the user requirements as indicated by those exploiting the space services of the Programme could not yet be met by those exploiting. This result was expected since most of them are due to financial or technical constraints. Nonetheless, most of the gaps are already being addressed by upcoming technologies, products and satellites: examples are the

[76] Commission Implementing Decision (EU) 2023/1055 of 30 May 2023 setting out the rules on the sharing and prioritisation of satellite communication capacities, services, and user equipment to fulfil the function referred to in Article 66(2) of Regulation (EU) 2021/696 of the European Parliament and of the Council

Copernicus Expansion missions or EGNOS V3. Therefore, the Programme yields significant strategic advantages for the European Union and will offer even more in the near future.

As regards the **pricing policy**, the evaluation confirmed that the current free pricing policy for Galileo, EGNOS, Copernicus, SST services, and GOVSATCOM should remain unchanged due to various reasons. This has also to be further recognised by the respondents of the Call for Evidence. Charging for these services could negatively impact public authorities and other users, violate existing agreements and licenses, and contradict the purpose of the Programme. Additionally, charging for certain services is not feasible due to their reliance on third-party data sources, limited user bases, and their essential role as public services in protecting satellites.

5. MAIN FINDINGS CONCERNING THE PERFORMANCE OF EUSPA

The findings of the IA which was undertaken in order to prepare the current Space Regulation, called for governance simplification by streamlining the management of the implementation of the actions and the role of the main stakeholders (the Commission, GSA, ESA and Member States), bringing coherence and synergies. Thus, since its creation, the Agency has undergone significant changes from the Galileo Joint Undertaking to the European GNSS Agency (GSA) and subsequently with its evolution to EUSPA. EUSPA came with an expanded mandate that requires the Agency to contribute to several components of the EU Space Programme, such as Galileo, Copernicus, EGNOS, SSA, and GOVSATCOM; furthermore, the IRIS² Regulation (EU) 2023/588 also includes tasks for the Agency.

The mission of the Agency is to support the **implementation of the EU Space Programme**, and to act as the user-oriented operational agency of the Programme, facilitating the delivery of **secure space-related data, information, and services** to maximise the socio-economic benefits provided to users in the EU and around the world, including governmental and downstream services[77].

In order to achieve its overall goals and aspirations, EUSPA's tasks spread across **three main pillars**:

- **Exploitation**, including the management, operation, maintenance, continuous improvement, and evolution of Galileo and EGNOS; the development of the GOVSATCOM Hub; and the operation of the SST Front Desk;
- **Security**, including the operational security and security monitoring of Galileo and EGNOS, and the security accreditation for all components of the Space Programme and for IRIS^2 through its Security Accreditation Board; and
- **Market-uptake**, including the communication, market development and promotion activities of services linked to Galileo, EGNOS, and of the data, information and services offered by Copernicus, GOVSATCOM and SSA, without prejudice of activities performed by entrusted entities and the Commission.

Across the above pillars, EUSPA delivers a series of **core and delegated tasks**, determined in the Article 29 of the Regulation, and summarised in its **Strategic Objectives**:

- Ensuring the security accreditation for Galileo, EGNOS, Copernicus, GOVSATCOM and SSA (core task, Art. 29.1(a)).
- Ensuring the operational security of Galileo and EGNOS (core task, Art. 29.1(b));
- Ensuring the operation of the GSMC (core task, Art. 29.1(b)).
- Performing the tasks related to the Galileo PRS (core task, Art. 29.1(b));

[77] EUSPA Single Programming Document 2023-2025

- Ensuring the promotion, market development and communication of the services of Galileo, EGNOS and Copernicus (core task, Art. 29.1(c, d)) without prejudice of activities performed by entrusted entities and the Commission.
- Ensuring the delivery of the services of Galileo and EGNOS (delegated task, Art. 29.2(a)).
- Ensuring the coordination of user-related aspects of GOVSATCOM (delegated task, Art. 29.2(b)).
- Implementing R&D activities in the context of Horizon Europe and Fundamental Elements (delegated task, Art. 29.2(c)); and
- Undertaking User Uptake activities in relation to GOVSATCOM and SSA (delegated task, Art. 29.2(d)).

The Agency's Headquarters are in the Czech Republic, with teams also in the GSMC in France and Spain, the Galileo Reference Centre (GRC) in The Netherlands, the European GNSS Service Centre in Spain, and in Toulouse and Brussels.

5.1. Assessment of the implementation of the entrusted tasks to EUSPA

The evaluation of EUSPA's entrusted tasks has been developed throughout the whole Staff Working Document, where the different components of the Programme are analysed across the five better regulation criteria. EUSPA is a key actor in the implementation of the Programme, and it contributes to the fulfilment of its objectives.

In case of **Galileo and EGNOS** the Commission has delegated **the operational management** of both components to EUSPA that oversees how Galileo and EGNOS infrastructure is used and ensures that services are delivered as planned and without interruption. EUSPA completed these entrusted tasks without major delays providing Galileo services with minimal incidents, ensuring the security of Galileo and EGNOS. However, areas for the improvement have been identified such as implementing cyber requirements and addressing delays in the development and deployment of Galileo infrastructure, notably in the space segment. But as most of the delays are related the external factors like technical problems of industry and the launcher crisis, it is difficult for EUSPA to fully mitigate these kinds of delays. Delays are expected also for EGNOS V3 and its services due to issues with site procurement and industry delays, but EUSPA has taken steps to mitigate these delays. As regards EUSPA **downstream activities** on Galileo and EGNOS, they are related to the development and evolution of fundamental technological elements, such as chipsets, receivers, and antennas. These tasks are addressed in a complementary way both under the Programme and under Horizon Europe and are instrumental to finance the future generations of EU Space infrastructure and ensure the uptake of the services provided. EUSPA may experience delays in making payments to beneficiaries due to the long and thorough review process. Efforts are underway to improve these internal processes and enhance communication with the beneficiaries.

For the implementation of **Copernicus**, EUSPA is entrusted to support the development of downstream and integrated applications based on Copernicus. While most of the tasks were implemented as planned, the development of Copernicus demonstrators was delayed due to a high number of proposals, leading to project kick-off postponement. The delays will not affect the overall implementation, as the budget will not be exceeded. Additionally, they have allowed for more time to network and raise awareness before the launch of the second call by EUSPA.

For the **SSA** component, EUSPA was entrusted to support the Commission as far as project management and technical matters are concerned, in particular in preparation of the operational users' management/coordination, The responsibility to manage and operate the SST Front Desk was transferred on 1 July 2023 but EUSPA worked already before together with Sat Cen to ensure a smooth transition.

Regarding **GOVSATCOM**, EUSPA has been entrusted with the procurement and the setting-up of the secure operational ground segments (GOVSATCOM Hubs), in addition to other tasks related to support for the definition of technical requirements, downstream activities and for security related activities. Despite the initial delays caused by the setup of the procurement process and the definition of the procurement conditions, EUSPA, together with the Commission managed to mitigate this risk and the activities are currently running smoothly.

5.2. Assessment of the implementation of the EUSPA core tasks

This section addresses all core tasks that were not evaluated elsewhere in this Staff Working Document, i.e.: Security accreditation; operational security for Galileo and EGNOS; Operation of the GSMC; PRS; Communication, promotion, and market development; Agency Management.

The targets linked to each core task activities as well as a set of indicators to be reached, have been defined from the EUSPA Single Programming Documents 2020-2022, 2021-2023, 2022-2024 and 2023-2025 as well as the Annual Activity Report of 2021 and 2022. More details are available in the appendix. Since 2023 results were not yet available, the evaluation covers the years 2021-2022.

Core task 1: Security accreditation

The SAB operates independently and autonomously within EUSPA, oversees security accreditation activities, and acts as the security accreditation authority for all the components of the Programme. The security accreditation task consists of 7 objectives, each with associated activities, indicators, and annual targets. These objectives include operating effective administration, providing support to SAB management, issuing necessary authorization statements, managing subordinate bodies and expert groups, conducting independent security assessments, ensuring key assurance, and preparing for new regulatory responsibilities.

The targets for all 7 objectives have been met (100%) in 2021 and 2022. The objective related to the plan for initial accreditation activities for Copernicus, GOVSATCOM and SSA was achieved in 2022.

Core task 2: Operational security for Galileo & EGNOS

This core task deals with ensuring the security of Galileo and EGNOS and includes two types of subtasks - the threat and risk analysis, and the operational security.

The evaluation Galileo Threat and Risk Analysis is based on four indicators. Each of these indicators refer to reports that EUSPA needs to provide for accreditation activities and meetings with the SAB. For 2023, these tasks and the production of these document is progressing well and without problems. Only the final document (Galileo Security Accreditation Milestones and Schedule) has some external dependencies, as it is reliant on inputs from external stakeholders. For 2022, two indicators were fully met, one was not assessed under the core task, and the fourth one was met at 75%, due to changes in deployment activities and site status. There were no targets set for 2021.

The EGNOS Threat and Risk Analysis is based on five indicators. One of the indicators related to the compliance to the high-level security requirements is still in the definition stage, as these requirements are not yet finalised. There were no targets set in 2021, while in 2022, the indicators, related to number of accreditations, Services and System Security Plan and Security Accreditation Milestones and Schedule were fully met. The indicator related to EGNOS V3 sites was met 89%, with 14 of the 16 milestones being concluded in 2022, and outstanding 2 have been being implemented in Q1 2023 due to status of the relevant sites.

The evaluation of **Galileo Operations Security and EGNOS Operational Security** is based on two indicators for Galileo, while for EGNOS is based on three. For both there were no targets set for 2021 and all targets were met at 100% in 2022.

Core task 3: Operation of the Galileo Security Monitoring Centre

This core task involves operating the GSMC and encompasses five activities related to ensuring the security of Galileo services and operations, engineering activities in support of deployment and operations, availability of hosting services, continuity of service of GSMC operations, and local security. Targets for four out of five objectives were met for both 2021 and 2022, with regular tests conducted on switching the primary site and continuous availability of the GSMC. There was only one delay in 2021 for hosting services since the Spanish site was not ready on time due to non-compliance of buildings. However, the 2022 targets for both sites were met.

Core task 4: Galileo Public Regulated Service Activities

There is only one objective of core task 4 that focuses on the implementation of PRS activities, with two indicators related to timely review of the Agency PRS management

plans and level of compliance to the specific arrangement in handling of PRS information and items. The Agency has fulfilled its obligations towards the specific arrangement to the maximum extent possible, reporting regularly on the handling of PRS information and items within the Agency, and reviewing the PRS management plans for 2023. The compliance indicator, slightly below target in 2021 and 2022, was mainly affected by dependencies from actors external to the Agency, for which EUSPA has requested the Commission to adjust the arrangement in place to better frame the activities.

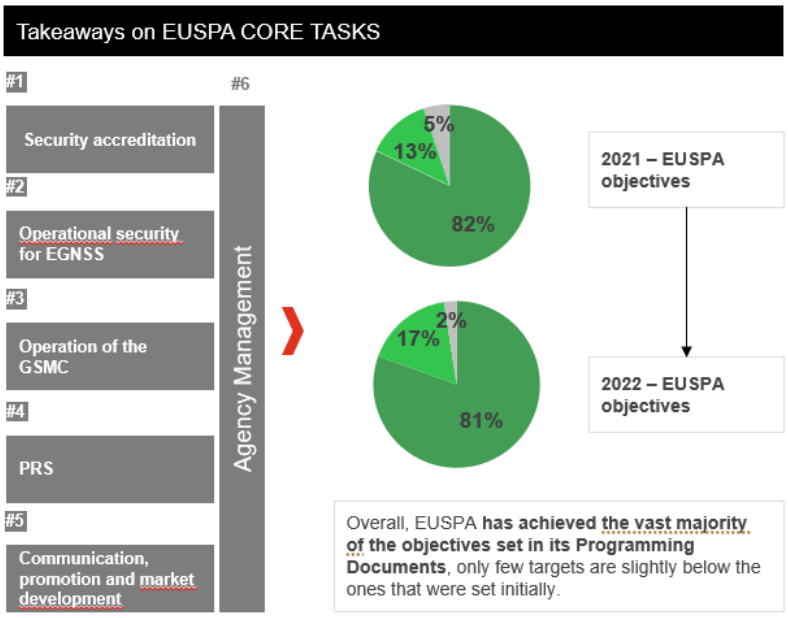
Core task 5: Communication, promotion, and market development

This core task encompasses activities related to market and technology monitoring, user scheme management, market development by user segment, and targeted communication initiatives to ensure an effective and efficient communications strategy. The assessment covers the years 2021 and 2022, since data for 2023 were not yet available. For these years, it encompasses 14 objectives[78] and the targets for 12 of them were fully met (. As regards objective related to the market development in Agriculture and Forestry, in 2021 all targets were met, while in 2022, the percentage of EGNOS receivers in the overall number of models for Agriculture and Forestry was 93%, slightly below the target of 97% due to the extension of receiver lifetimes caused by a chip shortage. A chip shortage was also a reason why the percentage of Galileo receivers in the overall number of Critical Infrastructures models was slightly below the target in 2022 (objective related to market development in Insurance and Finance, Infrastructures, Energy, and Raw Materials).

Core task 6: Agency management

The Agency Management core task aims at supporting EUSPA's core and delegated mission by providing support in areas of legal, procurement, grants, contracts, finance and budget, human resources management, ICT, facility management and logistics. It encompasses 18 objectives with associated activities, indicators, and targets, while one of them (related to the support the electronic exchange of classified information) is EU restraint). The targets for almost all 18 objectives were met, except two objectives: for the objective related to measuring and improving the quality of EUSPA processes, where one of 3 targets concerning the implementation of open actions was in 2021 slightly below the targeted percentage (94.5%). In case of the objective related to the statutory obligations of the Agency, one target has not been reached in 2022 – the timely execution of the corresponding yearly audits – due to a delay in the release of external audits and the need to launch a second audit on Galileo.

[78] Programme market development for aviation & drones, road & automotive, maritime & inland waterways, rail, agriculture & forestry, urban development & cultural heritage, consumer & health & tourism, insurance & finance, infrastructures & energy & raw materials, governmental use, emergency management & humanitarian aid, fisheries & aquaculture, climate & weather& biodiversity, and R&D communication



For the overview of all the objectives under core tasks with detailed description, please see the supporting Study, Section 4.1.2.

5.3 Independence and autonomy of the Security Accreditation Board

The Regulation requires the Commission to "*assess… the independence and autonomy of the Security Accreditation Board"* (Article 102.5).

The autonomy and independence of the SAB is addressed in the Regulation (Articles 37.i, 78.1, 82.1, 82.2, 83.1, 88.3, 99.2). Confidentiality rules have been set out in the SAB Rules of Procedure. Prevention and Management of the Conflict of Interest have also been set out in the SAB Rules of Procedure.

A separated department within the Agency (the Security Accreditation Department) was created in 2019 to ensure that EUSPA staff under SAB supervision perform their work in a manner ensuring autonomy and independence in relation to the other activities of the Agency. The staff belonging to that department reports directly to the SAB chairperson who exercises their appointing authority power.

In order to ensure the autonomy and independence of the Security Accreditation Board (SAB), the following rules are in place:

- Article 16 of the SAB Rules of Procedures, requiring the SAB to immediately inform the Executive Director, the Administrative Board and the Commission of any circumstances that could hamper its autonomy or independence, as well as that of staff performing the security accreditation activities.
- Declarations of Commitments, Interest and Confidentiality as stated in Article 15 of the SAB Rules of Procedure.
- According to Article 81.3 of the Regulation and Article 4 of the SAB Rules of Procedures, if the circumstances are a result of misconduct by the SAB chairperson

or deputy chairperson, the SAB has the power to dismiss them, upon proposal from any member with voting rights. Disciplinary measures under Article 86 of the Staff Regulations apply in case of staff misconduct).

In line with the Regulation, the Commission, as the overall Programme manager, is a member of SAB without voting rights. In several cases, SAB decisions added additional security requirements in ongoing contracts, leading to changes of the contractual baselines at a late stage, resulting in additional costs and delays in the implementation of the contracts.

5.4. EUSPA's Conflict of Interest Policy

In respect to EUSPA's Conflict of Interest Policy, the requirements of the Regulation have been fully fulfilled. Indeed, Article 79 (q) of the Regulation requires the Executive Director to draw up an anti-fraud strategy, and article 77(2)(l) requires the Administrative Board to approve the anti-fraud strategy. These obligations have been respected since EUSPA has updated and adopted a new Anti-Fraud Strategy on 25 October 2022.

Regarding specifically conflict of interest, Article 99 of the Regulation underlines that a declaration shall be made by Members of the Administrative Board and of the Security Accreditation Board as well as by the Executive Director, seconded national experts and observers, to declare the absence or existence of any direct or indirect interests which might be considered prejudicial to their independence. On a procedural level, this declaration shall be renewed annually and updated whenever necessary. This obligation is taken into account in EUSPA's policy of conflict of interest, e.g. in the Article 3 of the Agency's Decision on implementing rules on the prevention and management of conflicts of interests with regards to staff members and external workforce. Article 20 also states the importance of paying attention to the management of conflict of interest in procurement procedures for innovative solutions. Regarding this point, the EUSPA Internal Control Coordinator has confirmed that protocols are put in place while assessing the conflicts of interest policy (procurement, contract management, selection of experts, recruitment boards, post-employment, administrative board members).

Overall, the Conflict-of-Interest policy is structured around several pillars and adequate resources are made available:

- In relation to staff, contractors and detached national experts: a policy, implementing rules, conflict of interest boards have been set up (and active) and monitoring is active.
- In relation to departing staff (post-employment, Staff Regulation): implementing mechanisms is in place and active.
- In relation to Administrative Board members: specific conflict of interest provisions in Rules of Procedures have been set up and active monitoring is in place.

Furthermore, procedures are in place in the case of a conflict-of-interest suspicion.

6. WHAT ARE THE CONCLUSIONS AND LESSONS LEARNED?

6.1 General Conclusions

All existing and new EU space activities has been brought for the first time under the umbrella of a single Programme, establishing a coherent EU space policy and effective governance to support the EU's political priorities, economic growth and prosperity. Despite internal and external challenges, the system in place has proven to work well enabling a seamless transition of already operational services of Galileo, EGNOS, Copernicus and SST, provided under the previous MFF, and offering new or additional services, in an **effective** way. The Programme has managed to effectively attract and retain a growing number of users by demonstrating its capability to meet their diverse and changing requirements and by catering to a wide range of applications and sectors. However, some entrusted entities need more time in advance with better detailed requirements in order to be able to match new user needs.

In addition, the respondents of the Call of Evidence emphasised the need for the European Union, including through the Programme, to better leverage its regulatory strengths and considerable market size to foster the demand for new space services. The implementation of tasks by the entrusted entities have been aligned well with their contribution agreements and successfully implemented with minimal deviations or consequences and with any critical impacts on the services (Section on **Effectiveness**).

Despite a challenging environment and the complexity in the quantification of benefits, due also to the fact that each component has different timeframe, maturity, users and output, the Programmes' components are implemented in effectively and **efficiently**, the services are provided in a continuous, secure, and robust way providing significant value for money, and users are satisfied. The activities were carried out within the allocated budget and produced benefits much higher than the incurred costs, that were directly and indirectly sustained for their development. For the more recent components, a quantitative assessment was not yet possible but using proxy data indicates the enormous potential once the components are fully operational. The evaluation takes into consideration both the investment and spending into the deployment of the infrastructure and the provision of the services, and the wider socio-economic benefits resulting from their utilisation and exploitation (Section on **Efficiency**).

The evaluation has proved that the **EU relevance** of the Programme and its **coherence** with other EU programme and policies is unquestioned as it has been significantly contributing to the EU objectives of green and digital transitions, as well as resilience of the Single Market. The Programme enables solutions to tackle global challenges such as sustainability and climate change, safety and security, natural disasters and mobility and strengthens the EU's role on the international scene as a global space power (Section on **Coherence**). The EU's space flagships Galileo, EGNOS and Copernicus foster innovative services that can meet the needs of users whilst guaranteeing European competitiveness. They supports security and defence capabilities relying on space-based

services, and enhance safety and security of the Union and its Member States, and reinforce autonomy in areas of strategic importance. This has also been acknowledged by some of the Call for Evidence's respondents and during the meeting of the SDA Expert Group (section on **Coherence** and section on **Relevance**).

The **EU added value** of the Programme results from either EU space systems (space and ground infrastructure) or the pooling of a limited national resources from individual Member Stets for the benefit of the 27 and the UE. EU space-based data, services and information are freely available for the benefit for EU economy, industries, and citizens and for Member States' governmental users (for some specific services). EU added value is further ensured by close coordination with Member States, including in activities in international organisations such as ESA, EUMETSAT and ECMWF, with which the EU space programme cooperates directly. The assessment confirmed that **EU added value** is very high compared to what could be achieved at national or regional level. The Programme, by reason of scale, exceeds the financial and technical capacities of a single Member State and encompasses a pan-European capacity. In addition, given the requirements in terms of security for the EU, all Member States must be involved (section on **EU added Value**).

The evaluation demonstrated that the current free of charge **pricing policy** of the Programme, including Galileo, EGNOS, Copernicus, SST services and GOVSATCOM, should remain unchanged for several reasons. In case of Galileo, any payment for its services would negatively impact public authorities and other users, present operational challenges, and raise concerns about access to life-saving services. Charging for Copernicus data would violate existing agreements and licenses and go against the purpose of the Programme to process satellite and in-situ information. Nor the charging for Space SST, NEO, and SWE services is feasible due to their reliance on third-party data sources, limited user bases, and their fundamental role as public services in protecting satellites and safeguarding against space debris and extreme space weather events. Regarding the GOVSATCOM pricing policy that is defined in implementing acts, it consists of a token system to enable fair and optimized use of available resources, with compensation values based on request priority levels, allowing for the possibility of buying or donating tokens to facilitate efficient resource use and prevent market distortion (section on **Relevance**).

Concerning **EUSPA**, the Agency has performed well overall on its core and entrusted tasks under the Programme, as documented in its programming and reporting documents. In addition, the Agency ramped up its competencies and capabilities, including its staffing, to implement the tasks assigned by the Regulation. Nevertheless, further efforts could be made in order to further reduce the time to contract (including grants)[79] and the

[79] Recently the number of "2-stage" calls has increased slowing down the process. Same effect when using "innovation partnership".

planning of tenders. Both the implementation of novel procurement approaches, and the use of "industry days" and of thematic "Administrative Board Workshops" have proved to be successful and should be more widely used. The Security Administration Board (SAB) has delivered its tasks as planned. Improvements can, however, also be made regarding the SAB, in particular by ensuring an early integration of programmatic aspects in the SAB decision making (section on **Performance of EUSPA**).

6.2 Lessons learnt

Regarding the evaluation process, a longer timeframe would be more appropriate to assess the Programme's performance midterm review. In this case, the Regulation mandates the Commission to finalise the evaluation by mid-2024, but due to several factors such as delay on the entry into force of the Regulation, the start of the new components from scratch and the recollection of data on a quarterly or semestrial base, a longer timeframe would have made possible to have a larger amount of data.

While the Programme has been successful in meeting its objectives, there are some challenges that need to be further addressed. One significant issue is the temporary absence of an **EU launcher**, which has hindered the EU's ability to access space independently. The cancellation of Soyuz launches services and the delay in the EU launcher availability have had a significant impact on the launch schedule for Galileo satellites. In response, the Commission has taken proactive measures to ensure continuity and performance. As a temporary solution, it has secured replacement launches with a third country provider (SpaceX) to deploy four Galileo satellites in 2024. However, this situation underscores the pressing need for Europe to strengthen its autonomous access to space, thereby reducing reliance on non-European providers for satellite launches. On the short term, the entry into service of Ariane 6 and the return to flight of VegaC would match the launching needs of the Galileo and Copernicus constellations. In addition, the Commission is exploring possible ways of further implementing Article 5 of the Regulation, even if no specific budget was earmarked for this activity. Possible activities might regard the aggregation of European institutional demand for launch services from all European public actors, through digital aggregation platform and potentially work towards unified framework scheme and joint purchasing. Other activities cover the support to game-changing innovation on launch services, through prizes and grants, and the support to critical ground infrastructure, including testing and launching facilities, serving EU autonomous access to space. In order to test new policy initiatives and preparing the ground for the adoption of future measures, the Commission is implementing some Pilot projects and preparatory actions (PP/PAs) on access to space.

On **procurement**, the evaluation highlighted the need to address the inflexibility, length, and overly detailed nature of the **procurement processes** and to greater longer-term visibility in the industrial procurement of the Programme. The industry claimed that EU procurement rules are not flexible enough to adapt to external economic conditions such as raise of inflation and the chip shortages, causing delays in contracts. Compared to previous years, **inflation** has increased since early 2021 and climbed continuously up to a

peak of around 10 % at the end of 2022 (this was felt strongly in the energy sector). The industry (especially manufacturing) had expectations that the contracts signed under the Programme would be revised to align prices the with the higher inflation[80], while the Programme is based on a seven years fixed budget. On the short term, it is not possible to change the EU Financial Rules to allow immediate budgetary flexibility, however further reflection is needed by the EU budgetary authority as also recommended by a recent study by the European Parliament (see 'The impacts of recent inflation developments on the EU finances' study of the European Parliament Budgetary Committee[81]).

Moreover, some stakeholders called for setting up a system through which the Commission could report to the industry on the statistics related to its space procurement processes. In addition, to reduce the reporting obligations, the list of KPIs included in the Annex of the Regulation could be revised. The Commission has already been empowered by the Space Regulation (Article 101.2) to adopt delegated acts in order to amend the Programme's indicators.

Regarding **competitiveness,** initiatives like the Copernicus Dynamic Purchasing System (which streamlined procurement and encouraged competition and SMEs inclusion for Copernicus contributing missions) should be extended. In the SDA Expert group, Members' interventions welcomed the new system and suggested extending it to services as well.

The importance of enhancing the **resilience and non-dependence of the supply chains** of the EU space infrastructures has been recognised in the Call for evidence as a possible solution against future disruptions. Stakeholders have urged the Programme to improve its resilience and protection of space assets, as also recognized by the EU Space Strategy for Security and Defence, that includes several follow up actions. The Commission has adopted the **Economic Security Strategy**[82], to promote, protect and partner on EU competitiveness and EU economic security, including on space and propulsion technologies, while the **Action Plan on Synergies between civil, defence and space industries**[83] established the Observatory of Critical Technologies, *"to provide regular monitoring and analysis of critical technologies, their potential applications, value chains, needed research and testing infrastructure, desired level of EU control over them, and existing gaps and dependencies."*

On **User uptake** and foster the demand for new space services, the SOTEU Letter of intent 2023 called for an **EU Strategy on Space Data Economy**. In addition, the

[80] In some EU Member States, governments managed counter-inflation by state-aid measures

[81] Study 'Recent inflation developments'

[82] European Economic Security Strategy

[83] Action Plan on Synergies Between Civil, Defense and Space Industries

Commission is preparing a Staff Working Document on **EU Space Programme User Uptake Status** to present an analysis of the state of the play of the user uptake of Galileo, EGNOS and Copernicus, and the Commission with the support of EUSPA, has finalised a conceptual framework to measure the EU Space programme benefits.

ANNEX I: GENERAL INFORMATION

1. **Lead DG:** Directorate General for Defence Industry and Space (DG DEFIS)
2. **Organisation and timing:** The Staff Working Document on Mid-term evaluation of the implementation of the EU Space Programme and the performance of EU Space Programme Agency (EUSPA) is accompanied by the Report from the Commission to the European Parliament and Council on the same topic. To take stock of the expertise available in other Commission services, an Inter-Service Group (ISG) comprising of the following Directorate-Generals and Agencies: AGRI, BUDG, CINEA, CLIMA, CNCT, COMM, COMP, EAC, ECHO, EEAS, EISMEA, EMPL, ENER, ENVI, ESTAT, EUSPA, FRONTEX, GROW, HADEA, HOME, HR, INTPA, JRC, LS, MARE, MOVE, REFORM, REGIO, RTD, SANTE, SG, TAXUD, TRADE was informed and consulted on the evaluation process on 6 June, 4 October and on 15 December 2023.
3. **Evidence used in the interim evaluation:** In order to assess the Effectiveness of the Programme the starting information (A) used were KPIs which are collected through regular implementation reports (always annual – for the KPIs listed in the Regulation, and additionally semestrial or quarterly). The KPIs are collected in electronic form (excel, word, pdf, etc) either by the Commission (where the programme is implemented in direct management) or by agencies to whom the Space Programme budget implementation has been entrusted. The quarterly/semestrial reports including the KPIs are subject to approval by Commission management and the control is ensured since they condition further payments to the respective entity.

Furthermore, the benefits of the Programme were listed (B), based on economic studies or previous impact assessments performed:

- Study to examine the socioeconomic impact of Copernicus in the EU (2016).
- Study in support of the impact assessment of an EU GOVSATCOM initiative (2017).
- Copernicus ex-ante societal impact assessment (2018).
- Copernicus market report (2019).
- Impact Assessment of EGNSS FE R&D in synergy with H2020 and analysis of business and technology gap (2021).
- Socio-economic impact assessment and accompanying foresight study of selected ESA Earth observation activities & Socio-economic impact assessment of ESA's ground systems engineering and operations activities and the Space Safety programme for ESA (the two studies issued in 2019 are public an update was performed in 2022 and was available for consultation by the Commission).
- An assessment of the possible EU space situational awareness initiative

Other sources of information were used for statistics of the EU space economy:

- Structure of the European Space Manufacturing Sector by ASD EUROSPACE (2021)

In order to assess the Efficiency of the Programme the information used was the budget allocated for each component.

In order to assess the Relevance of the Programme the information used were previous Staff Working Documents (Expression of User Needs for the Copernicus Programme) or similar acts (ESA Customer Requirements Document for SWE) and previous reports on Galileo/EGNOS from EUSPA documenting feedback from stakeholders. Interviews were performed with staff from agencies implementing the programme to gather emerging trends and demands of relevant user groups. Bilateral interviews were also performed with end user community representatives (the interviewees selected were considered the best to provide such information based on their track-record in the respective domain).

In order to assess the Coherence of the Programme the source of information was data gathered from public repositories documenting policies (environmental and climate change policies, transportation policies from public authorities or international organisations).

The EU added value was based on inputs gathered through interviews or written consultations (the interviewees selected were considered the best to provide such information based on their track-record in the respective domain).

The EU Space Programme' evaluation has been selected for scrutiny by the Regulatory Scrutiny Board (RSB) in 2024. The Staff Working Document on the interim evaluation of the Programme was presented to the RSB on the 14 of February 2024 and received a negative opinion. The RSB asked to explain in the Annex 1 of SWD what changes have been made compared to the earlier draft, in response to the Board's recommendations.

Implementation of the RSB opinion[84]	
RSB comments	**Explanations**
The report does not present clearly the intervention logic and evaluation matrix to guide the analysis for each component of the programme. The report does not present and use the available evidence in a self-standing way. It does not sufficiently assess the programme's performance in terms of effective and efficient delivery on its	**Intervention Logic** The intervention logic (Section 2) had been revised in accordance with the comments of the RSB. It builds upon the legal text of the Space Programme Regulation, the Impact Assessment accompanying the Commission proposal for the Regulation (IA) and the 2016 Space Strategy for Europe (the Space Strategy). The starting

[84] The Regulatory Scrutiny Board gave a negative opinion in writing on 16/02/2024.

objectives based on robust impact indicators. The report does not clearly present the methodology used, its assumptions and limitations, and does not adequately distinguish between the evaluation of actual impacts and ex-ante projected results. (1) The report should include a comprehensive intervention logic for each programme component reflecting their specific policy needs and better regulation requirements. This should include all elements in such a way as to allow for a full understanding of causality, identifying relationships and dependencies and linking the specific objectives to policy actions and to their output/result/outcome/impact and their related indicators. To support the analysis of the intervention logic and evaluation findings, the report should develop a comprehensive evaluation matrix and present it in the annex. (2) The report does not present and use the available evidence in a self-standing way. It does not sufficiently assess the programme's performance in terms of effective and efficient delivery on its objectives based on robust impact indicators. (3) The report should clearly present the available evidence, incorporating it from all relevant sources such as the accompanying study, earlier work and the data sets supporting the key performance indicators, to render the analysis robust, the evaluation SWD self standing and to comprehensively report on the programme's main achievements and progress towards targets. The report should explain how the evidence is used to	point of the intervention logic consists in the challenges identified in the IA and in the Space Strategy and justifying the EU intervention, i.e., the Regulation and the Programme. The general and specific objectives of the Regulation are included in article 4 of the Regulation, while Article 102 of the Regulation clearly identifies the criteria of the evaluation, mainly the provision of the services and the evolutions of the users' needs, in complementarity with the better regulation requirements. The revised intervention logic then illustrates broadly how the financial and human inputs, hence the budget and the different implementing actors, implement several activities described in the Regulation and detailed in the Contribution Agreements with entrusted entities. The concrete and measurable outputs of the intervention are a synthesis of the work done by the Commission, EUSPA, ESA and the other entrusted entities for the provision of the services and their uptake. They are evaluated towards Key Performance Indicators identified both in the Regulation (and based on the IA analysis) and in the different Contribution Agreements. The activities and their outputs are assessed in the SWD following the better regulation criteria of effectiveness and efficiency, coherence, EU added value and relevance. The Space Programme is embedded in very numerous policy actions such as agriculture, forestry, transport, climate and environmental monitoring, biodiversity monitoring, emergency management, urban development and many others, as illustrated in the section on coherence. EU space data and services directly support these policies and contribute to the green and digital transition of the economy and the resilience of the EU. For each policy

substantiate the assessment and findings. It should take full ownership of all evidence used, the methodology applied, and the analysis undertaken, up to conclusions and lessons learned. It should provide a comprehensive narrative enabling the understanding of the main elements of the programme, avoiding unnecessary technicalities and focusing on the programme's tangible achievements against the points of comparison / baseline based on clear performance indicators. (4) The analysis should clearly present the methodology applied, including approach, assumptions, quality and relevance of evidence, gaps and their impact on the evaluation, estimates and calculations. Costs and benefits should be systemised and triangulated as far as possible with other findings. The report should ensure that methodology presented in Annex II is aligned with the analysis in the body of the document, including the terminology used. References to accompanying studies should not substitute essential explanations and evidence, which should be included in the report. The report must be clear on the reference period for this mid-term evaluation, distinguishing in the analysis and methodology between the results and impacts effectively achieved in the period under consideration, and those that are expected, based on ex-ante models and/or projections. Limitations to evaluating certain programme components which are more recent or still under development, and the implications for the assessment of costs and benefits, should be clearly explained. The report should use the most relevant key programme indicators on outcomes, results and impacts, demonstrating the programme's performance evolution.	there may be sub-categories and an unlimited number or applications, outside the scope of the Programme. This is now clearly presented in Annex VI of the SWD. A reference to the European Court of Auditors recommendation on space uptake and follow up actions has been added in the subsection 3.2 of the SWD. A sub-section on the Programme's contribution the UN Sustainable Goals' implementation has been added (4.1.F as well as Annex VII). **Evidence** To reinforce the robustness of the conclusions and the findings of the evaluation, the SWD and its annexes now include more elements on the evidence (as indicators, evaluation questions, evaluation matrix, benchmarks, and limits of the methodology) to ensure a self-standing presentation. As requested by the RSB limitations have also been indicted, whereby the evidence varies through the different components according to their maturity. For example in the case of GOVSATCOM, only the preparatory activities have been so far implemented therefore most of the indicators are not applicable yet. In addition, unlike other EU funding programmes, the co-legislators inserted in the Regulation the deadline till when the evaluation should be submitted – June 2024. The late adoption of the Regulation in April 2021 and the addition of two new components brings with it that the evidence is not the same for all components. The indicators (KPIs) used are those identified in the Space Regulation (Annex) and are based on the findings of the Impact Assessment that accompanied the proposal for the Space Regulation, mainly based on

	the specific objectives of Article 4.2. In addition, to reinforce the robustness of the evaluation, relevant indicators from the Programme Performance Statements have been introduced in the SWD - the baseline, annual implementation and long term (2027) targets. Specific and numerous targets have been identified for each component in the Contribution Agreements with the entrusted entities implementing the Space Programme reflecting the different nature and maturity of each component. More details on the KPIs and targets have been added in the SWD annex II and III to ensure a self-standing evaluation. **Evaluation Matrix** The Regulation brings under a single legal framework different EU space programmes and initiatives, but given the difference of management, governance, users and output of the different components, the evaluation tackles each component separately, while providing an overall picture of the Programme's benefit and performances. Therefore, to ensure coherence within the evaluation, the same evaluation matrix has been repeated for each component along the different better regulation criteria. A comprehensive evaluation matrix has been added in Annex II. **Efficiency** The Efficiency matrix is based on a ratio between the benefits of a programme component and the budget allocated to it in the Programme. Given the fact that it is not possible to measure actual impacts, because the Programme has a direct or indirect influence on a virtually unlimited

	number or applications, as illustrated in Annex VI of the SWD, the benefits taken into consideration in the SWD are macro-economic projections which have already been made public, based on well-established calculation's methodology. As estimated costs of each component have been considered the ones defined in the annual budgets approved by the budget authority and included in the annual work programmes of the Space Programme. The benefit of the Space Programme, as well the cost-benefit analysis, are not calculated from scratch in the SWD. They are taken from previous studies which the study accompanying this evaluation has updated and harmonised to the extent possible. For clarity and to ensure a self-standing presentation, in the SWD have been added a range of graphs to have a synthetic presentation of the cost- benefit analysis, as well as a short description of the methodology used and its limitations. **Methodology** Cost and benefit calculation has been described in the previous point on Efficiency. As explained in the SWD, the Space Programme builds on the success of its predecessor programmes, namely Copernicus, Galileo, EGNOS and the SST components which continue with a number of new services. In a nutshell, for services not yet operational (e.g. SWE, NEO, GOVSATCOM) the high-level target must be understood as the availability of these service by the end of this MFF. For Copernicus, Galileo and EGNOS there is a seamless transition from one MFF to the other in terms of performance, the high-level target must be understood as the continuity of the level of data and services. In fact, there is a clear limitation in the

	timeframe of the evaluation: It is not possible to count benefits only from the period 2021-2023 for Copernicus, Galileo and EGNOS. They have started to provide benefits long before 2021 and at the same time rely on high infrastructure investments which started more than 10 years ago. Between 2021-2023 the infrastructure investments were minimal since constellations were mature and the ratios with benefits would give disproportionate results. Also, the benefits time-frame is not identical for Copernicus, Galileo and EGNOS since they rely on different satellites or stations with completely different life-times and they've started at different time in the past. The benefits of Copernicus with models and calculations are in Annex II.B.a of the SWD. The benefits of Galileo with models and calculations are in Annex II.B.b of the SWD. For SSA and GOVSATCOM there are cost incurred in the period 2021-2023, however there are noy yet benefits to put into the matrix since no services are yet operational. The benefits of SST with models and calculations are in Annex II.B.c of the SWD. The benefits of SWE with models and calculations are in Annex II.B.d of the SWD. The benefits of NEO with models and calculations are in Annex II.B.e of the SWD. The benefits of GOVSATCOM with

	models and calculations are in Annex II.B.e of the SWD (they are limited to the transportation sector since, there was no public data available for other sectors).
(4) The report does not sufficiently analyse the impact of the programme's components on the competitiveness of the EU space industry ecosystem and connected sectors. The SME competitiveness and participation dimensions are underdeveloped. (5) The analysis should be more explicit on the potential for simplification of the programme, reduction of administrative costs and burdens, including for SMEs, in particular as regards procurement procedures which are acknowledged as sometimes burdensome. (6) The report should put more emphasis on evaluating how the programme affects the competitiveness of the European space industry eco-system, related industries and sectors as well as those who benefit from the programme in a more indirect way. Particular attention should be paid to the impact on SMEs, including ease of their participation, programme relevance and ultimately SME competitiveness.	**Competitiveness of the EU space industry ecosystem and SME** As regards the Space Programme's support to the competitiveness of the EU space sector, the SWD already includes the evaluation of the CASSINI initiative which is focusing in particular on the competitiveness of SMEs. The impact on the competitiveness of the EU economy in general and on SMEs specifically is in section 4.1.1.F. The impact on indirect beneficiaries of the programme is potentially unlimited as described before. Examples can be found in the sections on coherence and relevance, and in Annex VI. **Simplification** It has to be noted that the Programme as such does not impose measures which have to be respected by natural or legal persons. The objective of the Regulation is to continue funding from the EU budget critical EU Space infrastructure (ground infrastructure and in orbit satellite constellations), that are EU owned and deliver services continuity for the EU Space flagships which produce data and services as a public good. To reduce the reporting obligations, the list of KPIs included in the Annex of the Regulation could be revised and a suggestion is made in the SWD to that effect. Concerning the procurement procedures, the Section 6.1 on "Conclusions and lessons learnt" has been redrafted to show the potential for simplification.
(5) The report does not present clear and operational conclusions and lessons learned to inform on future actions, based on the	A subsection on "Lessons Learnt" in section 6 has been added. This notably addresses areas where improvements can

analysis.	be made within the existing legal framework, including the possibility of reviewing the list of KPIs included in the Annex of the Regulation, simplification of procurement processes or duration of the evaluation.
(6) The assessment of the pricing policy should explain how international outlook and technological advancements were taken into consideration, including in the conclusions.	This has been addressed in redrafted section 4.3.A (Galileo), 4.3.C (Copernicus), 4.3.D (SSA), 4.3.E (GOVSATCOM) and in Section 6.1 (Conclusions).
(7) The report should present conclusions, based on the preceding analysis, of the programme's functioning against all mandatory evaluation criteria. The conclusions should reflect the analysis in a more balanced way.	Section 6.1 on "Conclusions and lessons learnt" has been redrafted to show the analysis.
The lessons learned should be presented as a separate section, which should include any issues affecting the programme's performance and ways to address them with a view to inform further policy developments.	Lessons learnt have been added in a new separate section (6.2).
The report should also discuss the recommendations from earlier evaluations and ECA reports of the programme's components and assess the extent to which they have been addressed or difficulties persist.	Sub-section 3.2 of the SWD explains how previous ECA recommendations have been addressed.
(8) The synopsis report on stakeholder views should be more comprehensively presented, and the report should explain how the views of the different stakeholder groups are reflected in the analysis.	Concrete elements from the different stakeholders' consultations and input have been added in the SWD in different sections, while the Annex V of the SWD has been enriched with more details.

ANNEX II. METHODOLOGY AND ANALYTICAL MODELS USED

In accordance with the Better Regulation toolbox, the assessment of the performance of the implementation of tasks, objectives, mandates, and policies was be done based on the evaluation of five main criteria: effectiveness, efficiency, relevance, coherence and EU added value.

A. Effectiveness

For **Effectiveness** the objectives of the Programme are the one of the Regulation measured in the Programme Performance Statement. To perform an accurate comparison and assessment of the outcomes versus the expectations, the performance of the entrusted entities or the implementation of new activities where the Programme Performance Statement is not providing any data, are measured based on KPIs pre-defined in between 2020 and 2021 in Contribution Agreements or Work Programmes. The figure below shows the key KPIs used[85].

Component	KPIs	Source
Copernicus	- Number of users	Regulation
	- Number of activations requested or served	Regulation
	- User satisfaction	Regulation
	- % Reliability, availability, and continuity	Regulation
	- Number of new information products delivered	Regulation
	- Amount of data generated	Regulation
Galileo	- Total # of satellites	Regulation
	- Navigation service performance	Regulation
	- Timely achievement of service milestones	Contribution Agreement
	- Timely delivery of reports	Contribution Agreement
	- GSC[86] portal statistics	Contribution Agreement
	- Share of market	Regulation
EGNOS	- # of airports with EGNOS APV-I & LPV-200 procedures (for an explanation of acronyms see link below)[87]	Regulation

[85] For more detailed information, see supporting Study, section 3.

[86] GSC is the Service Centre which provides a single interface for the Galileo OS and Commercial Service (CS) user communities and offers specific added-value services.

[87] Press Release: EGNOS LPV-200 Enables Safer Aircraft Landings

	- APV-I & LPV-200 availability - APV-I * LPV-200 & NPA EGNOS SOL coverage area over EU-MS+NO+CH (+IS*) land masses	Regulation Regulation
SSA	- Number of users - Availability of services	Regulation Regulation
GOVSATCOM	- Number of users - Availability of services - Contracts signed schedule - Contracts commitment ceiling - Research & Development contracts cost accrued - Milestone achievement chart	Regulation Regulation Contribution Agreement Contribution Agreement Contribution Agreement Contribution Agreement

a. Galileo Effectiveness

In order to verify the effectiveness, the evaluation matrix described in Annex III has been applied to EUSPA. EUSPA is the entity directly reporting to the Commission for Galileo. While ESA has several tasks, these tasks are subdelegated to ESA by EUSPA and are thus included. The entrusted tasks have been split by the Contribution agreement in the main following categories:

1. Ensure Galileo Service Provision.
2. Ensure Security of the Galileo Programme.
3. Roll out new services or features anticipated in the space programme regulation.
4. Ensure development and deployment of Galileo infrastructure evolutions.
5. Support Commission international activities.

Each category splits in several sub-categories, the details are available in Annex III.

The specific outcome of each activity was determined based on the status, timeline, and budget, that mapped to a numerical outcome on a scale of 1-6. The exhaustive presentation is detailed in the supporting study (Section 3.2.3), the summary of the findings is as follows:

#	KPI	Target	Outcome *(Q4 2022)*	Notes
1	Total # of satellites *(ratio of satellite successfully launched vs planned)*	100%	93%	Linked to launch availability as mentioned above
2	Total # of fully operational satellites *(ratio of fully operational satellites vs commissioned satellites)*	100%	Sep – 87.6% Oct – 86.0% Nov 85.0%	The low value is due to several reasons: GSAT104 is commissioned but not fully operational. There are ongoing discussions for decommissioning During the upgrade to ASW3.1, one satellite was out for upgrade every fortnight with each update taking one week. Additional issues like clock jumps, failures, and ground segment issues.
3	Navigation Service Performance *(as per MPL in SDDs for all declared services)*	100%	Sep - 100% Oct – 100% Nov – 100%	Data only for OS No data for PRS in 2022
4	Timely achievement of Service milestones vs. FOC Service roadmap non-risk adjusted and risk adjusted objectives (covers G1G and G2G) – *SB2.0 S-DQR4 Jul 2022, SB2.1 S-DQR5*	As close as possible from the non-risk adjusted schedule	SIP: Jul 2022 Working schedule: SB2.0 S-DQR4 Step1 19/12/22 SB2.0 S-DQR4 Step2 31/03/23 Working schedule: 29/03/24	SB2.0 delayed due to change in SAB conditions and ESA development activities. See Intervention 4.2

5	Timely achievement of Infrastructure milestones vs. FOC Service roadmap non-risk adjusted and risk adjusted objectives (covers G1G and G2G1)	As close as possible from the non-risk adjusted schedule	*Relative to non-risk adjusted*, FOC is delayed, SB2.0 is delayed, G2G is delayed	See intervention 4.1, 4.2, 4.3.
6	Timely achievement of accreditation milestones vs FOC Service roadmap non-risk adjusted, and risk adjusted (covers G1G and G2G1) *(M4B & M5 delay)*	As close as possible from the non-risk adjusted schedule	3 months at least	Linked to intervention 2 and caused by the delay in SB2.0
7	Timely achievement of PRS uptake and technological roadmap versus approved PRS uptake and technological roadmap	As close as possible from the non-risk adjusted schedule	NA	Not a metric that is tracked publicly, so not available.
8	Timely delivery of GSMC Security Monthly Report *(delay)*	0 days	OK	
9	Timely GSMC reaction to incident reported *(delay vs. nominal value for 95% of cases)*	0 day	OK	
10	Mean time between CAT-1 service incidents *(avg. time between 2 CAT-1 consecutive incidents)*	As long as possible	NA	There have not been two CAT-1 incidents yet.
11	Timely completion of preliminary analysis of security	0 day	OK	

	incident by GSMC *(delay vs. nominal value for 95% of cases)*			
12	Mean time to mitigate CAT-1 service incidents *(time between incident observation and recovery)*	< a few hours	OK	
13	Timely delivery of GRC Monthly Performance Reports *(delay vs nominal delivery date)*	0 day	OK	
14	GSC Portal statistics *(Sessions | page views | registered users | subscribed users to NAGU notifications | user requests)*	For information	Sessions – 16063 Page Views – 40532 Registered Users – 143 Subscribed Users – 25 User Requests - 47	
15	GSC web portal availability *(monthly availability)*	> 97%	100%	
16	GSC Reaction Time for NAGU *(avg. reaction time in days)*	As per SSD	0.37 days	
17	GSC Reaction Time for User queries *(avg time to answer user queries that do not require escalation)*	< 3 days	1.28 days	
18	Timely delivery of Quarterly Performance Reports *(delay vs nominal*	0 day	One quarterly report delayed by 1 day	No impact of this delay

	delivery date)			
19	Market (2027) *(ratio of Galileo EGNOS enabled receivers to total receivers)*	EGNOS 65% Galileo 70%	EGNOS 62% Galileo 65%	Target is for 2027.

Therefore, the evaluation concludes that, the Galileo programme has achieved its key objectives set out for the evaluation period, providing long-term, state-of-the-art and secure positioning, navigation and timing services whilst ensuring service continuity and robustness.

b. EGNOS Effectiveness

In order to verify the effectiveness, the evaluation matrix presented in Annex III has been applied to EUSPA. EUSPA is the entity directly reporting to the Commission for EGNOS. While ESA has several tasks, these tasks are subdelegated to ESA by EUSPA and are thus included. The entrusted tasks have been split by the Contribution agreement in the main following categories:

- Ensure EGNOS Service Provision.
- Ensure Security of the EGNOS Programme.
- Develop new EGNOS services enabling new application.
- Ensure EGNOS evolution.
- Support Commission International Activities.

Each category splits in several sub-categories, the details are available in Annex III.

According to the matrix in section 4.1, the specific outcome of each activity was determined based on the status, timeline, and budget, that mapped to a numerical outcome on a scale of 1-6. The exhaustive presentation is detailed in the supporting study (Section 3.2.3), the summary of the findings is as follows:

#	KPI	Target	Outcome *Q4 2022*	Notes
1A	# of airports with EGNOS APV-I procedures	For Info	286	Continual increase in 2022
1B	# of airports with EGNOS LPV-200 procedures	For Info	204	Continual increase in 2022
2A	# of airports with EGNOS procedures implementing APV-I service level and with APV-I available	For Info	284	Continual increase in 2022
2B	# of airports with EGNOS procedures implementing LPV-200 service level and with LPV-200 available	For Info	203	Continual increase in 2022
NA	# of EGNOS procedures	For Info	837	Continual increase in 2022
NA	# of EGNOS Procedures with an availability ≥ 99%	For Info	833	Continual increase in 2022
3A	EGNOS APV-I service availability %	>99%	98.24%	Target not met in Q4 due to underperformance in some peripheral areas caused by higher solar and ionospheric activity
3B	EGNOS LPV-200 service availability %	>99%	99.5%	Target met every quarter
4A	APV-I EGNOS SOL coverage area over EU-MS+NO+CH (+IS*) land masses	100%	97.03% (incl. IS)	Caused by a design limitation of V2, performance should be increased by V3
4B	LPV-200 EGNOS SOL coverage area over EU-MS+NO+CH (+IS*) land masses	100%	89.73% (incl. IS)	Caused by a design limitation of V2, performance should be increased by V3
4C	NPA EGNOS SOL coverage over EU-MS+NO+CH (+IS*) Flight Information Regions	100%	100% (incl. IS)	
5	EDAS users monitoring	For Info	445 (EU)	EU increasing over 2022,

			1 (non EU) 70 (actual)	others decreasing over 2022
6A	APV-I SoL availability service area vs SDD	100%	92.7%	Underperformance in some peripherical areas due to solar and ionospheric activity higher than expected and GPS maintenance impacts on performance
6B	LPV-200 SoL availability service area vs SDD	100%	90.41%	Same as above
6C	NPA SoL availability service area vs SDD	100%	100%	
7A	APV-I SoL continuity service area vs SDD	100%	95.75%	Same as above
7B	LPV-200 SoL continuity service area vs SDD	100%	82.08%	Same as above
7C	NPA SoL continuity service area vs SDD	100%	99.63%	Same as above
8	OS performance and availability *(RIMS sites above 99% availability)*	100%	88.88%	Same as above
9	EDAS performance and availability	100%	99.99%	Considered compliant
10	EU user satisfaction with respect to EGNOS services	80%	85.6% (Q3 value)	Q4 value not available yet
11	Share of EGNOS enabled receivers in the worldwide (1) and the EU (2) GNSS / SBAS receiver market	For Info	(1) 62% (2) 62%	65% is a proposed target for 2027
12	EGNOS Service helpdesk Reaction Time	< 3 day	2.95 day	
13	Timely achievement of Service milestones vs. objectives (a) Delay per service milestone (b) Average delay versus objective) (As	(a) < 3m (b) 0m	(a) 16m (EDAS) (b) 3.7m	Due to a change in priority with no impact on users.

	per EGNOS objective 3 service milestones)			
14	Timely achievement of EGNOS V2 developments (e.g. V242B and 243) qualification milestones vs. objectives (a) Delay per System milestone (b) Average delay) (As per EGNOS objective 4 milestones related to EV2 developments)	(a) < 3m (b) 0m	(a) target achieved for all milestones (b) positive margin in average	
15	Timely achievement of EGNOS V3 development and Phase B studies milestones vs. objectives (a) Delay per System milestone (b) average delay) (As per EGNOS objective 4 milestones related to EV3 development and Phase B studies)	(a) < 3m (b) 0m	a) Not achieved for V3.1 (7m delay), positive margin for V3.2 b) average delay = 1m	Caused by industrial delays
16	Timely achievement of accreditation milestones (Delay per accreditation milestone versus approved Exploitation Roadmap) (As per objectives 2)	< 1 m	Data unavailable (milestones TBD EEXP 2023)	
17	Mean time between important/severe/critical service incidents	For info	14 days	
18	Mean time to mitigate important/severe/critical service incidents	< few hours	1 day	It has been agreed with EC that the time to mitigate a service incident for SOL service will be reported with a granularity of 1 day. Given that the criteria to raise the service incident is based on a degraded

				coverage computed over 24 hours, the minimum recovery time is 1 day.
19	EGNOS Portal statistics (Sessions (1), Page views (2), Registered users (3), Subscribed users to notifications (4), User requests (5))	For info	(1) 26013, (2) 33627, (3) 4266, (4) 2929 (new doc)/ 2070 (perfo alerts), (5) 11	
20	EGNOS web portal availability (Monthly availability)	>97%	99.33%	

c. Copernicus Effectiveness

In order to verify the effectiveness, the evaluation matrix presented in Annex III has been applied to following entities, each implementing a part of the Copernicus component:

- ESA
- EUMETSAT
- EEA
- MOI
- ECMWF
- EMSA
- FRONTEX
- EUSPA

ESA was in charge of developing and operating the space component, procuring launches, managing Sentinels and CCM data, and ensuring continuous and available data access for all Sentinel data. ESA successfully carried out most of the entrusted tasks without delays, in particular in the intervention areas of data access and distribution and user uptake. Within intervention area related to data acquisition, one activity was delayed mostly due to the external factors, as impacted by the loss of Sentinel-1B and the unavailability of VEGA-C to launch Sentinel-1C. This has not led to any critical consequences as Sentinel-1A is still operational, however the data that is unavailable due to the loss of Sentinel-1B cannot be fully covered.

EUSPA has been entrusted the implementation of activities related to the user uptake of data, market development, and capacity building, extension of the European GNSS User Consultation Platform to Other Copernicus users, and analysis of trends in user needs and requirements. While most of the tasks were implemented without delay, the development of Copernicus demonstrators was delayed due to a high number of proposals, leading to project kick-off delays. However, these delays will not impact the overall

implementation, as the budget will not be exceeded and has provided additional time for networking and awareness raising before the launch of the second call by EUSPA.

The entrusted tasks have been split by the Contribution agreements in the main following categories:

Intervention Group	**Entity**
Objective 1: Data acquisition	ESA
Objective 3: Data access and distribution	ESA
Objective 4: User uptake, market development and capacity building	ESA
Objective 1: Data acquisition	EUMETSAT
Objective 3: Data access and distribution	EUMETSAT
Objective 4: User uptake, market development and capacity building	EUMETSAT
Objective 1: Data acquisition	EEA
Objective 2: Services Provision	EEA
Objective 3: Data access and distribution	EEA
Objective 4: User uptake, market development and capacity building	EEA
Objective 2: Services Provision	MOI
Objective 3: Data access and distribution	MOI
Objective 4: User uptake, market development and capacity building	MOI
Objective 2: Services Provision	ECMWF
Objective 2: Services Provision	ECMWF
Objective 3: Data access and distribution	ECMWF
Objective 4: User uptake, market development and capacity building	ECMWF
Objective 2: Services Provision	EMSA
Objective 4: User uptake, market development and capacity building	EMSA
Objective 2: Services Provision	FRONTEX
Objective 4: User uptake, market development and capacity building	EUSPA

Each of the above split into a larger number of sub-categories (sometimes more than 100 each), the exhaustive list is presented in the supporting study, Section 3.1.3.

According to the matrix in Annex III, the specific outcome of each activity was determined based on the status, timeline, and budget, that mapped to a numerical outcome on a scale of 1-6. The exhaustive presentation is detailed in the supporting study, Section 3.1.3, the summary of the findings is as follows:

Indicator of number of Copernicus users		
Service	**KPI**	**Outcome**
Transversal	# users	Number of users for Copernicus Services, Scientific/Other Access, National Collaborative Data Access, and International Agreements are higher than the targeted number of users
CLMS	# users	Total number of registered users and active users increasing over time
CAMS	# users	Total number of registered users and active users growing over time
C3S	# users	Total number of registered users and active users growing over time
Transversal	# users	Steady number of users over time
CMEMS	# users	Total number of users growing over time

Indicator of user satisfaction within Copernicus		
Service	**KPI**	**Outcome**
Transversal	EU user satisfaction	High user satisfaction of >85%
Transversal	Sentinel data user satisfaction	High user satisfaction of >85%
CLMS	% response rate	% response rate targets achieved
CAMS	EU user satisfaction	High user satisfaction of >85%
C3S	EU user satisfaction	High user satisfaction >85%
CMEMS	EU user satisfaction	High user satisfaction >85%

Indicator of reliability, availability or continuity of Copernicus		
Service	**KPI**	**Outcome**
Transversal	End-to-end Absolute Availability of Copernicus Data Access Service	Sentinel-3 & Sentinel-6 % availability were higher than the targets. Jason-3 % availability, however negligible, was slightly lower than the target, due to interruption of service during an orbit manoeuvre
Transversal	End-to-end Absolute Availability of 3rd party data	Overall % availability is above targets except S3 Land L2 for Africa STC and Suomi NPP Global Service. Their availability is dependent on infrastructure and services not under the control of EUMETSAT
Transversal	End-to-end Absolute Availability of Services implemented in coordination	Overall % availability is above targets

	with CNES/CLS	
Transversal	Continuity of service	Sentinel-1, Sentinel-2, Sentinel-5P % continuity is higher than the target
CLMS	Service availability	% availability of services equivalent to targets
CAMS/C3S	Uptime	% uptime consistent with standards set
CAMS	Reliability (% of Copernicus Information and Data products generated that are non-conformant)	High % reliability
CAMS	Availability (% of time that Copernicus Information and Data products are accessible)	High % availability
C3S	Availability (% of time that Copernicus Information and Data products are accessible)	High % availability
CMEMS	Reliability in percentage of Copernicus Information and Data products	High % reliability
CMEMS	Availability in percentage of time that Copernicus Information and Data products are accessible	High % availability
CMEMS	% Continuity of Copernicus Information and Data deliveries	High % continuity

Indicator of amount of data generated within Copernicus		
Service	**KPI**	**Outcome**
Transversal	Amount of data generated by the Sentinels	Nominal amount of data generated by Sentinels
Transversal	Volume of Sentinel Data produced	Volume of data produced daily for Sentinels 1/2/3 are above average targets. For Sentinel 5P, it is lower that the target since S-5P delivered data (L1b/L2) is compressed and this reduces the actual data volume
Transversal	Total number of available datasets from CCMs	Number of new datasets is higher than the target outcome

On top of the above there are also indicators which show that Copernicus has performed well, even where a numbered target had not been set (because by definition there was no target to achieve): new products have been released to users (against the baseline of 2021) and the number of Emergency Service activations has increased over the years.

d. SSA Effectiveness

As indicated in Section 4.1.1.D of the SWD, the table below shows the KPIs completion for SSA.

Year	Intervention Group	Intervention	Activities	Status	On time/ Delayed
2021-2027	NEO	Mapping of Member States' capabilities for detecting and monitoring NEOs	Map Member States' capacities for detecting and monitoring NEOs	Completed	On time
2021-2027	NEO	Promotion of the networking of Member State facilities and research	Promotion of the networking of Member State facilities and research centres	Ongoing	On time
2021-2027	NEO	Establishing and maintaining a European NEO catalogue	Incorporation of NEO physical data into database	Ongoing	Delayed
2021-2027	NEO	Development of provision of rapid expert response service in relation to new NEOs	Development of a rapid expert response service in relation to new NEOs including for potential ground impactors (>50m), fast-response space missions for reconnaissance and/or deflection missions	Not started	On time
First SWE IA and CBA should be completed in 2023 (Technical Annex)	SWE	Elaboration of user needs and service quality criteria	Definition of service selection priorities by elaborating user needs and quality criteria for Space Weather Services, through a Space weather impact studies of European Infrastructure and a Cost	Ongoing	Delayed
Q2/2024 (Technical Annex)	SWE	Pre-selection of space weather service for operational framework	Identification of initial service elements	Not started	Delayed
Target date for the completion of this task is 3 months after the adoption of the Implementing Act requested by the Space Programme Regulation. Contract foreseen to be kicked off in 2025 and to cover the service provision for 2.5 years (Technical Annex)	SWE	Preparation of invitation for tender, publication, evaluation and contract placement	Preparation of a tender related to the operation of the selected SWE service for the initial phase of activities	Not started	Delayed

e. GOVSATCOM Effectiveness

As indicated in Section 4.1.1.E of the SWD, the table below shows the KPIs completion for GOVSATCOM as reported by ESA.

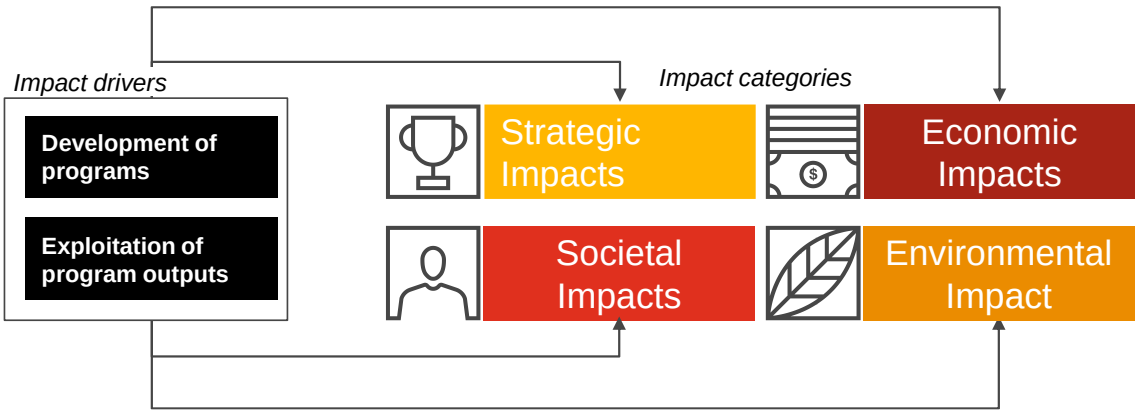
Year	Activities	Status	On time/ Delayed
2021-2027	Ensure the appropriate and timely preparation and design of any future GOVSATCOM space segment and its related ground segment through coordination and implementation of a set of system studies and up-stream R & D of key technologies, products and sub-systems	Ongoing	On time
2021-2027	Implement the development and deployment of end-to-end demonstrators of future GOVSATCOM space segment and related ground segment	Ongoing	On time
2021-2027	Contribute to assess the need for an additional GOVSATCOM space component and some innovative system features and identify relevant design options for GOVSATCOM evolutions responding to this need.	Closed	On time
2021-2027	Contribution to the preparation of the Horizon Europe Work Programme(s) to be prepared and adopted by the Commission when relevant to the GOVSATCOM activities.	Closed	On time
Test-beds in support to demonstration activities to be deployed in a consistent way with the need to conduct a first set of demonstrations in 2022, and pursue them over the 2022-2024 timeframe.	Execution of demonstrations to prepare the conditions for adoption of the GovSatCom services (GovSatCom annex 2022) / Development and deployment of end-to-end demonstrations of future GovSatCom space segment and related ground segment (Annex) Support to the Commission and EUSPA for the execution of end-to-end demonstrations involving users in specific environmental contexts, with the objective of showing the value of innovative system features on which GOVSATCOM can	Ongoing	On time

	leverage.		
From 2021	Provision of technical input to the Commission for the relevant Commission Programme Committee configurations (including those stemming from the Horizon Europe programme or the EU space programme), sub-groups or experts groups, task forces, workshops, or stakeholder consultations organised by the Commission in relation to the GOVSATCOM entrusted tasks	Ongoing (continuous process)	On time
2021-2027	ESA may lead and coordinate the elaboration and update of the GOVSATCOM Upstream R&D roadmap, in particular through chairing the work of a group of national space agencies and institute of technologies.	Not started because no request received	On time
Outcome of analysis on the need for an additional space segment: inputs for review and decision by EU Member States to be made available to the Commission by latest Q2 2024	ESA will contribute to assess the need (by mid-2024) for additional GOVSATCOM space and ground infrastructures through dedicated analyses and works conducted internally and/or through industrial contracts.	Closed (see above)	On time
2021-2027	Participation of ESA as full member in the integrated project teams set-up for the implementation of studies launched by the Commission towards the European space-based secure connectivity initiative, especially as focal point for space segment and ground segment	Ongoing (continuous process)	On time
2021-2027	Identification and assessment of relevant options for EuroQCI space segment and related ground	Ongoing	On time

	segment, in accordance with ESA role in EuroQCI		
From 2021	Upon the request of the Commission, support the Commission in the distribution of EUCI related to GOVSATCOM.	Not started because no request received	On time
From 2021	Manage the classified network for the provision of documentation associated to the GOVSATCOM component of the Programme to EU Member States, EUSPA and, upon instruction from Commission, also to industry.	Not started because no request received	On time

B. Efficiency

The Programme has different benefits and impacts that can be generated from each driver, they are not mutually exclusive and can always be categorized according to the following classification:



This classification is widely used for all types of research activities, space programmes and policies. The definition of the impacts and their association with each of the four categories is strongly dependent on the kind of initiatives/interventions conducted, their status (e.g., whether a project or a program is still at feasibility study level, design level, development, or operations), and on the involved stakeholders.

Particularly for the period of this assessment it was considered relevant to look at the following impacts:

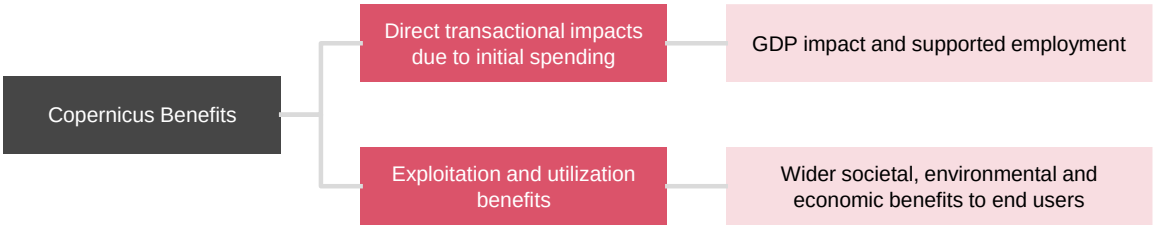
Impact Category	Impact	Development impacts	Exploitation impacts
Economic Impacts	GDP impact	X	
	Employment impacts	X	
	Industry stimulation	X	
	Enabled revenues	X	X
Strategic Impacts	EU industry competitiveness and leadership	X	
	EU non dependence	X	
Societal Benefits	Human capital	X	
	Inspiration	X	
	Improved Quality of life		X
	Improved Public Health		X
	Citizen Safety & Security		X
Environmental Benefits	Reduced emissions		X
	More efficient use of resources		X
	Reduced waste		X

To evaluate the efficiency of the Programme a costs assessment was performed (assessment of resource and inputs) and compared to the benefits previously evaluated (under effectiveness) in a cost-benefits assessment output.

a. Benefits assessment of Copernicus

It is not possible to count benefits only from the period 2021-2023 for Copernicus. They have started to provide benefits long before 2021 and at the same time rely on high infrastructure investments which started more than 10 years ago. Between 2021-2023 the infrastructure investments were minimal since constellations were mature and the ratios with benefits would give disproportionate results. Also, the benefits time-frame is not identical with Galileo and EGNOS since they rely on different satellites or stations with completely different life-times and they've started at different times in the past.

The first level of benefits includes the direct transactional impacts resulting from the investment and spending to develop the infrastructure. The second level of impacts includes the wider socio-economic benefits resulting from the utilization and exploitation of the infrastructure developed, as demonstrated in the figure below:



GDP impact assessment is performed to measure transactional impacts which are immediate impacts resulting from engaging a simple transaction. Here it is the immediate economic impact resulting from public funding into Copernicus by giving money to several stakeholders (private companies, academic entities...etc.) to contribute to certain developments. The impact of this money injected into the economy through Copernicus, is measured by assessing the overall impact on European GDP.

The objective of the GDP impact assessment is to assess the impact of spending in the space sector on the European economy, with 2 types: Gross Value Added (GVA) and Employment.

The three types of GDP impact can be described as follow:

- Direct GDP Impact: The GDP impact of direct spending into the space industry, which typically initiated in upstream manufacturing, is the economic activity stimulated in the space industry itself; it represents the Gross Value Added (GVA) realised in the industrial sector receiving the initial spending.
- Indirect GDP Impact: The indirect impact represents the economic activity (i.e., GVA) supported by the spending made in the space industry. To fulfil a contract, space companies need to procure equipment (i.e., electronic equipment, computers, etc.) and/or material (i.e., raw metal, plastic) from non-space industrial sectors. These secondary or "2nd round" impacts would not occur if the upstream space industry operations had not required the support to fulfil their orders.
- Induced GDP Impact: The induced impact represents the economic activity (i.e., GVA) supported by those people directly (i.e., jobs supported by space suppliers) or indirectly employed (i.e., jobs supported by non-space suppliers) thanks to the initial injection of spending into the economy. Induced impact illustrates the economic impact of these people when they spend their incomes on goods and services in the wider European economy. This induced spending supports the industries that supply these non-space purchases, and includes housing, retail outlets, companies producing consumer goods and a variety of service industries.

The space supply chain has been applied a modelling of the in order to provide the spending inputs associated to non-space industrial sectors. The two steps that consisted of the methodology used are:

- First step – Modelling of the space activities: This step takes as input the institutional spending in space, and produces as output the space Gross Value

Added (equal to labour plus profit) based on statistical information and models available on the Space sector, and the spending into a number of non-space industrial sectors that are modelled in the Input-Output (IO) matrix "E3ME model" designed by Cambridge Economics[88].

- Second step – Feeding the E3ME model with spending: The spending into non-space industrial sector is fed into the IO model, producing as output the overall GDP impact (total GVA), employment impact and government revenues.

The Gross Value Added is a measure of the value created in the economy due to the public spending. The main objective of this indicator is to measure the impact that the initial public spending had on creating value in the space sector and in the wider European economy.

When this approach and the E3ME model was utilized, and the GVA and employment impacts were deduced, multipliers were calculated.

One of these multipliers is the **type 2 return multiplier** and it is calculated according to the following formula:

$$Type\ 2\ RETURN\ multiplier = \frac{Direct_{GVA} + Indirect_{GVA} + Induced_{GVA}}{Initial\ Spending}$$

and it was found to be 1.4.

Therefore, assuming the Multiplier is a constant, and provided that we have the total spending on Copernicus, we are able to deduct the total GVA.

The total Copernicus spending over 2014 – 2020 period amounted to a total of EUR 4.145 billion, additionally the new MFF 2021 – 2027 had EUR 5.073 billion for Copernicus. Therefore, total spending of 2014 – 2027 is expected to be EUR 9.218 billion (EU budget only, i.e. not accounting to the ESA allocated budget to Copernicus, notably the ground segment infrastructure).

$$Total\ GVA = Initial\ Spending\ (2014 - 2027)\ x\ Type\ 2\ return\ multiplier$$

$$= EUR\ 9.218\ billion\ x\ 1.4$$

Therefore, according to this approach, the total GVA of Copernicus is expected to be EUR 12.9 billion.

Furthermore, we can deduce the expected Direct GVA (i.e. the GVA in the Space sector) from a different type of multiplier which is the type 2 multiplier defined as follows:

[88] E3ME Model Manual

$$Type\ 2\ multiplier = \frac{Direct_{GVA} + Indirect_{GVA} + Induced_{GVA}}{Direct_{GVA}}$$

which was found to be 2.39.

Assuming a constant multiplier over time, and having obtained the updated expected total GVA, the new updated expected Direct GVA is assumed to be:

$$Direct_{GVA} = \frac{EUR\ 12.9\ billion}{2.39} = EUR\ 5.40\ billion$$

b. Benefits assessment of Galileo

The calculations build on the London Economics (2018) impact assessment of GNSS in Europe. This study is not public but was available to the Commission. We can report that EUR 1 invested in Galileo/EGNOS upstream generates EUR 2.4 for the industry (dividends, salaries, etc). This can be used to identify the Gross Value Added (GVA) for the EU economy.

EGNSS Total Spending (spending) (2014-2020)	EUR 5.765 bn
EGNSS Total Spending (commitment) (2021-2027)	EUR 7.437 bn
Total EGNSS Value (2014-2027)	EUR 13.202 bn

The total upstream impact can be calculated by following the formula:

$$Total\ GVA = Type\ II\ Multiplier \times Direct\ GVA$$
$$Direct\ GVA = Total\ Contract\ Value \times (profit\ margin + labour\ input)$$
$$Total\ GVA_{Upstream} = 2.4 \times (8\% + 27.6\%) \times Contract\ Value_{Upstream}$$
$$Total\ GVA_{Upstream} = 85.44\% \times Contract\ Value_{Upstream}$$

In this case, the upstream impact can be estimated based on the total contract value for Galileo and EGNOS. This results in a **value of EUR 11 279.79 million in total GVA** in current prices.

The Market Benefits of GNSS can be summarised as below:

GNSS Benefit *(million EUR) (2017-35) (2023 prices)*	
Internet of things	55 424.14
Safety Critical and Liability Critical Transport	2 508.25
Terrestrial Vehicles monitoring & Automation	49 274.90
Drones	809.11
Critical Infrastructure	1 254.12
High Precision Professional Applications	26 174.76
TOTAL	**135 445.28**

The Utility Benefits of GNSS can be summarised as below:

Vertical	**GNSS Benefit *(million EUR) (2017-35) (2023 prices)***
Internet of things	85 361.27
Safety Critical and Liability Critical Transport	25 729.75
Terrestrial Vehicles monitoring & Automation	412 849.19
Drones	43 772.94
Critical Infrastructure	1 213.67
High Precision Professional Applications	121 649.93
TOTAL	690 576.74

GNSS is a public good, meaning that it is both non excludable and non-rivalrous. In the context of the evaluation, this means that it is difficult to attribute benefits to one single GNSS system (there are four global GNSS systems: GPS vs Galileo vs Beidou vs Glonass), as the majority of benefits do not depend on a single system.

Two different scenarios have been used to calculate the benefits of Galileo and EGNOS, as explained below. The scenarios are based on assumptions on how benefit is attributed to Galileo, as benefits cannot be split between all GNSS constellations.

- **100% of benefit allocated to Galileo**. Takes the assumption that all exploitation benefit in Europe is derived from Galileo. Therefore, this benefit is combined with the EGNOS benefits.
- **25% of benefit allocated to Galileo**. Takes the assumption that all exploitation benefit in Europe is derived equally from each of the four GNSS. Therefore, this is divided by four, and the EGNOS benefits are added on top.

Over the timeframe 2017 – 2027[89]:

Costs	Benefit Scn. 1	Benefit Scn. 2	Benefit cost ratio 1	Benefit cost ratio 2
EUR 13.20 bn	EUR 352.40 bn	EUR 93.39 bn	26.7	7.1

As shown in the table above, even when assuming that the benefits are split equally between the four constellations, the benefits massively outweigh the costs. This is because of the extremely wide-reaching use cases of GNSS: Safety Critical and Liability Critical Transport, Terrestrial Vehicles monitoring & Automation, Drones, Critical Infrastructure, High Precision Professional Applications. The global economy is dependent on these. In fact, the costs only account for 3.7% of the total value of the

[89] This period corresponds to the deployment of the Galileo constellation (first generation).

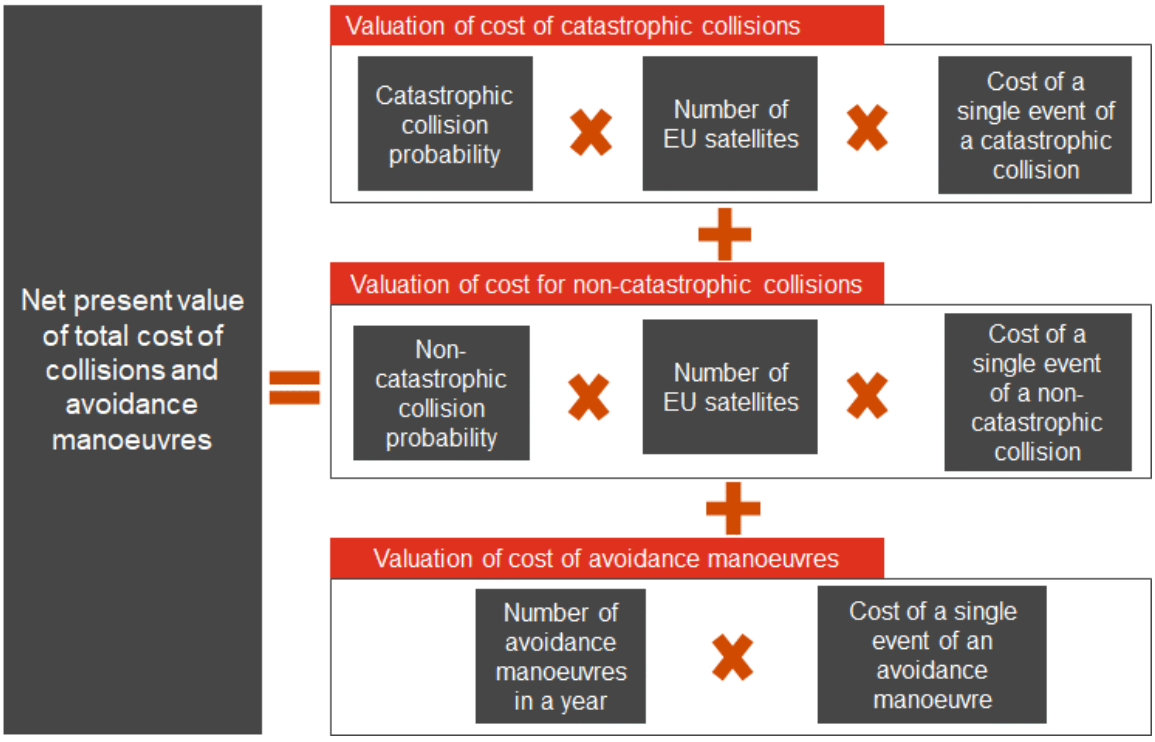
benefits, meaning that the benefit cost ratio would be greater than one even if only 3.7% of the benefits of GNSS were allocated to Galileo and EGNOS.

c. Benefits assessment of SST

The benefits assessment of SSA builds on the 2018 impact assessment study of the EU SSA initiative[90]. The relevant quantitative impacts have been updated thanks to more recent data (the number of satellites in orbit which is the main parameter impacting the probability of collisions - this was updated taking into account the presence of mega constellations).

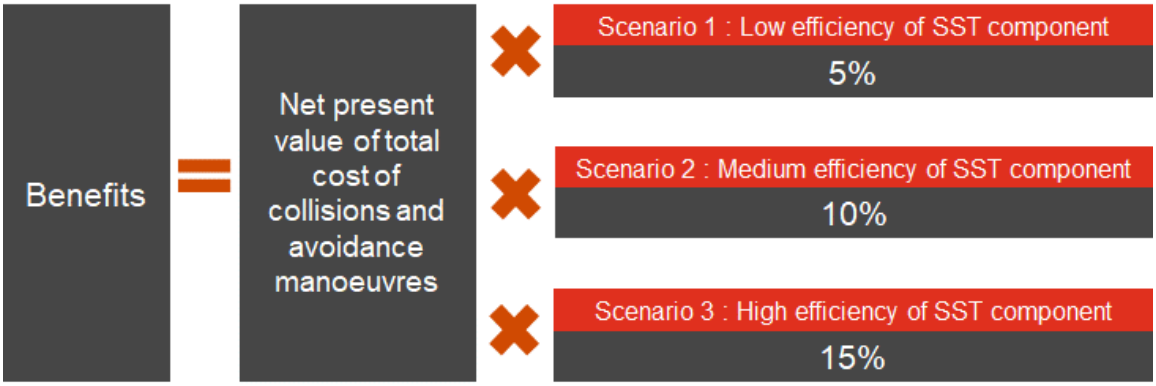
The most important economic impact expected to materialize from the SST service is the reduction in collisions between spacecrafts and space debris. This impact is considered by far the main driver for SST therefore the largest focus of the assessment is on this benefit. This benefit is assessed quantitively by analysing the different costs linked to collisions and avoidance manoeuvres, and then evaluating the benefits that may be enabled thanks to the SST component.

Reduced loss of revenues is the main commercial driver for SST as it represents the largest impact. The first step of the assessment is based on the valuation of the costs of collisions and avoidance manoeuvres between 2020 and 2035 as shown in the figure below. The collisions can be either lethal or non-lethal, each case having a different cost due to replacement of the satellite or lost revenue for service interruption, and a different probability of happening. Avoidance manoeuvres also have a significant cost to take into account as each manoeuvre reduce the lifespan of the satellite.



[90] Assessment of the Possible EU Space Situational Awareness Initiative

Once all the costs are calculated, the next step is to evaluate how the SST component of can help in reducing these costs. This cost reduction is precisely the benefit of the SST component for this impact. To assess this benefit, three scenarios were considered which translate the efficiency of the SST component as shown in the figure below.



Considering the impact description that has been developed above, impact of catastrophic collisions with electrically propelled and chemically propelled satellites in Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) have been quantified.

A catastrophic collision leads to two impacts:

1. Revenue is lost from the interruption in services during the time in which a replacement satellite is built.
2. The satellite is replaced sooner than anticipated, with additional investment required to maintain services up to the originally planned satellite lifetime.

In order to understand the baseline costs of catastrophic collisions in a given year, the cost of a single event is multiplied by the probability of this event happening to an EU satellite and the number of EU satellites.

Cost of a single event: catastrophic collision

Lost revenue is calculated as the average annual revenue of a satellite (electric or chemical, GEO or LEO) multiplied by the number of years of lost revenue. It is assumed that if a satellite is destroyed, a replacement will be commissioned and launched into orbit after **2.5 years**, so that 2.5 years of revenue are lost. The additional investment cost to replace the satellite is estimated as the annualised cost of satellite manufacture and launch multiplied by the years of life lost by the satellite due to the collision, discounted based on the year using the social discount rate[91] (4%). In all calculations, it is assumed that the catastrophic collision occurs at the midpoint of the lifespan of a satellite for those that are in LEO and GEO. The table below outlines the assumptions used for satellite lifespan and annualised costs and revenues.

[91] The social discount rate compares costs and benefits occurring in different time periods from the point of view of society. Such concept is taken from the European Commission Better Regulation "Toolbox".

	Chemical propulsion		Electric propulsion	
	GEO	**LEO**	**GEO**	**LEO**
Lifespan (years)	15	7.5	20	10
Average Annual revenue (million EUR)	63.84	25.01	43.68	25.01
Annualised investment cost (million EUR)	21.51	13.33	9.81	6.00

The table below shows the cost of a single catastrophic collision in present value terms.

	Chemical propulsion		Electric propulsion	
(million EUR)	**GEO**	**LEO**	**GEO**	**LEO**
Cost of revenue interruption	155	61	126	61
Cost of sooner replacement	140	46	82	27
Total benefit per avoided lethal collision	**295**	**107**	**208**	**88**

Baseline cost: catastrophic collision probability and number of satellites

The baseline cost is driven by the probability of satellite collision in each year and the number of Member States' and EU satellites in orbit in each year. It takes into account the cost of replacing the satellite and the revenue lost while the new satellite is rebuilt. The probability of a collision varies between LEO and GEO, as the population of space debris is not evenly distributed among orbital regions. Therefore, it is assumed that the probability of collisions is higher in LEO at an altitude of ~800 km, as this region has the highest concentration of space debris[92].

The probability of a collision occurring in an orbit evolves over time, as does the number of satellites in each orbit, and the mix of electric and chemical propelled satellites.

Orbital regime	2020	2035
LEO	0.000030	0.00033
GEO	0.00000061	0.00000129

[92] Presentation on Space Traffic Management

Number of EU satellites

The number of EU satellites is expected to increase over time. In addition, the share of satellites with electric versus chemical propulsion is expected to change over time. Satellites with different types of propulsion system have different lifespans, annual revenues, and costs, and therefore there is a different level of impact associated with their loss or damage.

The table below shows the number of satellites in 202 and the assumed number in 2035:

Orbit – Propulsion type	2020	2035
GEO – chemical propelled	74	46
LEO – chemical propelled	106	158
GEO – electric propelled	3	32
LEO – electric propelled	-	-

Baseline impact of catastrophic collisions

The baseline impact of catastrophic collisions is shown in the table below, in net present value terms. It is achieved by summing the annual cost of catastrophic collisions to satellites over the period 2020-2035. This period is the most adequate to consider based on the technology currently used to derive the information for the service: radars, telescopes and ranging stations and their expected lifetime. The benefits timeframe is not identical with Copernicus, Galileo and EGNOS since they rely on different technologies and started operations at different times in the past.

The cost for each year is calculated by multiplying the cost of a single collision, the number of satellites in orbit, and the probability for a satellite to have a collision.

(million EUR)	Net present value of impact between 2020 and 2035
GEO – chemical propelled	0.24
LEO – chemical propelled	28.93
GEO – electric propelled	0.04
LEO – electric propelled	-
Total	**29.22**

d. Benefits assessment of SWE

This section aims at presenting the main sectors that would be affected in case of a space weather event. As previously defined, there are three types of events that could cause damages: ionospheric disturbances, geomagnetic storms, and solar radiation storms. Several domains have been listed as being potentially directly or indirectly concerned by the impacts of SWE. Indeed, either the infrastructure, operations or service provision of an industrial domain are directly affected (e.g., degradation of navigation satellite signals, change in flight latitude, etc.); or the impact is indirect, meaning that, following direct disturbances of the functioning of operations or of service provision of some space

activities, other domains reliant on these are affected (e.g., the degradation of navigation satellite signals affects maritime operations).

List of domains impacted by SWE:

Domains		Impact Category	Impacts
Aviation		Economic	Additional staff and other operational needs due to flights being delayed (quantified) Disruption to flight due to damages to aircraft and malfunctions
		Strategic	Delayed journeys due to flights being grounded (quantified)
		Social	Increase in morbidity due to exposure to radiation
		Environmental	Increased flight time causing environmental damages
Power grid operations		Economic	Increased cost due to need of equipment replacement Loss or damages on equipment due to power fluctuations across network Need of replacement for transformers (quantified)
		Strategic	Disruption to the running of the economy following loss of power in sectors dependent on electricity (quantified)
		Social	Disruption to the running of the economy following loss of power in sectors dependent on electricity (quantified)
		Environmental	Increase in fuel burnt due to use of fuel power energy generators to compensate loss of electricity
Space sector	Spacecraft operations and design	Economic	Prolonged or permanent loss of satellite subsystems and of satellite functionalities (quantified) Complete loss of satellite/no longer functioning (quantified)
		Strategic	Partial degradation of satellite/reduced functionality (quantified) Reduced lifespan of specific services/satellites (quantified)
	Launch operations	Economic	Waste of propellant due to defueling Complete loss of launcher (quantified)
		Strategic	Delays in launch

Impact 1: Temporary disruption/loss of service

A Single Event Effect (SEE) is a general class of radiation effects on electronic devices. SEEs can be of two types: soft (non-destructive) and hard (potentially destructive).

Soft SEE are generally identified with Single Event Upsets (SEU) - temporarily failure or upsets of subsystems due to the effect of high-energy particle (SEP) impacts. As SEUs are soft errors and therefore non-destructive, the impact is that some part or all the avionics is temporarily lost. These errors normally appear as transient pulses in logic or support circuitry, or as bit flips in memory cells or registers. An SEU can cause the payload or subsystem to switch automatically to "safe mode." In this mode, the system is safe, but its activities are in idle, and services can be disrupted. In case of commercial satellites, this can generate a loss of revenue for the operator; while in case of military satellites (high requirement in term of availability and continuity of service), an SEU can even result in loss of human lives.

The table below indicates the number of SEUs registered during Solar Cycle 23 for a specific satellite fleet, where a solar cycle is the periodic cycle, the Sun goes through, of high and low activity that repeats every 11 years. Using this as an example snapshot, it is clear many SEUs can therefore occur.

Single Event Upsets	Number
Total number of registered SEU	226
Number of SEU during solar maximum (1998-2002)	21
Total number of monitored satellites	8

Impact 2: Reduced lifespan of specific services/satellites

Solar cells are degraded by solar particles during solar storms. This degradation is expected during the operational life of the satellite, and is factored in during the design phase, during which the expected efficiency of the solar panel at the end of its operational life is defined by customer/user requirements. Solar panels are usually sized to ensure extra efficiency at the end of the mission with regards to the defined threshold. In order to mitigate risk of augmented degradation some manufacturers size the solar panels to allow for an extra 50% of efficiency at the end of the satellite operational life (as opposed to around 30%).

Impact 3: Risk of complete loss/lack of functioning of satellite

Energetic particles, mainly from geomagnetic storms, can cause surface or internal charging, by charging one side of the spacecraft or internal components, with possible electric discharges that can result in malfunctions or even complete failure of the satellite. The charging may generate high voltage discharge through the structure of the satellite and the active subsystems, with risk of a Single Event Burnout (SEB) that could cause prolonged or permanent loss of satellite subsystems and therefore of its functionalities. Currently, the only mitigations for the charging effect are through passive

mitigation design, by applying an appropriate coating on satellite surfaces that can potentially accumulate electronic charges.

In order to calculate the benefit of investing in SWE on space operations, first a baseline cost per year was calculated. This baseline figure is the impact of single event upsets in LEO and GEO and is calculated by multiplying the number of expected anomalies per year by the cost of an anomaly. These single event upsets are the results of several SWE: for the calculations, it has been assumed that an extreme SWE would happen between today and 2040.

It is assumed that a certain number of anomalies are avoided as a result of investment in SWE. This reduction in anomalies is presented as two percentages. The first impact is the general reduction in anomalies, which is 10% of the baseline per year. The second impact is the percentage of anomalies avoided as a result of better design. This percentage is 0% in 2021 and grows to 40% in 2035, remaining at 40% thereafter. The table below highlights the baseline impact amount, the anomaly percentages, and the benefit of SWE:

	2021	**2030**	**2040**
Baseline Impact of critical and non-critical anomalies on LEO and GEO commercial satellites	EUR 5.84 m	EUR 7.57 m	EUR 14.15 m
Anomalies avoided (general)	10%	10%	10%
Anomalies avoided (design)	0%	23%	40%
Benefit of SWE	EUR 0.58 m	EUR 2.52 m	EUR 7.08 m

The arrival of high-energy protons not only affect humans but can also cause **damage on aviation** induced by Single Event Effects (SEE) and **on ground systems**[93]; particles resulting from solar radiation disrupt the charge in semiconductor materials. In order to calculate the benefit of investing in SWE on aviation, first a baseline cost per year of the impact of space weather on delayed flights was calculated. The impact is quantified as the value of time to passengers that are delayed, and the financial cost of delayed flights.

The value of time is calculated as follows: value of an hour consumed (EUR **42.07**[94]**)** multiplied by the number of passengers delayed and the average length of delay (**3 hours**).

The financial cost of delayed flights is calculated as follows: total flights delayed due to space weather x average cost of a 3-hour delayed flight **(EUR 46 638)**.

It is assumed that investing in SWE will reduce the average flight delay time to 2 hours instead of 3 hours. Therefore, the average cost of a 2-hour delayed flight **(EUR 32 762)**

[93] North Atlantic Minimum Navigation Performance Specification (MNPS) Airspace Operations Manual

[94] "Standard Inputs for EUROCONTROL Cost-Benefit Analyses", Edition Number 7.0, Edition Date November 2015.

is applied to the total flights delayed due to space weather to calculate a total cost of delays under an SWE scenario. The difference between these two values is therefore the benefit.

(million EUR)	2021	2030	2040
Baseline: financial cost	0.047	0.084	0.148
Baseline: value of time	0.019	0.034	0.060
Investment in SWE: financial cost	0.033	0.059	0.104
Investment in SWE: value of time	0.013	0.023	0.040
Benefit of investing in SWE	**0.020**	**0.036**	**0.064**

SWE has an impact on power grids. It is assumed that a G5 or G5+ storm[95] leads to the following outcomes:

- 3 major city blackouts for 3 days.
- 100% blackout outside major cities in Europe for 2 weeks, 50% blackout outside major cities in Europe for 3 weeks and 10% blackout outside major cities in Europe for 1 week.
- 68 transformers damaged with a cost of EUR 4.2 million.

Blackouts in major cities and outside major cities have an impact on GDP, morbidity, and mortality.

If there is investment in SWE, it is assumed that a G5 or G5+ storm leads to the following outcomes:

- 2 major city blackouts for 2 days.
- 33% decrease in blackouts outside major cities.
- 33% decrease in the number of transformers damaged.

This therefore means that if there is investment in SWE, the associated impact as a result of a G5 or G5+ storm event reduces in terms of GDP, morbidity, mortality and damage to transformers.

The following table shows summary of the impact on transformer cost, GDP, mortality, and morbidity of space weather under the baseline, and the total benefit as a result of investment in space weather.

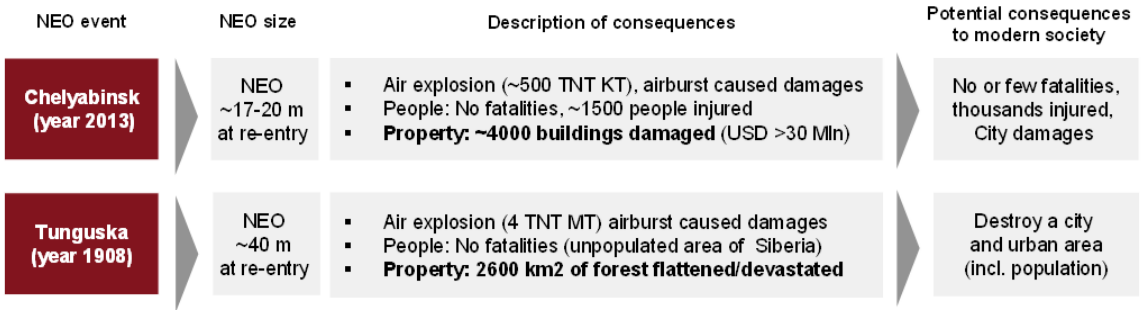
[95] Geomagnetic Storms

(million EUR)	2021	2030	2040
Baseline: major cities (GDP, mortality, morbidity)	204.7	234.1	267.7
Baseline: outside major cities (GDP, mortality, morbidity)	183.0	205.7	231.6
Baseline: loss of transformers	20.6	20.6	20.6
Benefit of SWE: major cities	**113.7**	**130.0**	**148.7**
Benefit of SWE: outside major cities	**61.0**	**68.6**	**77.2**
Benefit of SWE: loss of transformers	**6.9**	**6.9**	**6.9**

e. Benefits assessment of NEO

The characterisation of NEO impacts indicates that a NEO can cause anything from a negligible air blast (<10 m NEO) up to the end of civilisation (>1 km NEO), and these impacts vary mostly based on NEO size. However, NEO impacts should be seen in light of their probabilities. NEO impacts are rare events (for example on the order of 1 in 70 years up to 1 in 15 000 years for the NEO family of 20-140 m).

The following figure provides quantitative figures from these past NEOs (≥20 m) events that caused severe consequences to people and property.



A modelling was performed by PwC (contracted by the Commission) using mostly the ratio of injuries to fatalities during historical tornados and natural events, and the results are as follows:

NEO Size	Impact Type	Societal Outcome	Raw Number	Raw Value (million EUR)	Average Event Value (million EUR)
20 m	Air Blast	Fatalities	0 persons	0	0
		Injuries	1 217 persons	57	17
		Infrastructure Damage	EUR 23 m	23	6.8
		Land Damage	10 km^2	8.2	2.5
	Tsunami	Fatalities	3 persons	3.4	0.4
		Injuries	0 persons	0	0
		Infrastructure Damage	EUR 0.7 m	0.7	0.1
50 m	Air Blast	Fatalities	6 712 persons	7 125	2 137
		Injuries	100 211 persons	4 681	1 404
		Infrastructure Damage	EUR 528 m	528	158
		Land Damage	376 km^2	310	93
	Tsunami	Fatalities	3 persons	3.6	0.43
		Injuries	2 persons	0.1	0.01
		Infrastructure Damage	EUR 1.2 m	1.2	0.14
140 m	Air Blast & Crater	Fatalities	51800 persons	55 028	16 508
		Injuries	1.7 m persons	78 500	23 550
		Land Damage	7 468 km^2	6 145	1 843
	Earthquake	Infrastructure Damage	EUR 2 867 m	2.867	860
	Tsunami	Fatalities	85 persons	90.2	11
		Injuries	69 persons	3.2	0.4
		Infrastructure Damage	EUR 12.1 milMil	12.1	1.5
1 km	Air Blast & Crater	Fatalities	9.3 m persons	9 849 638	2 954 891
		Injuries	18.2 m persons	851 923	255 577
		Land Damage	90 996 km^2	74 874	22 462
	Earthquake	Infrastructure Damage	EUR 24 841 m	24 841	7 452
	Tsunami	Fatalities	467 persons	496	60
		Injuries	155 persons	7.2	0.9
		Infrastructure	EUR 160 m	161	19

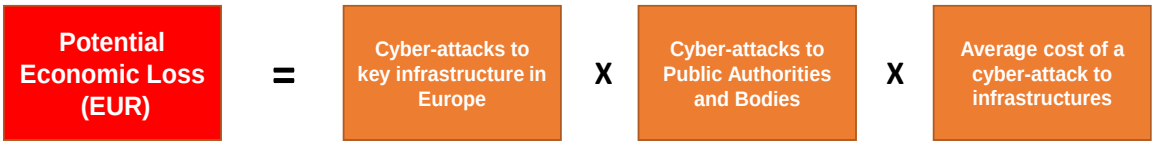
		Damage			

f. Benefits assessment of GOVSATCOM

The benefits assessment of GOVSATCOM builds on the "Study in support of the Impact assessment of an EU GOVSATCOM initiative", performed by PwC for the Commission in 2017. The protection of key infrastructures is a very critical aspect, and GOVSATCOM would be beneficial in these terms. Given the relevance of protecting transportation infrastructures from threats such as cyber-attacks, and the potential help that GOVSATCOM would bring for this purpose, calculations were made considering such a scenario.

In order to calculate the potential impact of GOVSATCOM on cyber-attack mitigation, information has been extracted from the ENISA report for transportation in the EU[96]. Taking the reported cyber-attacks in the EU to transportation infrastructures, it is possible to:

- Extract the number of cyber-attacks in 2021-2022 in Europe, targeting Aviation, Rail and Road segment.
- Extract the number of cyber-attacks that targeted public authorities and bodies.
- Forecast their number up to 2035 with three different growth factors, to account for three scenarios, thus for uncertainty.
- Multiply the number of cyber-attacks for the average costs faced when receiving a cyber-attack to an infrastructure.



The cyber-attacks on key infrastructure in Europe have been calculated through multiple steps. First, the number of reported cyber-attacks in Europe targeting Aviation, Rail and Road segment in 2021 and 2022 have been extracted from the ENISA 2023 report. To further restrict the scope, only the attacks to public authorities and bodies have been considered, since GOVSATCOM is intended to serve National and EU actors mainly.

Secondly, their growth until 2035 was predicted with a growth factor of 32% in the medium scenario. This growth factor is the result of the average between the growth from 2021 to 2022 of cyber-attacks in the transportation sector of the ENISA report excluding the maritime segment (not in GOVSATCOM scope) and the growth coming from a research of Check Point.[97] To account for uncertainty, three different scenarios of growth

[96] ENISA Report on Transport Threat Landscape

[97] Check Point Research: Third quarter of 2022 reveals increase in cyberattacks and unexpected developments in global trends

have been implemented: 32% for the medium scenario as above-mentioned, 22% for the low scenario and 42% for the high scenario.

Finally, we extracted the average costs to bear for an attack to a key infrastructure, which is estimated at around USD 5 million[98] following the IBM report on cyber security.

As a result, the potential economic loss of cyber-attacks to transportation infrastructure in Europe until 2035 are calculated. They range, cumulatively, between EUR 3.7 billion and EUR 18.3 billion, proving that there is room and need for GOVSATCOM to support the infrastructure segment and allow safer, cheaper, and more effective communication:

IMPACT: GOVSATCOM potential impact on cyber-attacks to transportation infrastructure	Low scenario	Medium scenario	High scenario
Cumulative: 2025-2035	EUR 3 780 559 016	EUR 8 412 179 900	EUR 18 325 648 110

C. Relevance

The Space Regulation stipulated that "To maximise the socio-economic return from the Programme, it is essential to maintain state-of-the-art systems, to upgrade them to meet evolving users' needs." The mechanisms to keep the Programme relevant are thus embedded into its life cycle, by consulting users and updating the portfolio of services and data provided by all components.

The main elements used for the evaluation were:

- Inputs from previous SWD such as the Expression of User Needs for the Copernicus Programme, or other information from users as compiled by agencies: ESA Customer Requirements Document for SWE, the EUSPA User Consultation Platform for Galileo/EGNOS[99].
- Consultations with entrusted entities.
- Consultations with end user community representatives.

D. Coherence

The coherence assessment was be done based on a comparison of the EU Space Programme with different policies and actions. Other relevant EU policies were first identified (such as environmental and climate change policies, transportation policies etc.). Afterwards the coherence verification was performed taking into account also EU member states national policies, or international organisations' policies.

[98] IBM Report: Half of Breached Organizations Unwilling to Increase Security Spend Despite Soaring Breach Costs, Jul 24 2023

[99] EUSPA Report on User Needs and Requirements 2020

E. EU Added Value

The EU added value assessment took as inputs the analysis done under the other axes particularly effectiveness and efficiency. For the companies involved in the space domain, Eurospace and ESA have information covering the EU's investments and ESA's combined. It is impossible make a segregation since most private companies apply/depend on funds from both organisations (and subcontractors can be from a different country). Companies contracted by ESA directly (not acting for the EU) can be from all 22 ESA Member States[100] and not just the European Union Member States but there is a very large intersection in membership.

[100] Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom

ANNEX III. EVALUATION MATRIX

In accordance with the Better Regulation toolbox, the assessment of the performance of the implementation of tasks, objectives, mandates and policies was be done based on the evaluation of five main criteria: effectiveness, efficiency, relevance, coherence and EU added value.

The overall evaluation matrix is presented in the following table:

Question	Indicator	Applied to	Data sources
Is the space component **Effective**?	- Programme Indicators as per Annex I of the Regulation - KPIs as per the Contribution Agreement - Target Outcome - Actual Outcome - Status (On time/ Delayed)	EUSPA (for Galileo and EGNOS[101])	Analysis of relevant documentation Targeted interviews (staff from EC, EUSPA and ESA) Analysis of statistical and quantitative data
		ESA (Copernicus)	
		EUMETSAT (Copernicus)	
		EEA (Copernicus)	
		Mercator Ocean (Copernicus)	
		ECMWF (Copernicus)	
		EMSA (Copernicus)	
		FRONTEX (Copernicus)	
		EUSPA (Copernicus)	
		EUSPA (SST)	
		ESA (SWE and NEO)	
		ESA (GOVSATCOM)	
		EUSPA (GOVSATCOM)	
Is the space component **Efficient**?	BENEFITS[102] / COST[103] = EFFICIENCY	Galileo	Analysis of relevant documentation Analysis of statistical and quantitative data
		EGNOS	
		Copernicus	
		SSA	
		GOVSATCOM	
Coherence: To what extent is this intervention coherent with other interventions which have similar objectives? To what extent is the intervention coherent internally? To what extent is the intervention coherent with wider EU policy? To what extent is the	Not applicable	Galileo	Analysis of relevant documentation Analysis of statistical and quantitative data
		EGNOS	
		Copernicus	
		SSA	
		GOVSATCOM	

[101] Includes tasks subdelegated to ESA

[102] Indicated in the SWD (identified directly or based on previous studies)

[103] EU budget allocated for the relevant period

intervention coherent with international obligations?			
Added Value: What is the additional value resulting from the EU intervention, compared to what could be achieved by Member States at national and/or regional levels? To what extent do the issues addressed by the intervention continue to require action at EU level?	Not applicable	Galileo EGNOS Copernicus SSA GOVSATCOM	Analysis of relevant documentation Analysis of statistical and quantitative data
Is the component **Relevant**?	Comparison between user needs (from previous documentation) and services currently provided	Copernicus	Updating previous consultations plus several new interviews
	Highlighting the needs of end users, ensuring that space services provided are driven by these needs	Galileo and EGNOS	No new consultation (desk update of previous ones of 2020 and 2022)
	Examining the link between user needs and service definition	SSA	Targeted interviews (staff from EC, EUSPA and ESA)
	As per questionnaire (classified)	GOVSATCOM	The actual interviews have been conducted in the past and are classified, the Study and SWD make a public summary of it

A. Effectiveness

The objectives of the Programme are measured in the Programme Performance Statement.

The **Commission's Programme Performance Statements**[104] for the Space Programme detail every year the baseline, annual implementation and long term (2027) targets of the main KPIs annexed to the Regulation and linked with the Specific objectives of the Programme. It clarifies the source of information and identifies the methodology and provides a clear overview on the implementation of the Programme and its components for the period 2021-2027.

The Programme Performance Statements have the following structure (it is repeated for each main KPI):

Indicator										
Baseline	2021	2022	2023	2024	2025	2026	2027	2028	2029	Target
2021	Milestones									2027
	Actual Progress									Final
Indicator type			Result/Output							
Unit of measurement										
Linked to objective			[quote objective]							
Justification of the trend			[narrative on target, below target etc]							

Given the differences among the Programme components and their complex implementation, for the Programme Performance Statements main KPIs have been identified for each component with a few transversal main KPIs.

To perform an accurate comparison and assessment of the outcomes versus the expectations, the performance of the entrusted entities or the implementation of new activities where the Programme Statement is not providing any data, are measured based on the evaluation matrix described below. The evaluation matrix for effectiveness is an excel questionnaire which was sent to all the entrusted entities to whom Programme funds were delegated. Information was collected on:

A. The year of implementation (2021, 2022 or 2023)
B. Activities implemented
C. Expected Outcome
D. Programme Indicators as per Annex I of the Regulation
E. KPIs as per the Contribution Agreement
F. Target Outcome
G. Actual Outcome
H. Status (On time/ Delayed)
I. Allocated Budget
J. Budget Spent
K. Budget Expected to spend

[104] Report on the Performance of the EU Space Programme

This was repeated for each component of the Programme. The results, measured as per the KPIs identified in the Contribution Agreements are shown in Annex II.

B. Efficiency

To evaluate the efficiency of the Programme a costs assessment was performed (assessment of resource and inputs) and compared to the benefits previously evaluated (under effectiveness) in a cost-benefits format as demonstrated in the figure below:



Checking the Efficiency starts from the standard Better Regulation questions:

- To what extent are the costs involved justified, given the changes/effects which have been achieved?
- To what extent are the costs proportionate to the benefits achieved? What factors are influencing any discrepancies?
- What factors influenced the efficiency with which the achievements observed were attained?
- How affordable were the costs borne by different stakeholder groups, given the benefits they received?
- To what extent has the intervention been cost effective?

Furthermore, the exact modelling, points of comparison and questions are tailored to each component of the Space Programme and presented in Annex II, B.

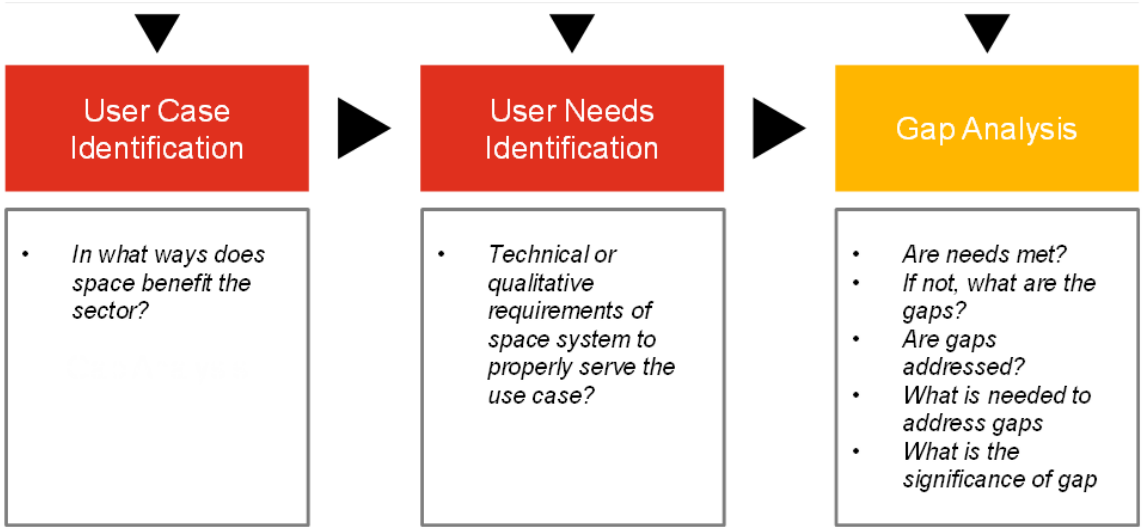
C. Relevance

Checking the Relevance starts from the standard Better Regulation questions:

- To what extent is the intervention still relevant?
- To what extent have the (original) objectives proven to have been appropriate for the intervention in question?
- How well do the (original) objectives (still) correspond to the needs within the EU?
- How well adapted is the intervention to subsequent technological or scientific advances? (N.B. Could include issues related to the specify policy here e.g., social, environmental)
- How relevant is the EU intervention to EU citizens?

The questions are further tailored as described in Annex II, part C.

The matrix can be summarised as in the picture below:



The first step is a highlight of the status quo. It is based on desk research, market reports and other data to give a high-level indication of the current state of the market.

The second step deals with identifying use cases. The use cases are concrete examples of where the Union Space Programme currently is or could be used to improve the user experience in the sector.

The third step is technical requirements such as resolution, latency, precision, reliability, etc., or could be qualitative needs for users such as dedicated platforms.

Last is the gap analysis. This is based on stakeholder consultation and looks into the extent to which the current Union Space Programme meets the needs of the user communities.

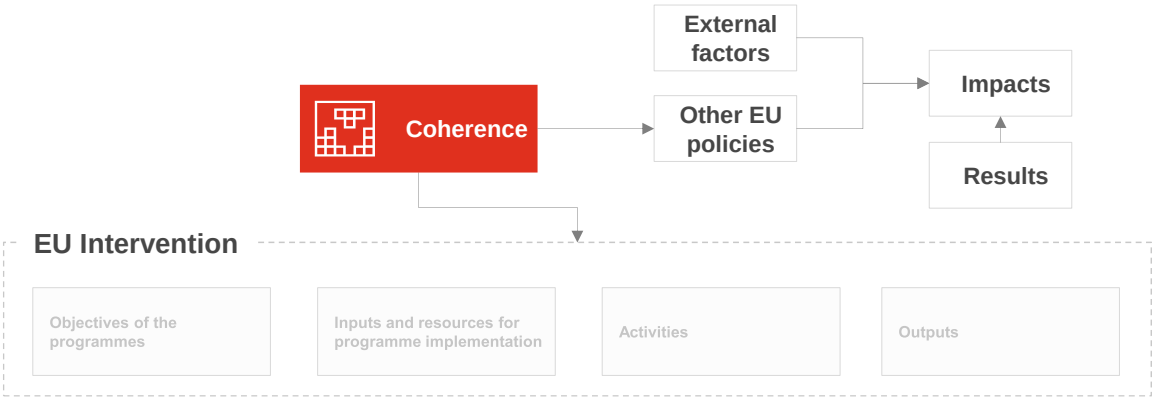
Consultations with Entrusted Entity representatives and desk research identified whether these gaps are being addressed, and what is required for the gaps to be addressed.

D. Coherence

Checking the Coherence starts with the standard Better Regulation questions:

- To what extent is this intervention coherent with other interventions which have similar objectives?
- To what extent is the intervention coherent internally?
- To what extent is the intervention coherent with wider EU policy?
- To what extent is the intervention coherent with international obligations?

As explained in Annex II, part D, the coherence logic has been tailored as in the figure below:



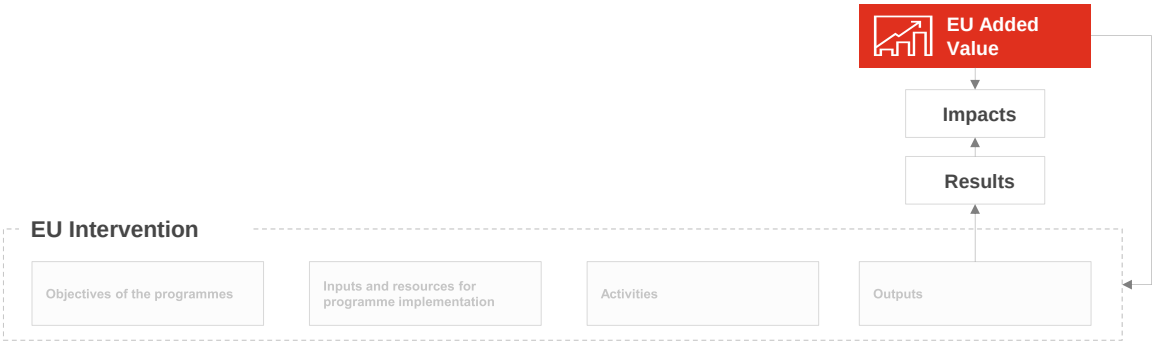
E. EU Added Value

Checking the value added starts with the standard Better Regulation questions:

- What is the additional value resulting from the EU intervention(s), compared to what could be achieved by Member States at national and/or regional levels?
- To what extent do the issues addressed by the intervention continue to require action at EU level?

For EU added value the inputs were desk research and stakeholder consultations. The aim was to determine the added value achieved by the component as a whole, beyond what would have been achieved by Member States acting alone, in a qualitative way. This includes an overview of the performance of the component compared to what could be achieved on a national scale from the perspective of users, Member States, and the overall perception on an international scale.

The logic is pictured below:



Ccosts and benefits identified in the evaluation			
	Citizens/Consumers	Businesses	Administrations

ANNEX IV. OVERVIEW OF BENEFITS AND COSTS

<table>
<tr><th></th><th>Quantitative</th><th>Comment</th><th>Quantitative</th><th>Comment</th><th>Quantitative</th><th>Comment</th></tr>
<tr><td colspan="7">Costs</td></tr>
<tr><td>Direct compliance costs (adjustment costs, administrative costs, regulatory charges)
Enforcement costs (costs associated with activities linked to the implementation of an initiative such as monitoring, inspections and adjudication/litigation)
Indirect costs (indirect compliance costs or other indirect costs such as transaction costs)</td><td>Not applicable</td><td>The Programme does bring any cost to citizens or consumers (all is provided for free)</td><td>Not applicable</td><td>The Programme does bring any cost to businesses (all is provided for free)</td><td>Not applicable</td><td>The Programme does bring any cost to administrations (all is provided for free)</td></tr>
<tr><td colspan="7">All benefits are considered recurrent (the underlying calculations and explanations can be found in Section 3.1.4.2 of the Supporting Study). The services and data provided by the Programme are embedded in the daily activities of every end-user, regardless if it is a citizen, a company or an administration. It is not possible to make a precise apportionment between these three categories: there are for example more than one billion Galileo receivers, it is impossible to identify to whom each belongs and for what activities it is used.</td></tr>
<tr><td>Benefits for Administrations for increased ability to meet EU air pollution targets</td><td colspan="6"><table>
<tr><th></th><th>Pessimistic scenario</th><th>Neutral scenario</th><th>Optimistic scenario</th></tr>
<tr><td>2017-2022</td><td>2 176 757 203€</td><td>3 265 135 805€</td><td>4 353 514 406€</td></tr>
<tr><td>2023-2035</td><td>6 599 023 706€</td><td>9 893 334 795€</td><td>13 158 470 599€</td></tr>
<tr><td>Total</td><td>8 775 780 910€</td><td>13 158 470 599€</td><td>17 544 627 466€</td></tr>
</table></td></tr>
<tr><td>Benefits for Citizens for decreased exposure to air pollution</td><td colspan="6"><table>
<tr><th></th><th>Pessimistic scenario</th><th>Neutral scenario</th><th>Optimistic scenario</th></tr>
<tr><td>2017-2022</td><td>317 882€</td><td>367 155€</td><td>394 576€</td></tr>
<tr><td>2023-2035</td><td>5 549 412€</td><td>10 038 892€</td><td>14 070 040€</td></tr>
<tr><td>Total</td><td>5 867 295€</td><td>10 406 047€</td><td>14 464 616€</td></tr>
</table></td></tr>
<tr><td>Benefits for Businesses for reduced costs as a result of better solar panels infrastructure management</td><td colspan="6"><table>
<tr><th></th><th>Pessimistic scenario</th><th>Neutral scenario</th><th>Optimistic scenario</th></tr>
<tr><td>2017-2022</td><td>1 452 978€</td><td>2 164 026€</td><td>3 490 714€</td></tr>
<tr><td>2023-2035</td><td>3 656 584€</td><td>5 165 925€</td><td>7 546 708€</td></tr>
<tr><td>Total</td><td>5 109 562€</td><td>7 329 952€</td><td>11 037 422€</td></tr>
</table></td></tr>
</table>

Benefits for **Businesses** for reduced CO2 emissions due to a decrease in reliance on fossil fuel energy sources

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	23 740 720€	35 412 625€	57 196 419€
2023-2035	48 392 817€	68 384 422€	99 958 023€
Total	72 133 538€	103 797 048€	157 154 442€

Benefits for **Citizens** for improved food security

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	591 402 827€	971 626 631€	1 342 720 425€
2023-2035	5 992 296 686€	8 407 031 477€	1 038 555 268€
Total	6 583 699 514€	9 378 658 108€	11 728 273 108€

Benefits for **Businesses** for improved agriculture profitability and cost efficiency

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	862 061 093€	1 179 353 866€	1 433 002 370€
2023-2035	3 698 638 481€	5 822 416 798€	8 252 719 029€
Total	4 560 699 575€	7 001 770 664€	9 685 721 399€

Benefits for **Administrations** for cost reduction of forest management and control

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	7 648 747€	9 133 699€	10 618 651€
2023-2035	17 029 701€	19 747 414€	22 465 127€
Total	24 678 449€	28 881 114€	33 083 779€

Benefits for **Businesses** in improved yields in forests

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	120 698 334€	142 852 938€	165 007 543€
2023-2035	502 732 781€	582 750 703€	662 768 625€
Total	623 431 115€	725 603 642€	827 776 169€

Benefits for **Administrations** to improve and restore forest ecosystems and green infrastructures

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	314 124 285€	628 248 570€	942 372 855€
2023-2035	2 698 556 418€	5 397 112 836€	8 095 669 255€
Total	3 012 680 703€	6 025 361 406€	9 038 042 110€

Benefits for **Administrations** to improve profitability in the Hydropower sector

	Pessimistic scenario	Neutral scenario	Optimistic scenario

	2017-2022	21 356 075€	40 438 488€	70 337 564€
	2023-2035	438 496 811€	691 858 149€	1 125 191 522€
	Total	459 852 886€	732 296 638€	1 195 529 087€
Benefits for **Businesses** for improved agriculture productivity through better irrigation management		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	321 235 387€	383 374 426€	509 441 995€
	2023-2035	1 098 923 802€	1 391 532 096€	2 002 035 952€
	Total	1 420 159 190€	1 774 906 522€	2 511 477 948€
Benefits for **Administrations** for reduced groundwater depletion		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	43 841 339€	52 308 890€	69 491 523€
	2023-2035	152 007 122€	192 481 760€	276 928 869€
	Total	195 848 461€	244 790 650€	346 420 392€
Benefits for **Administrations** for improved restoration of wetlands ecosystems		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	305 535 473€	509 225 788€	712 916 104€
	2023-2035	3 304 825 843€	5 508 043 072€	7 711 260 300€
	Total	3 610 361 316€	6 017 268 860€	8 424 176 405€
Benefits for **Businesses** for reduced maintenance costs and improved safety to water and gas pipeline monitoring		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	236 132 456€	259 883 177	283 633 897€
	2023-2035	459 642 458€	505 786 029€	551 929 600€
	Total	695 774 915€	765 669 206€	835 563 497€
Benefits for **Businesses** for increased revenues due improved offshore wind energy production		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	297 640 464€	671 197 473€	1 594 539 832€
	2023-2035	2 667 479 219€	5 136 945 885€	12 439 213 980€
	Total	2 965 119 684€	5 808 143 358€	14 033 753 812€
Benefits for **Administrations** for reduced toxic emissions and avoided waste of water		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	129 307 747€	304 630 987€	721 073 533€

	2023-2035	1 183 866 008€	2 279 749 145€	5 479 604 183€
	Total	1 313 173 755€	2 584 380 132€	6 200 677 716€
Benefits for reduced cost and increased revenues for Oil and Gas **Businesses**		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	1 667 281 220€	2 576 434 229€	3 621 606 426€
	2023-2035	4 370 149 810€	5 970 020 931€	7 820 912 221€
	Total	6 037 431 030€	8 546 455 159€	11 442 518 647€
Benefit for **Citizens** related to avoided economic losses from climate related extreme weather events		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	6 985 764€	10 478 646€	18 628 705€
	2023-2035	212 547 335€	318 821 003€	564 298 750€
	Total	219 533 100€	329 299 650€	582 927 457€
Benefits for **Citizens** for reduced fatalities caused by urban heat islands		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	3 248 948€	7 025 056€	111 64 453€
	2023-2035	322 864 349€	759 668 646€	1 313 970 471€
	Total	326 113 298€	766 693 703€	1 325 134 924€
Benefits for **Administrations** related to reduced costs of land planning		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	244 947 141€	517 774 444€	1 115 206 496€
	2023-2035	517 034 578€	1 092 918 620€	2 353 978 566€
	Total	761 981 719€	1 610 693 065€	3 469 185 062€
Benefits for **Administrations** to prevent loss of land		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	39 785 766€	119 357 298€	198 928 831€
	2023-2035	93 462 408€	280 387 224€	467 312 040€
	Total	133 248 174€	399 744 522€	666 240 871€
Benefits for protected coastal **population** against natural disasters		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	16 608 730€	44 289 947€	99 652 382€
	2023-2035	35 604 114€	94 944 305€	213 624 686€

	Total	52 212 844€	139 234 252€	313 277 069€
Businesses benefits for protection of agriculture		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	43 365 243€	65 047 865€	86 730 487€
	2023-2035	76 046 150€	115 381 830€	157 342 720€
	Total	119 411 393€	180 429 695€	244 073 208€
Businesses benefits for increased productivity associated with reduced fishing time		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	66 321 188€	99 481 782€	132 642 377€
	2023-2035	251 209 837€	376 814 756€	502 419 675€
	Total	317 531 026€	476 296 539€	635 062 053€
Benefits for **Citizens** for increased productivity associated with harmful algal blooms		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	30 572€	53 502€	76 431€
	2023-2035	208 255€	364 446€	520 638€
	Total	238 828€	417 949€	597 070€
Benefits for **Citizens** for reduced treatment costs associated with jellyfish sting		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	1 510 301€	1 678 113€	1 845 924€
	2023-2035	5 614 170€	6 237 967€	6 861 763€
	Total	7 124 472€	7 916 080€	8 707 688€
Businesses benefits for reduced costs of arctic navigation		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	39 875 316€	75 577 119€	146 902 820€
	2023-2035	485 774 974€	679 577 304€	1 230 168 156€
	Total	525 650 290€	755 154 423€	1 377 070 976€
Businesses benefits for avoided loss of goods during maritime transport		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	12 216 415€	37 143 273€	63 392 065€
	2023-2035	43 144 329€	137 368 716€	256 625 158€
	Total	55 360 744€	174 511 990€	320 017 224€

Businesses benefits for fuel savings reached through optimized navigation routes

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	7 407 471€	11 273 168€	15 420 935€
2023-2035	15 154 885€	24 069 631€	35 911 212€
Total	22 562 356€	35 342 800€	51 332 148€

Benefits for **Administrations** for reduced forest fire area

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	252 258 736€	313 482 401€	374 706 066€
2023-2035	611 866 807€	756 394 901€	900 922 996€
Total	864 125 544€	1 069 877 303€	1 275 629 063€

Benefits for **Administrations** for reduced toxic emissions to reduced forest fire area

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	377 562 406€	468 929 657€	560 296 908€
2023-2035	701 059 539€	865 030 764€	1 029 001 989€
Total	1 078 621 946€	1 333 960 421€	1 589 298 897€

Businesses benefits for reduced economic damages in forestry

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	1 557 849 293€	1 934 837 056€	2 311 824 819€
2023-2035	2 892 621 429€	3 569 178 343€	4 245 735 258€
Total	4 450 470 722€	5 504 015 399€	6 557 560 077€

Businesses benefits for reduced economic damages thanks to flood forecasting

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	1 504 881 572€	2 164 091 906€	2 823 302 239€
2023-2035	10 364 193 681€	14 869 297 368€	19 374 401 054€
Total	11 869 075 253€	17 033 389 273€	22 197 703 293€

Benefits **for Citizens** for avoided fatalities and injuries thanks to flood forecasting

	Pessimistic scenario	Neutral scenario	Optimistic scenario
2017-2022	45 762 911€	64 996 316€	84 229 721€
2023-2035	587 439 190€	844 706 602€	1 101 974 015€
Total	633 202 101€	909 702 918€	1 186 203 736€

Benefits **for Administrations** for avoided fatalities and injuries thanks to improved response

	Pessimistic scenario	Neutral scenario	Optimistic scenario

	2017-2022	3 835 619€	5 447 668€	7 059 716€
	2023-2035	49 236 232€	70 799 108€	92 361 983€
	Total	53 071 852€	76 246 776€	99 421 700€
Benefits for increased revenues for the fishing **industry**		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	277 553€	510 239€	815 269€
	2023-2035	2 362 474€	3 416 939€	4 558 570€
	Total	2 640 028€	3 927 179€	5 373 840€
Benefits **for Administrations** for preservation of fish stocks sustainability on the long term		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	210 558€	387 078€	618 480€
	2023-2035	1 792 221€	2 592 161€	3 458 226€
	Total	2 002 780€	2 979 239€	4 076 706€
Businesses benefits for reduction of casualties in maritime disasters (regular maritime traffic)		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	5 622 341€	52 588 548€	157 077 098€
	2023-2035	309 793 120€	617 700 378€	1 021 243 349€
	Total	315 415 462€	670 288 927€	1 178 320 448€
Benefits **for Administrations** for reduction of casualties in maritime disasters (refugees boats)		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	2 555 268€	16 537 042€	40 953 638€
	2023-2035	67 322 996€	120 044 758€	187 828 213€
	Total	69 878 264€	136 581 801€	228 781 852€
Businesses benefits for reduced economic damage due to oil spills		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	124 869 339€	166 598 150€	214 017 182€
	2023-2035	154 278 285€	203 226 984€	257 773 955€
	Total	279 147 625€	369 825 134€	471 791 138€

Administrations benefits for reduced environmental damage due to oil spills		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	59 461 590€	79 332 452€	101 912 943€
	2023-2035	73 465 850€	96 774 754€	122 749 502€
	Total	132 927 440€	176 107 207€	224 662 446€
Administrations benefits for increased interception of illegal goods (border surveillance)		Pessimistic scenario	Neutral scenario	Optimistic scenario
	2017-2022	2 255 210€	3 847 300€	5 737 184€
	2023-2035	11 223 203€	14 210 001€	17 488 151€
	Total	13 478 413€	18 057 301€	23 225 336€

ANNEX V. STAKEHOLDERS CONSULTATION - SYNOPSIS REPORT

Call for evidence Mid-term evaluation of the Space Programme[105]

The Commission launched a call for evidence (consultation) to gather stakeholders' views on the functioning of the Programme and the performance of EUSPA. It has been promoted via the Commission's official social media networks in addition to its publication on the Have Your Say portal. The Commission used the results of the call for evidence to feed the evaluation and the preparation of the SWD and Report.

The consultation run from 12 October 2023 to 16 November 2023. Overall, this consultation can be considered comprehensive, as it has received 23 responses from the largest and most representative associations in the sector, representing over 150 members from numerous countries.

It is important to highlight that the respondents praised the EU for its accomplishment in implementing an ambitious programme despite challenging economic conditions.

The respondents have emphasized that the majority of the Programme is flown down to the industry through contracts that have insufficient flexibility (especially in light of high inflation- Hyperinflation). They have also expressed a need for greater longer-term visibility in the industrial procurement of the Programme.

Respondents have also urged the Programme to improve its resilience and non-dependence from third countries to secure strategic autonomy in critical areas such as raw materials, and critical technologies as well as the protection of space assets, as also recognized by the March 2023 EU Space Strategy for Security and Defence. The respondents recognise that increased funding in Europe is needed to translate into reality the concept of European strategic autonomy. Regarding the protection of space infrastructures, a higher attention should be given to Space Situational Awareness (and invest more into Space Weather) and to pursue synergies between "defence" and "space" through dual-use activities. The respondents also called for synergies were with other EU initiatives such as Destination Earth. Overall, the Programme was encouraged to further expand and strengthen its engagement into international relations.

Respondents from the public sector, who operate within limited budgets, emphasized the importance of keeping data and services free of charge.

Respondents also asked for measures to strengthen the space industry, ensure its competitiveness, and promote a "buy EU" procurement strategy.

[105] Call for Feedback for the Mid-Term Evaluation of the Space Programme

Beyond developing capabilities, the respondents emphasised the need for the European Union, including through the EU Space Programme, to must better leverage its regulatory strengths and considerable market size to foster the demand for new space services. For examples, in reference to policies related to the Programme, respondents highlighted the need to embed/integrate positioning services into rail transport, like what has already been done for air transport. They also stressed the need to further integrate the services of the Programme in the climate and ocean conservation policies.

Some individual responses have highlighted the importance of improving services for the outermost regions of the EU, and one respondent proposed that the Earth observation needs of the Programme should rely exclusively on third-party data purchases.

Additionally, responding SMEs have welcomed the special focus of the Space Programme on them, particularly in terms of procurement and subcontracting.

Finally, some feedback from citizens has shown a limited expertise and understanding of the Programme, with comments largely falling outside the scope of the consultation. However, it is noteworthy that there was an encouragement for the Programme to invest in outer-space exploration.

In addition to the Call for Evidence, questionnaires and interviews were sent (bilaterally) to the Agencies to whom the Space budget was entrusted. Furthermore, to identify gaps in user needs for Copernicus, several interviews were carried out with representatives from the expert group of the Programme Committee (Copernicus User Forum).

The evaluation also relies on consultations with the Commission services (Inter- Service Group on Space), dedicated meetings with the Space Programme Committee's different configurations and a meeting with representatives of the industry in the framework of the Commission Expert Subgroup on Policies & Programmes relevant to EU SDA Industry SDA, particularly on the topic of new ways of doing space procurement. The presentations in the Space Programme Committee were welcome but did not trigger but did not produce relevant comments, but more request for clarifications on the content.

Commission Expert Subgroup on Policies & Programmes relevant to EU SDA Industry, meeting of the 16 of November 2023[106]

The Members (list below) of the subgroup were asked to discuss about the "New way of doing space procurement", around the following guiding questions:

In your view, which factors contribute most to the difficulties in complying with contractual schedules and Programme plans and what measures could be implemented so that the Programmes' roadmaps could be reliable in the horizon of 3-5 years?

[106] Documents for the Fourth Meeting Commission Expert Subgroup on Policies & Programmes Relevant to EU Space Industry

Possible topics could include the improvement of: ways of making procurements; ways to estimate and account for risks in the original schedules; structuring of procurement lots; relations with the industry.

At the meeting of the 16 of November 2016 of the SDA Expert Group, the Commission presented an update on several recent initiatives, such as the Copernicus Dynamic Purchasing System, the Flight Ticket Initiative or the Public-Private Partnership approach of IRIS2, aimed at making the procurement process simpler, more agile, and allowing for on-boarding new actors. In addition, the Commission outlined some issues with the current procurement processes which often result in delays and over-costs. The Commission presented a list of questions to the industry to start the discussion.

The Members of the Expert Group identified changes in security requirements introduced during the execution phase as one of the main contributors to delays and over-costs. Additionally, public procurement projects relaying on technologies at a low maturity level which further complicates the process. The intervening Members suggested that sometimes there is overspecification in the procurements from the public sector and that procurements could set only mission and service requirements and leave the system requirements and design to the industry (likely in dual or triple source) for a final selection before implementation. This approach could be further strengthened by having two or more contractors competing at the design stage. Some Members added that the inclusion of startups and scaleups in the implementation of the EU space programme components can also contribute to the issues. Furthermore, in case a procurement process has more than one client or interlocutor (e.g., EUSPA and ESA) the problems with coordination between the public entities can cause delays for the private sector. In addition, the Members recognised that contrary to the recent years' tendency of cost reduction, now the focus was on timely delivery and hence suggested that the public sector should prioritise quick deliveries even to the expense of quality risks (which could be corrected in evolutions). Moreover, some Members consider that space procurements are unique and sometimes the Financial Regulation is not fit for purpose. The Members of the Expert Group added that a better understanding of the Commission political goals and expectations would allow them to better implement public contracts. Access to qualified workforce and insufficient budgets of public projects were additional problems identified by the Members. Nonetheless, the Members underlined, that given the challenging circumstances and global competition the EU Space Programme was still a success. Other interventions suggested broadening the Dynamic Purchasing system from only data to services as well, and establishing a system through which the Commission could report to the industry on the statistics related to its space procurement processes. Lastly, the Members highlighted that some of the contractual schedules are too ambitious from the outset but that the industry is cautious in negotiating on this point in order to not lose the public contracts.

The Commission took good note of the Members interventions, which provide food for thought in the preparations of the future space programme regulation. It recognised that public procurement processes are often exceedingly risk-averse but reassured the

Members that it is something that it was working on. The Commission recognised the importance of skills and education policy, budget for R&D activities to achieve mature technologies to implement and stressed that it was working on it, within the limits of its competence.

In addition, in the same meeting the Commission presented the preliminary results of the mid-term review of the Regulation. The Members of the Expert Group inquired whether the Article 24 of the Regulation would be under review as well. The Commission replied that the study was based on already established KPIs, looking at past activities and budget implementation. The Commission will reflect upon all provisions of the Regulation when the drafting the next one.

ANNEX VI: COHERENCE AMONG EU SPACE COMPONENT

Segments	Subsegments	Applications	GNSS	EO	Synergy
Agriculture	Environmental monitoring	Carbon capture & content assessment		x	
		Environmental impact monitoring		x	
	Natural resources monitoring	Biomass monitoring			x
		Crop yield forecasting			x
		Soil condition monitoring			x
		Vegetation monitoring		x	
	Operations management	Asset monitoring	x		
		Automatic steering	x		
		CAP monitoring			x
		Farm machinery guidance	x		
		Farm management systems			x
		Field definition			x
		Livestock wearables	x		
		Pastureland management		x	
		Precision irrigation			x
		Variable rate application			x
	Weather services for agriculture	Climate services for agriculture		x	
		Weather forecasting for agriculture		x	
Aviation and drones	Communication	ATM System Timing	x		
	Environmental Monitoring	Aircraft Emission Measurement and Monitoring			x
		Particulate Matter Monitoring		x	
	Navigation	Drone navigation			X
		Performance Based Navigation (PBN)	x		
		VFR complement	x		
	Operations Management	Aircraft Maintenance and Operation Optimisation		x	
		Airport Capacity and Safety, Monitoring Terrain		x	
		Obstacles near an Airport			X
	Surveillance	Electronic Conspicuity	x		
		GADSS	x		
		Infrastructure Timing	x		
	Weather Services	Hazardous Weather Identification		x	
Biodiversity, ecosystems, and natural capital	Animal tracking for biodiversity purposes	Animal tracking for biodiversity purposes	x		
	Coastal ecosystems monitoring	Coastal ecosystems monitoring		x	
	Snow and ice ecosystems monitoring	Snow and ice ecosystems monitoring		x	
	Terrestrial ecosystems monitoring	Terrestrial ecosystems monitoring		x	
	Water ecosystems monitoring	Water ecosystems monitoring		x	
Climate services	Climate change mitigation and adaptation	Climate change mitigation and adaptation		x	

Segments	Subsegments	Applications	GNSS	EO	Synergy
	Climate modelling	EO-based climate modelling		x	
		GNSS-based climate modelling	x		
	Climate monitoring and forecasting	Climate monitoring		x	
		Climate forecasting		x	
Consumer solutions, tourism and health	Corporate	Billing	x		
		Geo-advertising			x
		Mapping & GIS			x
		Satcom users	x		
		Workforce management	x		
	Health & Lifestyle	Air quality monitoring		x	
		Games			x
		Geo-tagging			x
		mHealth	x		
		Safety and emergency	x		
		Social networks	x		
		Sport, fitness and wellness incl. specialist support tracking	x		
		UV monitoring		x	
	Navigation & Tracking	Navigation	x		
		Personal & asset tracking	x		
		Visually impaired support	x		
	Robotics	Consumer robotic	x		
		Enhanced human	x		
	Tourism	Points of interest	x		
Emergency management and humanitarian aid	Early warning	Early warning			x
		GNSS-related ocean monitoring buoys	x		
	Migration and settlement	EO human displacement monitoring		x	
		Management of refugee camps			x
		Population counting		x	
		Telematics for Humanitarian Aid	x		
	Post-event analysis	Post-event analysis			x
	Preparedness	Preparedness			x
	Rapid mapping	Rapid mapping			x
	Search and Rescue	Beacons for Aviation	x		
		Beacons for Land	x		
		Beacons for Maritime	x		
		Situational awareness supporting search and rescue		x	
Energy and raw materials	Energy Network Fidelity	Energy Network conditions monitoring		x	
		Phasor Measurement Units (PMU)	x		
	Environmental Impact Monitoring	Environmental impact assessment of energy and mineral resources plants		x	
	Market Intelligence	Supply chain insights		x	
	Raw Materials	Illegal mining monitoring		x	
		Mining machinery guidance	x		
		Mining Surveying			x
		Site selection, planning and monitoring for raw materials			x
	Renewable Energy	Renewable energy assessment potential and forecast		x	

Segments	Subsegments	Applications	GNSS	EO	Synergy
		Power plant design optimisation		x	
		Risk assessment for energy assets		x	
		Site selection, planning and monitoring for renewable energy		x	
Environmental monitoring	Environmental auditing	Environmental auditing		x	
	Environmental resources management	Environmental resources management		x	
	Impact studies and ESG	Impact studies and ESG		x	
Fisheries and aquaculture	Aquaculture	Aquaculture operations optimisation			x
		Aquaculture site selection		x	
	Fisheries	Illegal, unreported and unregulated fishing (IUU) control			x
		Catch optimisation		x	
		Fish stock detection		x	
		Fishing aggregating devices	x		
		Fishing vessels navigation	x		
Forestry	Environmental monitoring	Biomass monitoring			x
		Deforestation/degradation monitoring		x	
	Natural resources monitoring	Forest Inventory monitoring			x
		Forest vegetation health monitoring		x	
		Illegal logging monitoring		x	
	Operations management	Automatic steering	x		
		Forest asset management	x		
		Forest exploitation certification		x	
		Forest machinery guidance	x		
Infrastructure	Environmental Impact Monitoring	Environmental impact assessment of infrastructure		x	
	Infrastructure Construction and Monitoring	Construction Operations			x
		Monitoring of impact of human activities on infrastructure		x	
		Oracle Database Appliance (ODA) Support Monitoring		x	
		Pipeline Monitoring			x
		Post-Construction Operations			x
	Infrastructure Planning	Infrastructure Site Selection and Planning			x
		Permitting		x	
		Vulnerability Analysis		x	
	Timing & Synchronisation of Telecommunication Networks	Data Centre	x		
		Digital Cellular Network (DCN)	x		
		Professional Mobile Radio (PMR)	x		
		Public Switched Telephone Network (PSTN)	x		
		Satellite Communication (SATCOM)	x		
		Small Cells	x		
Insurance and finance	Finance	Commodities trading		x	
		Risk assessment		x	

Segments	Subsegments	Applications	GNSS	EO	Synergy
		Timing and synchronisation for finance	x		
	Insurance for natural disasters	Event footprint		x	
		Index production		x	
		Risk modelling		x	
Maritime and inland waterways	Environmental monitoring	Marine pollution monitoring		x	
	Inland waterways	Inland waterways navigation			x
	Maritime engineering	Marine surveying and mapping			x
		Dredging			x
	Merchant vessels	Collision avoidance (AIS)	x		
		GNSS vessel engine management systems	x		
		Merchant navigation	x		
		Navigation through sea ice			x
		Ship route optimisation			x
	Ocean services	Metocean		x	
	Ports	GNSS automated port operations	x		
		Piloting assist at ports			x
		Port safety			x
		Port security		x	
		Ports	x		
	Recreational craft	Recreational navigation	x		
	Vessel tracking	Dark vessel monitoring			x
Rail	Attractiveness enhancement	Passenger information systems	x		
		Public Transport – Tram and Light Rail	x		
	Maintenance improvement	Condition-based maintenance	x		
		Infrastructure monitoring		x	
		Predictive maintenance	x		
	Safety related	Enhanced Command & Control Systems	x		
		Trackside personnel protection systems	x		
	Train driving optimisation	Driver Advisory Systems (DAS)	x		
		Fleet management	x		
Road and automotive	Fleet management systems	Bike sharing	x		
		Public transport - buses	x		
		Road fleet management	x		
	Liability	Insurance telematics	x		
		Road User Charging (RUC)	x		
		Smart tachographs	x		
	Safety related	Connected and Automated Driving (CAD)	x		
		Emergency assistance	x		
	Smart mobility	Congestion control			x
		Driving comfort			x
		Navigation – In-Vehicle Systems (IVS) & Personal Navigation Devices (PND)	x		
Urban development and cultural heritage	Environmental Monitoring	Air quality monitoring in urban environments		x	
		Light pollution		x	
		Thermal auditing		x	
		Urban greening			x

Segments	Subsegments	Applications	GNSS	EO	Synergy
		Urban heat islands		x	
	Smart Cities Operations	Smart streetlights	x		
		Smart waste management	x		
	Urban planning and monitoring	Cultural heritage monitoring		x	
		Informal dwellings		x	
		Real estate		x	
		Surveying and mapping of urban areas			x
		Urban modelling			x
		3D modelling, Digital Twins, Urban planning		x	
Space	Acting/Supporting Mission Payloads	Technology Demonstration (TechD)	x		
		Scientific & Operational Missions (SOM)	x		
	Deep Space Applications	Lunar Transfer Orbit (LTO)	x		
	Navigation and Control (GNC) Subsystem	Attitude Determination (AD)	x		
		Precise Orbit Determination (POD)	x		
		Space Timing and Synchronisation (S-T&S)	x		

ANNEX VII. OVERVIEW OF THE PROGRAMME'S ACHIEVEMENTS TOWARDS SDGS GOALS

SDG 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

The information by Copernicus CLMS is highly valuable for agricultural activities, monitoring crop conditions, providing early warnings on failing crops and predicting crop yields (food security). Given that agriculture is a vital economic activity worldwide, supporting livelihoods and employment for many, these monitoring activities have the potential to reduce hunger.

SDG 3 Ensure healthy lives and promote well-being for all at all ages

Copernicus (CAMS) provides global and European air quality forecasts using satellite observations, which are used by various entities for decision-making and informing the public. The Programme's components Copernicus and Galileo, are crucial for the development of smart health services, which use in situ data and other technologies like 5G and AI. These technologies enable new applications for consumer apps, patient monitoring, and emergency response systems like eCall, which is estimated to save lives and reduce injuries in road accidents.

SDG 6 Ensure availability and sustainable management of water and sanitation for all

Copernicus CLMS provides real-time information on global inland water bodies and their characteristics, supporting various applications related to food security, sanitation, energy, health, transport, biodiversity preservation, and natural risk management. Space technologies, particularly Copernicus services, are also crucial for optimizing water processing operations and providing early warning systems for water quality deterioration. These technologies assist water managers in dealing with water allocation, flood management, ecological status, and industrial water use, helping them adapt strategies to mitigate the effects of climate change.

SDG 7 Ensure access to affordable, reliable, sustainable and modern energy for all

Copernicus and Galileo data improve the resilience and efficiency of energy infrastructure, enhance the production of renewable energies, and support the implementation of smart grids for improved energy efficiency and synchronization. Moreover, Copernicus provides forecasts of desert dust and other aerosols for solar power plants and climate indicators for electricity consumption and renewable energy production in Europe, aiding in investment decision-making. In addition, Galileo's authentication services contribute to a more resilient infrastructure with better synchronization and power system monitoring.

SDG 11 Make cities and human settlements inclusive, safe, resilient and sustainable and SDG 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage.

Galileo & EGNOS technologies improve city services and infrastructure, as positioning and timing information is essential instance e.g., for operating and managing public transportation, power supply, connectivity, or waste management. Copernicus provides crucial information for emergency response, urban planning, and monitoring of cultural heritage affected by natural disasters. Floods and earthquakes pose significant challenges to cities, and these technologies help in managing and mitigating these risks.

SDG 13 Take urgent action to combat climate change and its impacts

Copernicus through C3S routinely monitors the Earth's climate and its evolution, providing routine access to key indicators on several Essential Climate Variables (temperature, sea-ice, CO2, etc.) and is therefore a powerful tool to monitor the success of the implementation of the Paris Agreement. These climate indicators will also support European adaptation and mitigation policies in a number of economic sectors. Galileo's SAR service helps reduce response times and save lives during extreme weather events and natural disasters.

SDG 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Copernicus CMEMS uses satellite and in situ observations to monitor the Arctic Ocean supports fisheries control, contributing to sustainable fisheries goals. The service provides data for monitoring sea-ice, temperature, and salinity changes, and uses Galileo for vessel positioning to combat illegal fishing practices. In the EU, about 9 000 fishing vessels are equipped with a satellite-based device (VMS) providing data to fishery authorities to support enforcement efforts.

SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

The Programme's technologies, in particular Copernicus' CLMS and Galileo-enabled drones, aid in understanding and protecting wildlife and forests through detailed land cover and land use information, mapping protected areas, and supporting biodiversity conservation and climate modelling. These technologies also support smart farming, leading to decreased resource consumption while increasing production.