

Special Report

EU space programmes Galileo and Copernicus:

services launched,
but the uptake needs a further boost



EUROPEAN
COURT
OF AUDITORS

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Executive summary

I The global navigation satellite system Galileo and the Copernicus Earth observation programme are flagships of the EU space policy. They enable more accurate navigation and timing and deliver valuable data about the Earth, and help monitor the environment, land and oceans. The programmes entail significant and long-term costs for the EU budget, which up to the end of 2020, totalled around €18 billion.

II In its 2016 Space Strategy for Europe, the Commission committed to better exploiting the potential of the EU space programmes, by maximising their benefits for society and the EU economy. It set up and funded dedicated actions to encourage the use of space services, data and applications and committed to ensuring that EU legislation supported the uptake of space services, where justified and beneficial.

III Our audit assessed the measures taken by the Commission since 2014 to promote the uptake of services derived from the EU space programmes Galileo and Copernicus, towards achieving the expected economic and societal benefits. We examined whether the Commission (a) developed a comprehensive and forward-looking strategy for promoting the uptake of services, including all relevant actors, (b) set up sound systems to assess the benefits of these services and monitor the achievements of strategic objectives of the programmes, (c) funded actions that contributed effectively to a measurable uptake of services, and (d) took appropriate measures to create a regulatory framework, supportive of the uptake of space services.

IV This audit sought to assess the effectiveness of the measures taken by the Commission to promote the uptake of space services. We expect that our audit results and recommendations will add value by helping the Commission to promote effectively the uptake of EU space services in the new multiannual financial framework 2021-2027, and to monitor better the achievement of the programmes' objectives.

V Our overall conclusion is that the EU space programmes Galileo and Copernicus provide valuable services and data, which the Commission promoted in various ways but it has not done enough to harness the full potential of the programmes and capitalise on the significant investment made to achieve the expected benefits.

VI Galileo services already enhance the accuracy of navigation and there is good use of Copernicus data in monitoring of some EU policies, but the Commission has no comprehensive strategy yet for promoting the uptake of the EU space programmes that includes all relevant actors and entities at EU and Member State level.

Furthermore, its approaches for supporting the uptake are only partly linked to specific, measurable, accepted, realistic and time-bound strategic objectives that clearly explain what should be achieved.

VII The Commission has not addressed the fragmented nature of the services markets in its own approach and has only received little information on the significantly diverging Member State strategies and approaches in using the services in their administrations and in supporting uptake.

VIII There is no generally recognised conceptual statistical framework in the EU for estimating the benefits of space services and the Commission's estimations have shortcomings in terms of methodology and coverage. This makes it challenging to reliably estimate the benefits of the programmes. Key performance indicators used provide only basic information and do not measure the achievement of main objectives of the programmes.

IX The Commission's actions aimed at supporting the development of new technologies in navigation, access to and use of Copernicus data, raising awareness about the programmes, and market uptake. However, the objectives and the impact of several key actions were not clear and the potential for synergies is not being exploited yet. Moreover, key features of Galileo are not yet available, which may hamper its ability to gain the market for these services.

X The Commission adopted regulations in road safety and emergency services to facilitate the uptake of Galileo, but there is still little action in other areas or market segments. There is also no comprehensive analysis conducted yet to identify where the use of Copernicus could be better promoted in EU legislation. The Commission and Member States have also no systematic overview of regulatory or administrative barriers that may inhibit the use of space services.

XI In order to better exploit the potential of the EU's space programmes, the Commission should:

- (a) develop a comprehensive strategy for supporting the uptake of EU space services;
- (b) develop a conceptual framework for estimating the benefits of the EU space programmes and improve performance measurement;

- (c) ensure full readiness of Galileo, and better targeted action on uptake of the EU space services; and
- (d) use the regulatory framework better to support the uptake of EU space services.

Introduction

The EU space programmes

01 In the 1990s, the European Union became involved in the development of space programmes. The initial reason for this initiative was to provide satellite-based radio navigational support to the Trans-European transport networks. In addition, there was a need for a global satellite-based Earth observation system to provide information on the environment, to understand and to mitigate the effects of climate change, and to ensure civil security.

02 Currently, the EU has three flagship space programmes:

- **Galileo** is a civil global navigation satellite system (GNSS). Started in 1999, the programme aims at providing very precise navigation and time signals independent from other existing systems. Currently, there are 26 satellites in orbit. Since 2016, Galileo provides initial services: an open signal for high-volume satellite radio navigation applications such as motor vehicle navigation or mobile telephone services, a “public regulated service” (PRS) for governmental users in the area of security and defence, and a search and rescue service, which helps to faster locate and save people in emergency situations. More services are planned to be available in the next few years; a second generation of Galileo with new features is already under preparation and the first satellites are foreseen to be launched as from 2024.
- **EGNOS**, the European Geostationary Navigation Overlay Service, provides, since 2009, navigation services to aviation, maritime, and land-based users by enhancing the accuracy of data from the American Global Positioning System (GPS). EGNOS consists of three geostationary satellites and 40 ground stations¹.
- **Copernicus** aims to provide accurate and reliable Earth observation information in the field of the environment, agriculture, climate, security, maritime surveillance and other EU policies. It is the world’s largest programme of its kind and is the EU’s contribution to the Global Earth Observation System of Systems (GEOSS)².

¹ The rules for both EGNOS and Galileo are set out in Regulation (EU) No 1285/2013 of 11 December 2013 on the implementation and exploitation of European satellite navigation systems, OJ L 347, 20.12.2013, p. 1.

² The Copernicus programme was established by Regulation (EU) No 377/2014 of 3 April 2014, OJ L 122, 24.4.2014, p. 44, building on the previous EU Earth monitoring

Copernicus became operational with the launch of its first satellite in 2014. Currently, it has eight satellites (“Sentinels”) in orbit, with additional Sentinels to be launched in the future.

03 The deployment and the operation of the EU satellite systems entails significant and long-term costs for the EU budget. From the start of the programmes until the end of 2020, total EU expenditure amounted to more than €18 billion. Galileo and EGNOS are fully financed from the EU budget³. The Copernicus programme is financed approximately two thirds by the EU budget, with the European Space Agency (ESA) and other third parties contributing the remainder of its costs.

04 The operation of the satellite systems and the deployment of new satellites will also entail significant costs for the EU budget in the future. The new single space programme starting in 2021, which accommodates the existing flagship programmes, will entail a budget of more than €14 billion for financing the operations of Galileo, EGNOS and Copernicus and their further evolution up to 2027⁴.

The value chain of the EU space programmes

05 All three flagship programmes are primarily justified by the EU’s need for independent access to space services providing information on navigation, timing and Earth observation data. The services provided by these programmes should also promote the growth of markets for GNSS and Earth observation-based applications and services within and beyond the EU Internal Market. This should also lead to new market opportunities and support the Europe 2020 strategy and its objectives of smart, sustainable and inclusive growth⁵.

initiative GMES established by Regulation (EU) No 911/2010 of 22 September 2010, OJ L 276, 20.10.2010, p. 1.

³ For more details see [Annex I](#).

⁴ Proposal for a Regulation of the European Parliament and of the Council establishing the space programme of the Union and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU, COM/2018/447 final, 6.6.2018.

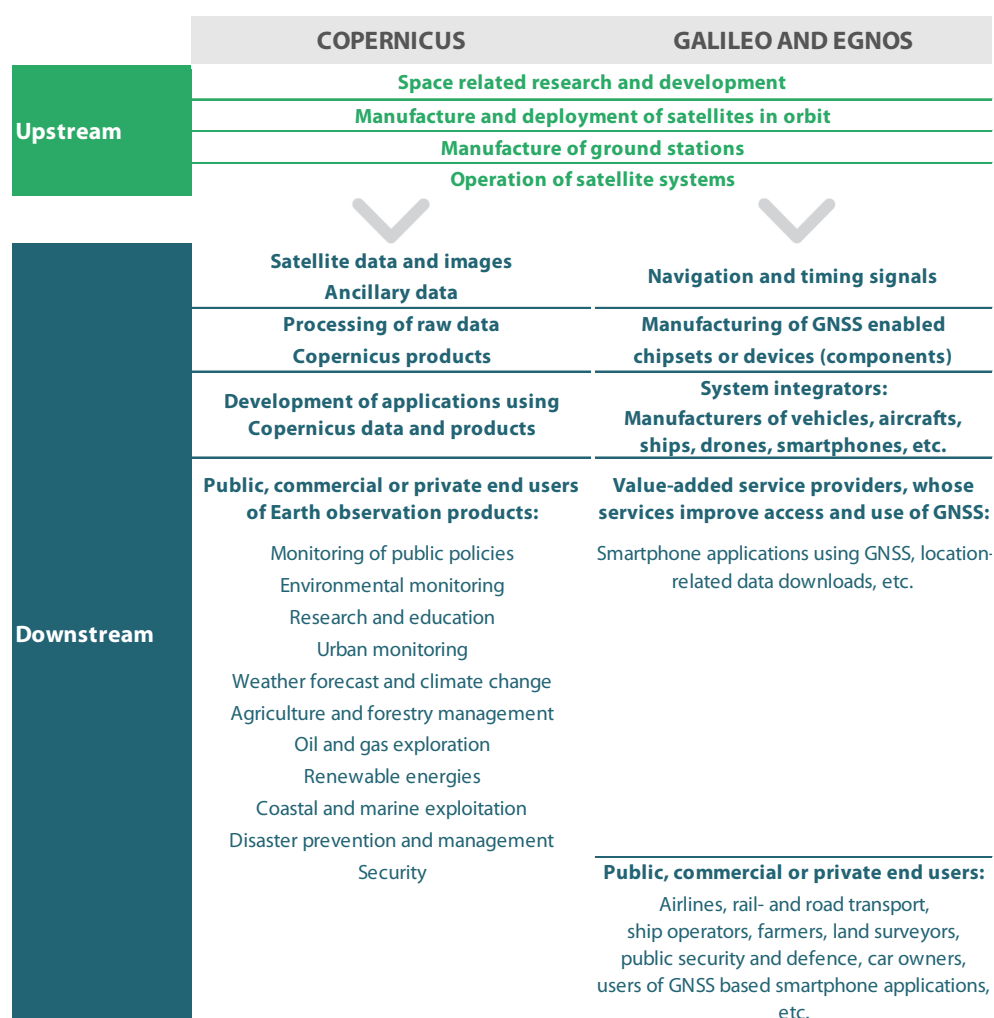
⁵ See Article 2 of Regulation (EU) No 1285/2013 and Article 4(1) of Regulation (EU) No 377/2014.

06 In the value chain for space activities there is usually a distinction between:

- o the upstream sector that covers activities leading to the development of space infrastructure, the production of satellites and ground stations, the deployment in space and their operation; and
- o the downstream sector, which covers the acquisition and storage of space data, the development of products or services using signals or satellite image data (intermediate users), and the end users who use navigation, timing services or Earth observation applications in their businesses or daily lives⁶.

Figure 1 shows this value chain for the EU space programmes.

Figure 1 – Value chain of the EU space programmes



Source: ECA.

⁶ See, for example, OECD (2007), *The Space Economy at a Glance 2007*, OECD Publishing.

The Commission's 2016 Space Strategy for Europe

07 To give a long-term vision for a European space policy⁷, in 2016, the Commission adopted its Space Strategy for Europe. In view of the significant investments made in the space infrastructure and the significant operating costs they entailed, one of the four strategic goals defined in the strategy was to better exploit the potential of the EU space programmes by maximising their benefits for society and the EU economy. Starting from the already existing framework for the EU space programmes, the Commission committed in its strategy, to encourage the use of space services, data and applications in EU policies, whenever they provide effective solutions⁸. It also committed to ensure that EU legislation supported the uptake of space services where justified and beneficial, in line with accompanying measures at national and regional level. The European Parliament supported these commitments in two resolutions⁹.

08 Dedicated EU funding to support uptake was made available under the space programmes or as part of the EU Horizon 2020 Framework Programme for Research and Innovation¹⁰. In total, for the period 2014-2020, around €565 million was committed by the Commission, the European Global Navigation Satellites Agency (GSA), and the Copernicus entrusted entities. *Figure 2* shows a breakdown of this amount per entity and programme.

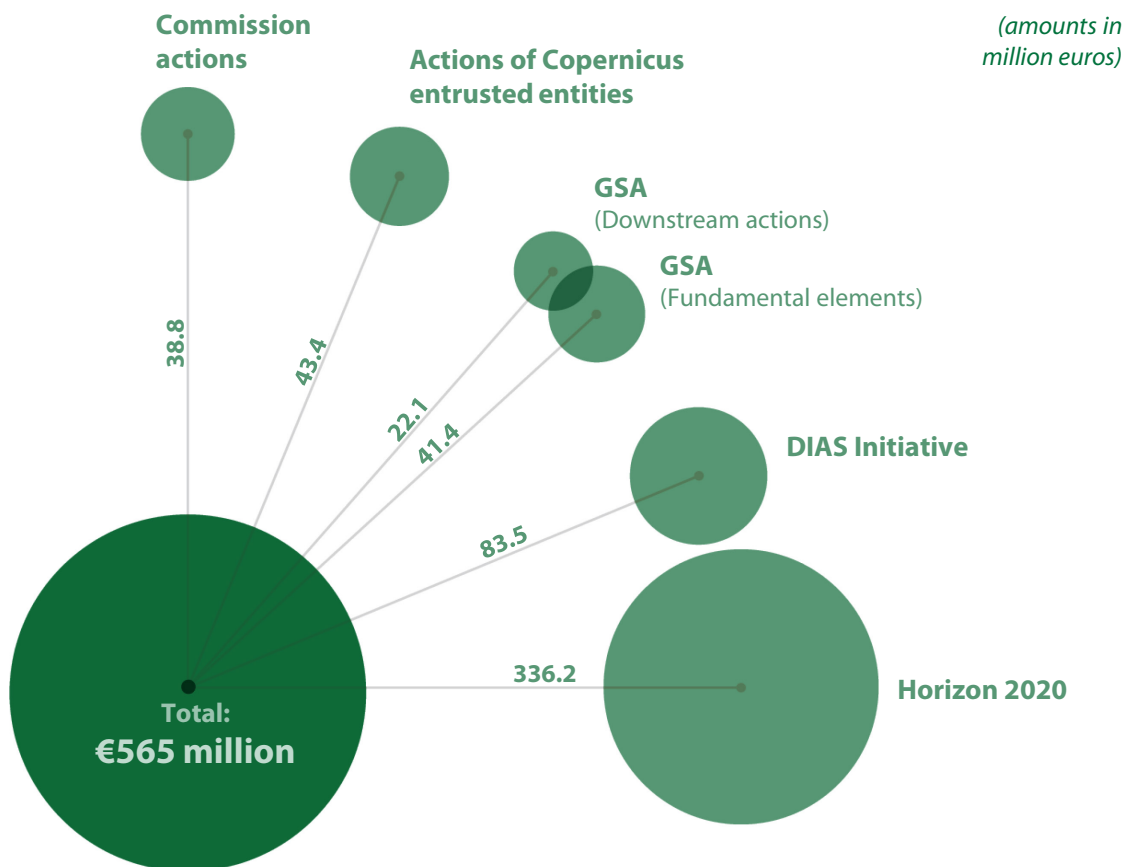
⁷ Article 189 of the Treaty on the Functioning of the European Union, OJ C 326, 26.10.2012, p. 47.

⁸ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions of 26.10.2016: Space Strategy for Europe; COM(2016) 705 final.

⁹ European Parliament resolution of 8 June 2016 on space market uptake (2016/2731(RSP) and of 12 September 2017 on a Space Strategy for Europe (2016/2325(INI)).

¹⁰ Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC; OJ L 347, 20.12.2013, p. 104.

Figure 2 – Budget for supporting uptake of EU space services (2014-2020)



Source: ECA, based on Commission data (amounts committed by 30.6.2020).

Management of the EU space programmes

09 The Commission, the ESA, and various other EU and non-EU entities share the management of the EU space programmes in cooperation with Member States.

The role of the Commission

10 The Commission has overall responsibility for the EU space programmes. It supervises their implementation and prepares the annual Galileo and Copernicus work programmes. It also manages directly some of the actions supporting the uptake of Galileo and Copernicus services.

11 For both programmes, the Commission chairs a committee composed of Member State representatives and delegates from the entities directly involved in the programmes, to ensure their coordination. For Copernicus, a specific working group (the “User Forum”) assists the Committee in identifying user requirements, verifying service compliance and coordinating public sector users.

The role of the European Space Agency

12 The ESA is an intergovernmental organisation established in 1975 with extensive expertise in the space domain¹¹. While it is not an EU body, it plays an essential role in EU programmes, providing expertise in the technical coordination of the programmes and the design, development, procurement and operation of satellite systems¹². In parallel, the ESA has its own programmes that support the development of positioning, navigation and timing technologies that use signals from GNSS and that promote the use of Earth observation in science or business applications.

The role of the European GNSS Agency

13 The GSA, an EU agency, is responsible for supervising infrastructures, ensuring the delivery of the services, and monitoring and developing markets for Galileo and EGNOS. It also managed the Fundamental Elements programme that supported the development of market-ready chipsets, antennas and receivers used for Galileo and EGNOS, and projects under the EU Horizon 2020 programme for these two systems. Under the new space programme, a new European Union Agency for the Space Programme (EUSPA) will replace and succeed the GSA. Among its responsibilities is promoting the uptake of Galileo, EGNOS and Copernicus services.

The Copernicus entrusted entities and their services

14 The Copernicus programme consists of three components whose management was entrusted to various EU and non-EU entities (see *Figure 3*):

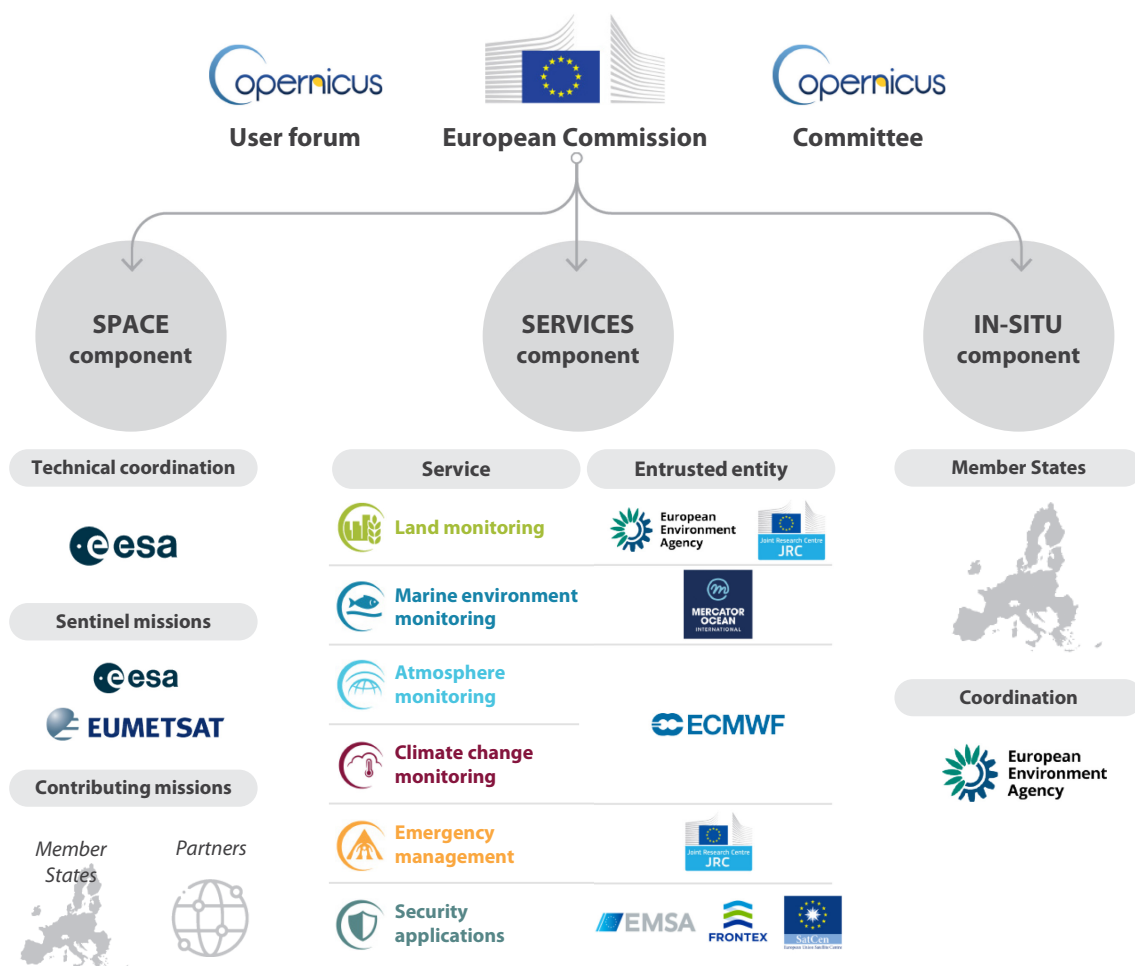
- o technical coordination, the operation of the Sentinel satellites and of contributing missions of the ESA, Member States or other international partners (“space component”), and making available raw data. This is shared between the ESA and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), another non-EU organisation. EUMETSAT will also operate the future Sentinel missions 4, 5 and 6;
- o the provision of the Copernicus services (“service component”), and

¹¹ Member States of the ESA are Belgium, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Luxembourg, Hungary, the Netherlands, Austria, Poland, Portugal, Romania, Finland and Sweden, and, as non-EU Member States, Norway, Switzerland and the United Kingdom. Latvia and Slovenia are associate members.

¹² Article 15 of Regulation (EU) No 1285/2013 and Article 10 of Regulation (EU) No 377/2014.

- the collection of ancillary data from ground-based, sea-borne or air-borne monitoring systems (“in-situ component”), for which either the Member States are responsible or which come from volunteer contributors.

Figure 3 – Copernicus components and services



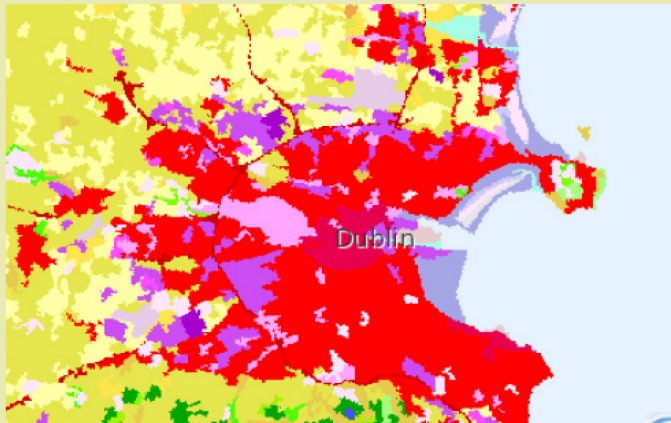
Source: European Commission.

15 The Copernicus services are data products or applications related to land, marine environment, atmosphere and climate change monitoring, emergency management, and security applications. They are a combination of the raw data from the Sentinels, from other satellites and ancillary data. There are more than 500 such products and their number is constantly evolving (see examples in [Box 1](#)). The users of the raw data and the products are primarily experts who combine them with other data. They use them in research or transform them into applications for end users, such as public authorities, businesses or consumers. Copernicus data and services are financed by the Programme, but provided free of charge and should, as a rule, not interfere with commercial service offers.

Box 1

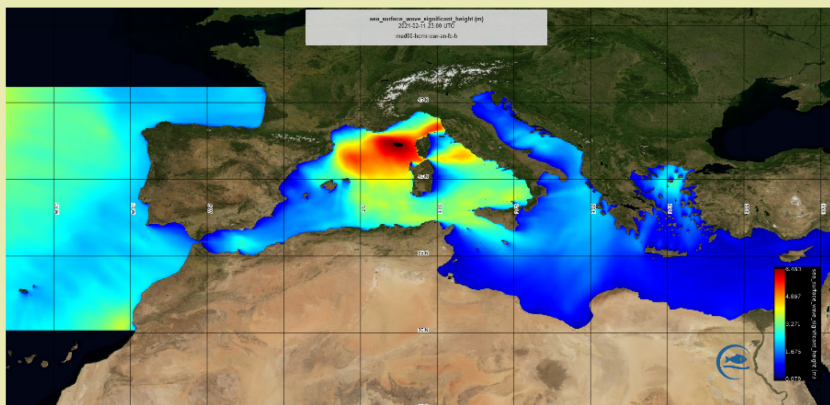
Examples of Copernicus products

CORINE Land Cover (CLC)



The CLC provides harmonized land cover and land use information for all Member States. CLC data are, for example, used to develop applications or analyses supporting urban or spatial planning, or for geospatial products such as navigation software.

Mediterranean Sea Waves Analysis and Forecast



The product provides a wave analysis and wave forecasts for the Mediterranean Sea. Data are, for example, used for applications supporting port authorities, search and rescue missions, or commercial ship operators.

Sources: Copernicus Land Monitoring Service, Copernicus Marine Service.

The role of Member States

16 Member States play an important role in the uptake of EU space services. They work in partnership with the EU and the other entities but can adopt their own space

strategies or programmes and conduct their own actions to support the uptake of services provided by the EU space programmes. They have no obligation to coordinate these with the Commission. The Galileo PRS (see paragraph 02) directly addresses the needs of national authorities. Together with EU or other international institutions and bodies, European national, regional or local authorities entrusted with the definition, implementation, enforcement or monitoring of a public service or policy are the “core users” of Copernicus¹³.

¹³ Article 3(9) of Regulation (EU) No 377/2014.

Audit scope and approach

17 The audit sought to assess the effectiveness of the measures taken by the Commission to promote the uptake of services derived from the EU space programmes, towards the achievement of expected economic and societal benefits provided by these services.

18 In particular, we examined whether the Commission:

- (a) developed a comprehensive and forward-looking strategy for promoting the uptake of services provided by the EU space programmes, including all relevant actors;
- (b) set up sound systems to assess the benefits provided by the EU space programmes and monitor the achievements of strategic objectives;
- (c) took effective action to increase the uptake of services; and
- (d) took appropriate measures towards the creation of a regulatory framework, supportive of the uptake of services provided by Copernicus and Galileo.

19 The results of this audit and the recommendations will add value by helping the Commission to promote more effectively, in the new multiannual financial framework 2021-2027, the uptake of space services provided by the Galileo and Copernicus space programmes and to better monitor the achievement of the related objectives associated with the programmes.

20 In this framework, we reviewed the approaches and actions taken by the Commission, the GSA and the Copernicus entrusted entities, in supporting the uptake of the services provided by the Galileo and the Copernicus space programmes.

21 We audited a sample of 30 actions funded since 2014. This sample covered key actions of the Commission and the other entities, which aimed to significantly enhance the uptake of EU space services as well as project related grants under the EU's Horizon 2020 programme. In addition, we used the services of external experts in assessing the quality of projects and for general technical support.

22 We also had meetings with representatives of the entities responsible for coordinating and implementing national space policy in the Czech Republic, Germany, France and Italy. We selected these Member States from the group of countries that

had adopted own strategies or plans in supporting the uptake of space services provided by the EU space programmes. We also met representatives of various stakeholder organisations representing European downstream industries¹⁴.

23 Due to its very specific scope and its limited financial importance, we did not include the EGNOS within the scope of this audit nor actions related to the uptake of the Galileo PRS, which is subject to specific provisions and actions.

¹⁴ European Association of Remote Sensing Companies, Galileo Services, Network of European Regions Using Space Technologies.

Observations

A comprehensive EU strategy that covers the uptake of space services is yet to be developed

Some of the objectives for the uptake of EU space services were insufficiently defined

24 As pointed out above (see paragraph [05](#)), both EU space programmes are closely associated with the objective of promoting the growth of markets for GNSS and Earth observation-based applications and services and thus support the general policy objectives of smart, sustainable and inclusive growth. However, as the legal framework governing the programmes defines these objectives only in a very general manner, we examined whether the Commission had developed a comprehensive and forward-looking strategy to support the uptake of services that included all relevant actors, and defined realistic targets and results.

25 The 2016 Space Strategy (see paragraph [07](#)) describes in very general terms, the objectives and actions for supporting the uptake of Galileo and Copernicus services: The Commission endeavoured to “maximise the benefits provided by the EU space programmes, connect the space sector better to other policies and economic areas at EU level and in all Member States, and optimise the benefits that space brings to society and the wider EU economy”¹⁵. It also mentioned some general actions to be undertaken to achieve this objective, such as introducing Galileo in specific markets, or to conduct information campaigns and supporting networks of Copernicus users and improve access to Copernicus data¹⁶.

26 In the strategy, the Commission did not define the benefits to be achieved and did not set clear targets or priorities, explaining what could be realistically expected by “maximisation” of benefits. Nor did it set a timeframe during which these benefits should materialise, nor define suitable indicators enabling it to monitor the achievement of benefits. This made it difficult from the outset to assess whether the actions undertaken met strategic objectives and achieved the desired results.

¹⁵ See COM(2016) 705 final, p. 3.

¹⁶ For a list of key actions envisaged in the 2016 Space Strategy see [Annex II](#).

The Commission's approach for promoting the uptake of Galileo and Copernicus is only partly supported with measurable targets

27 For both space programmes, the Commission prepares annual work programmes (AWP), which include implementation plans that detail actions and associated budgets¹⁷. The purpose of the AWP is to enable financing of actions and monitoring of programme related activities of the Commission, the GSA and the Copernicus entrusted entities.

28 For Galileo, the Commission has not yet developed a comprehensive strategy to support uptake. Moreover, while, the AWP mentions general objectives, such as “raise awareness” or “reinforce market uptake, and standards”, and defines main actions and milestones, there are no measurable targets for many actions, and results achieved are not clear nor time-bound. For example, in the 2018 work programme, the Commission wanted to “foster market uptake of Galileo and EGNOS services outside EU through dedicated application projects and awareness raising activities” or ensure that “Galileo and EGNOS were appropriately addressed in policy documents and incorporated in the research and development activities in the area of autonomous vehicles”. However, it is not entirely clear from the AWP, what precise results were expected for the market uptake, and by when the Commission expected to achieve them.

29 The GSA adopted a market development strategy and defined in its multiannual programming documents, as part of its performance framework as an EU agency, specific, measurable, accepted, realistic and time-bound strategic objectives. It also defined clear targets and results for its activities. Due to its role in the Galileo Programme, the strategy was focused on the development of markets for GNSS services in Europe, which is only a part of the potential market.

30 For Copernicus, the Commission has not yet developed a comprehensive strategy for supporting uptake. However, to complement activities of the Copernicus entrusted entities, and on the basis of an analysis of gaps and needs for intervention¹⁸, in 2016, the Commission created a framework for Copernicus user uptake activities, which aimed at (I) awareness raising, (II) facilitating access to Copernicus data and services, (III) support of downstream actors and (IV) leverage of Commission actions with Member States and the Copernicus entrusted entities, and defined a set of key actions

¹⁷ Article 27 of Regulation (EU) No 1285/2013 and Article 12(2) of Regulation (EU) No 377/2014.

¹⁸ [Copernicus User Uptake Engaging with public authorities, the private sector and civil society.](#)

to support uptake¹⁹. Most of these actions became part of the Copernicus AWP. However, for many of them, the AWP defined the expected output only vaguely such as “increased awareness” or “improved visibility”. The Commission did not prepare further programming documents that explained what it wanted to achieve by “engaging with national, regional or local stakeholders”, or “fostering the cross-sectoral dimension of Copernicus” (see [Table 1](#)).

¹⁹ Fostering the uptake of Copernicus and space applications; DG GROW (2016), updated in July 2017.

Table 1 – Objectives and actions for supporting Copernicus user uptake

Objective	Action	Purpose of the action	Expected output according to the AWP
(I) Increase awareness about Copernicus	Network of Copernicus Relays	Engage with national, regional or local stakeholders	Increased awareness raising of national Network of Copernicus helpdesks/information points.
	Network of Copernicus Academy	Bridging the gap between e-skills and data use, and enable the uptake of Copernicus data in new sectors	
	Training and information sessions	Provide attendees with examples on access and use of Copernicus data	(1) Studies, surveys, workshops, information sessions, customized consulting and training services. (2) GIS developer's work to assess and encourage the use of Copernicus data and information and the usefulness of Copernicus to various communities at national, regional or European level.
	Copernicus Market Report	Present opportunities and new markets created	-
	Copernicus Communication activities	Maximise impact and relevance of communication	Improved visibility of the Copernicus programme, awareness by the general public, by partner organisations, by European and non-European institutions and actors, etc.
	Copernicus internal uptake in the Commission	Identify opportunities and needs across the Commission to deliver tailor made products and applications	-
(II) Facilitate access to Copernicus data and services	Support office for Copernicus user uptake	Coordinate and support the development and implementation of user uptake activities in liaison with the Copernicus participating states	Running of the Copernicus User Uptake support office.
	Organising regular satisfaction surveys	Strengthen the user driven dimensions of Copernicus	-
	Produce success stories and material and present Copernicus to different market sectors	Fostering the cross-sectoral dimension of Copernicus	Improved visibility of the Copernicus programme, awareness by the general public, by partner organisations, by European and non-European institutions and actors, etc.
	Setting up a regular dialogue with industry through the Copernicus user forum	Extend user groups to others than core users	Increased awareness of Copernicus.
(III) Support downstream actors, researchers and public service providers	Ensuring maximum predictability for users	Ensure long-term availability and development of Sentinel satellites	-
	Delineation of the Copernicus programme	Evolution of Copernicus products	Service evolution defined.
	Copernicus Start-up programme	Support the creation and growth of businesses which use Copernicus data	(1) A new Copernicus Accelerator to provide a mentoring service to start-ups. (2) Copernicus Incubation Programme.
	Increasing synergies between Copernicus and Horizon 2020	Contribute to innovation in the Copernicus downstream sector	Ensure the complementarity, consistency and links between Copernicus and other programmes such as Horizon 2020.
	Copernicus Skills Programme	Develop actions to satisfy short and medium term skill needs	Promoting and implementing Copernicus in the frame of the action.
	Promote internationalisation through existing policy instruments such as COSME	Facilitate access to international markets for European Earth observation companies	Increasing the knowledge of the programme in international fora and attracting new users. Diffusing knowledge on data, information and products.
(IV) Leverage the Commission actions with Member States and entrusted entities	Enhance coordination between the user uptake activities of the entrusted entities	Supporting the Copernicus entrusted entities in their user uptake activities	-
	Caroline Herschel Framework Partnership Agreement	Promote the user uptake of Copernicus and space applications	(1) Involvement of public authorities in the implementation and the promotion of the Copernicus programme. (2) Extended use of Copernicus in public authorities, in particular for the monitoring and implementation of Union regulation and policies. (3) Support to the development of innovative Copernicus-based applications. (4) Boosting jobs and growth in the Copernicus downstream sector.

Source: European Commission.

31 In 2019, the Commission set up the InnovFin Space Equity Pilot (ISEP) under the Single EU Equity Financial Instrument, to encourage investments in capital funds whose strategies target upstream and downstream space technologies, commercialisation and market uptake. Space related projects could also be eligible under the European Fund for Strategic Investment (EFSI), but which at the conclusion of the audit supported only projects in the upstream space industry, or under the EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME)²⁰ and, in the framework of national smart specialisation strategies, from the European Regional Development Fund²¹. However, as these instruments were not specifically designed for supporting the uptake, they are not monitored for this purpose and thus their contribution to the uptake of EU space services is not known.

The Commission uses Copernicus data well in policy monitoring, but has yet to develop a comprehensive strategy to further enhance its use

32 In 2015, the Commission conducted a mapping exercise to identify the potential use for Copernicus data within the Commission, for example, for monitoring policies or for promoting the use of Earth observation in EU legislative texts.

33 In 2019, an internal evaluation conducted by the Commission's Joint Research Centre (JRC) found that while many Commission services recognised the benefit of global monitoring and used data for analyses, they did not exploit Copernicus and Earth observation related data and information fully²². However, to date, the evaluation, which had not included EU agencies or other EU bodies, has not been followed by a more thorough analysis of gaps, and the Commission has not developed yet a strategy to enhance further the use of Copernicus and other Earth observation

²⁰ Regulation (EU) No 1287/2013 of the European Parliament and of the Council of 11 December 2013 establishing a Programme for the Competitiveness of Enterprises and small and medium-sized enterprises (COSME) (2014-2020) and repealing Decision No 1639/2006/EC, OJ L 347, 20.12.2013, p. 33.

²¹ Regulation (EU) No 1301/2013 of the European Parliament and of the Council of 17 December 2013 on the European Regional Development Fund and on specific provisions concerning the Investment for growth and jobs goal and repealing Regulation (EC) No 1080/2006, OJ L 347, 20.12.2013, p. 289.

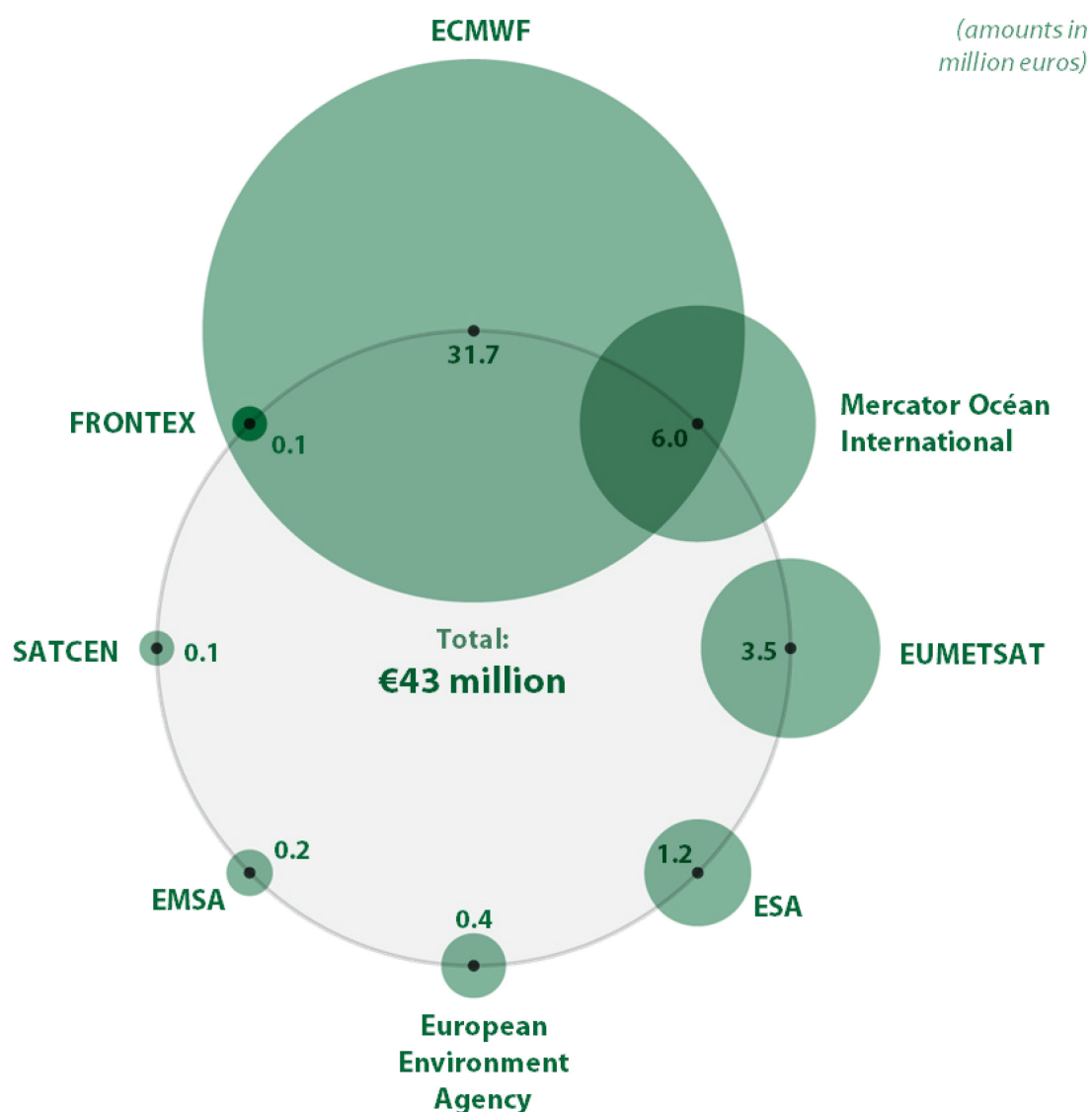
²² Copernicus and Earth Observation in Support of EU policies – Part I: Copernicus Uptake in the European Commission, 2020.

data within the Commission and other EU institutions or bodies covering all relevant policy areas.

The role of the Copernicus entrusted entities in supporting uptake was not clearly defined and their approaches varied

34 Regulation 377/2014 requires the Copernicus entrusted entities to ensure public sector uptake. From 2014 to 2020, these entities had a total budget of around €43 million for supporting uptake (see [Figure 4](#)).

Figure 4 – Budgets of the Copernicus entrusted entities for supporting uptake (2014-2020)



Source: ECA, on the basis of Commission data (amounts committed by 30.6.2020).

35 We found that the delegation agreements between the Commission and the Copernicus entrusted entities do not clearly define their tasks in supporting uptake. The available budgets for promotion activities varied significantly, as did the entities' approaches in promoting Copernicus services and products. For example, the entity in charge of the Copernicus Marine Environmental Monitoring Service (CMEMS), Mercator Océan International, adopted a user uptake strategy, whereby it sought to extend its service to new user communities. It also had a specific budget to support the identification of demonstration cases (i.e. individual small projects in downstream applications) promoting the CMEMS.

36 On the other hand, the European Environment Agency, which is in charge of the Pan-European component of the Copernicus Land Monitoring Service (CLMS), had no uptake strategy and only a very limited budget to promote these services, although this component is significantly important for uptake²³. It also lacked sufficient information on who the users of the services were and what they did with the data.

There is limited coordination of the Member States' uptake strategies

37 Member States and the ESA are close partners in the EU space programmes but they have no obligation to coordinate their own space strategies or measures with the Commission or the GSA. While cooperation between the ESA, which set up a programme to support the development of positioning, navigation and timing technologies, and the GSA is very close, prior to 2019 the GSA had only received little information on Member State strategies and actions in supporting the uptake of Galileo services.

38 In 2019, the GSA analysed available information on national space programmes of Member States and found that 18 Member States had a national space strategy²⁴. While four Member States had adopted specific national programmes to support the uptake of Galileo and EGNOS services, they had not coordinated their programmes with the GSA²⁵. No common roadmaps have yet been agreed between the GSA and

²³ Copernicus Market report, 2019, p. 32.

²⁴ Belgium, Bulgaria, Czech Republic, Denmark, Germany, Ireland, Greece, France, Italy, Luxembourg, Hungary, Malta, the Netherlands, Austria, Poland, Portugal, Finland and Sweden.

²⁵ Belgium, Ireland, Austria and Finland.

Member States to focus efforts on the segments most in need of EU support or to leverage national efforts.

39 For Copernicus, Member States play an important role, as national, regional and local authorities are core users of the programme. In its 2016 analysis²⁶, the Commission found significant differences among Member States in their stages of development. Although the Commission has carried out a number of actions, these were not part of a comprehensive strategic approach to specifically address the different needs in the design of its actions to support uptake. This is also reflected in the results of the Commission's 2018 impact assessment where it is stated that Copernicus did not sufficiently manage to attract potential users from outside the traditional space user communities, and which identified the need to strengthen the integration of space data into other policy areas and economic sectors²⁷.

40 Besides a very limited number of larger players, the European suppliers of applications using Earth observation data consist of many specialised micro, small and medium enterprises²⁸. On the demand side, in 2016, the public sector accounted for more than half of the European Earth observation downstream market in Europe. However, demand is very fragmented, with many national, regional or local authorities being potential users of space services. This could be an obstacle for a cost-effective use of space services across public authorities and Member States.

41 In the four Member States selected, we found significant differences in how the authorities had integrated the EU space programmes into national policies and supported the uptake (see [Box 2](#)).

²⁶ See footnote [18](#).

²⁷ Commission Staff Working Document accompanying the proposal for a Regulation of the European Parliament and of the Council establishing the space programme of the Union and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU, SWD(2018) 327 final, 6.6.2018, p. 11.

²⁸ European Association of Remote Sensing Companies, Industry Survey 2020.

Box 2

Significant differences in supporting uptake by Member States

Germany and France had adopted national work programmes, which assisted the national administrations in the uptake of Copernicus and other space services, but they had not conducted a comprehensive analysis of how their use could enhance the efficiency and effectiveness of their public administrations. The Czech Republic had included user uptake in its national space plan, but a specific work programme had yet to be developed.

In France, the programme covered only the services under responsibility of two ministries²⁹. However, the French Space Agency CNES moved from solely promoting space services and entered into specific partnerships with public administrations, agencies for economic development and initiatives supporting start-up companies to facilitate deployment, adoption and commercialisation of space applications, better connect the space sector with non-space actors and to facilitate the transfer of knowledge as a source of innovation.

Italy adopted a national strategy to exploit the potential of the EU space programmes in a holistic manner and with a view to enhancing economic growth³⁰. In contrast to the traditional approach of supporting individual small projects in downstream applications (“demonstration cases”), the novelty of the strategy was to focus on economic development and investment by the private sector and planned to pool demand of local or regional governmental authorities not using the potential of space services. This should create synergies between public authorities and enable them to benefit from cost-effective solutions.

42 These national initiatives showed promise in enhancing the use of space applications, but they remain limited to the Member States concerned and did not specifically address the EU market. We found that the Commission had no up-to-date overview of the overall situation of such national initiatives and had not considered them in its own strategic approach.

²⁹ Plan d’applications satellitaires (2018).

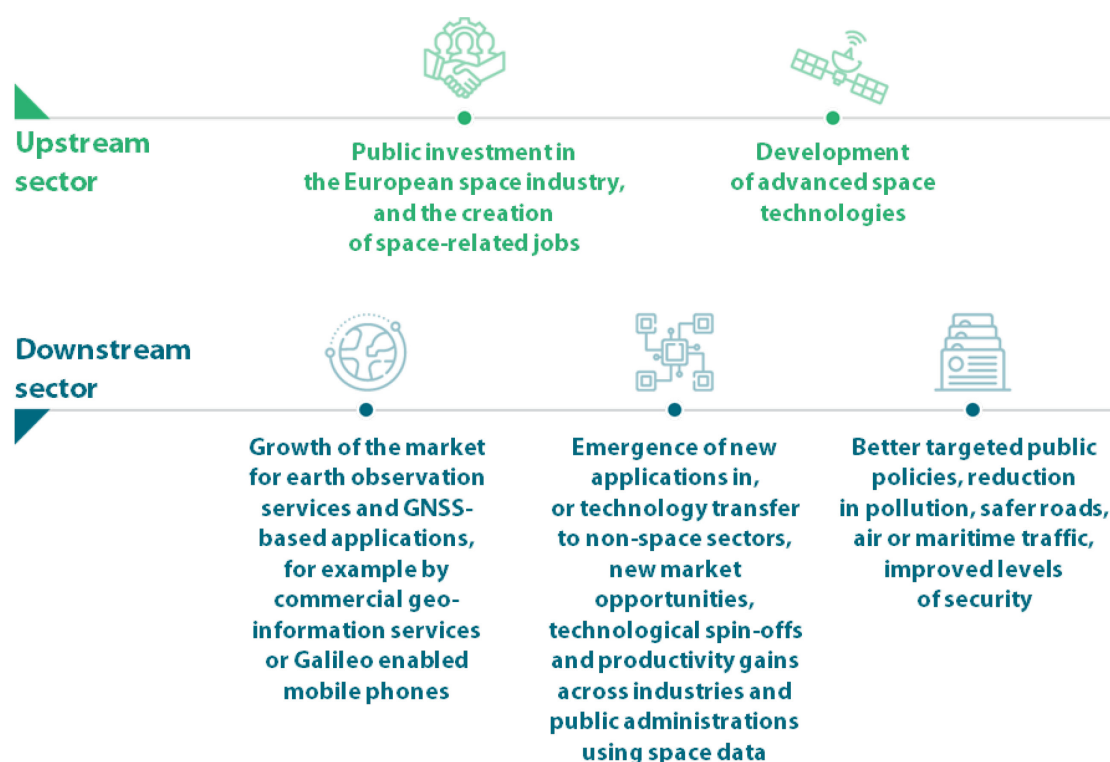
³⁰ Strategic Plan “Space Economy” (2016).

The EU space programmes provide benefits but there is limited information on their extent

There is no recognised conceptual framework for assessing the benefits of space services

43 The provision of space services is associated with a number of economic and societal benefits. These benefits derive from both the upstream and the downstream sectors (see [Figure 5](#)):

Figure 5 – Types of benefits generated by Copernicus and Galileo



Source: ECA.

44 There is no recognised conceptual framework for estimating benefits in the domain of space infrastructure, nor a structured system for compiling statistical data on the benefits of space services. Neither, is there an official definition of the value chain of the space economy, nor an agreed definition of “downstream activities”.

45 In 2012, the Organisation for Economic Co-operation and Development (OECD) published a Handbook on measuring the space economy, which proposes some methods and sources and a set of indicators³¹. Although the Commission used some

³¹ OECD (2012): [OECD Handbook on Measuring the Space Economy](#), OECD Publishing.

information from the handbook, it did not consider it fit for measuring the EU space economy and followed an own approach for determining the socio-economic benefits from Copernicus and Galileo, similar to those used by other European space actors. In the absence of an established conceptual framework, it is challenging to reliably estimate benefits from space services, compare them to other economic sectors, or devise a cost-benefit analysis of the space programmes.

The methodology used by the Commission for determining the benefits of space services has shortcomings

46 The Commission stated in 2018 that the impact of the services provided by the EU space programmes on economic growth and employment in the EU will eventually outweigh the substantial public investments made in the EU's space programmes³². It supported this statement by several studies, which estimated the benefits resulting from the EU space programmes. Such estimations are also important in the assessment of the impact of new space programmes. The estimation of the benefits of the programmes should thus be based on sound and, where applicable, consistent methodology, and realistic data. We examined whether the Commission applied a sound methodology consistently between the two programmes and whether the studies used reliable data sources.

47 Economic benefits of the space programmes can be expressed by the Gross Value Added (GVA) of the companies active in the space upstream and downstream sectors. The GVA corresponds to the value generated in the production sector and can be measured as the total of all incomes earned in the process of producing goods and services plus taxes on production and imports, less subsidies. However, the method used by the Commission to estimate the generated income by both Copernicus and Galileo was not in line with the conceptual framework set in Regulation 549/2013 used to calculate the Gross Domestic Product (GDP) in the EU³³, and thus resulted in an inaccurate measurement of this type of benefit.

³² Impact Assessment accompanying the proposal for a regulation of the European Parliament and of the Council establishing the space programme of the Union and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU; SWD(2018) 327 final, 6.6.2018, p. 7.

³³ Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European system of national and regional accounts in the European Union, OJ L 174, 26.6.2013, p. 1.

48 The methodology to calculate the benefits of Galileo differed from that of Copernicus. Non-monetary benefits, such as the contribution to mitigating climate change or lives rescued thanks to GNSS, had been attributed monetary values, resulting in different assessments for the same benefits. Examples of shortcomings in the calculation of benefits resulting from the EU space programmes are shown in **Box 3**. As a result, the economic impact on growth and jobs may be underestimated, while the actual overall benefits of the programmes may be overestimated.

Box 3

Examples for shortcomings in the calculation of benefits resulting from the EU space programmes

For Galileo and Copernicus, the Commission estimated the benefits for the whole value chain (upstream and downstream), but did not include public entities, such as universities, national space agencies, or non-profit organisations.

For Copernicus, the Commission did not include in its assessment the impact of the downstream activities in the GDP. In a separate study assessing the benefits of Copernicus for the downstream sector, the Commission included the “enabled revenues”, which are the value of goods or services, which European producers could sell, thanks to programme. However, apart from a general lack of data, these do not correspond to the income generated and the Commission did not estimate the resulting indirect and direct impacts for the downstream sector. As a result, the economic impact on growth and jobs may be underestimated due to insufficient coverage of the relevant statistical units and a lack of data.

The assessment of the benefits of Galileo included non-monetary benefits, such as the reduction of emissions, the time drivers saved in traffic jams, thanks to navigation systems, or the number of lives saved. Similarly, for Copernicus, the assessment encompassed societal benefits, such as meeting air pollution targets and decreased exposure to air pollution, reduction of harmful emissions, reduction of road traffic accidents, or reduction of casualties in maritime disasters. However, instead of including them in the list of indicators, these were reported in monetary values, which is subjective. The Commission could also not underpin its assumptions with sufficient evidence and reliable data. In summary, this may lead to inaccurate estimations of the actual benefits of both space programmes.

The Commission lacks information and relevant key performance indicators to monitor uptake

49 Both Regulations 1285/2013 for Galileo and EGNOS and 377/2014 for Copernicus as well as the new regulation establishing the EU space programme require the

Commission to monitor regularly performance. They also define basic performance indicators³⁴. Apart from technical aspects, such as the availability of the services or data, the Commission has to monitor regularly the impact of the services on the various sectors of the economy, and to assess if EU industries actually increase their market share in the worldwide downstream market for satellite navigation and in Earth observation. This requires the definition of relevant indicators, as a basis for evaluating the effects of the programmes.

50 For Galileo, the GSA generally provides useful and overall consistent key performance indicators showing progress made. However, over time, their number had grown to 97 output and result indicators, which made monitoring them complex. Some indicators are not presented in a meaningful context, which makes their interpretation difficult. For example, the indicator showing the number of companies commercialising products using Galileo shows annual changes, but does not indicate how much of the respective market these companies represented. Moreover, there are no indicators on the costs and benefits of the GSA's efforts to develop certain markets over others for their strategic and economic importance. By the end of this audit, the GSA was already working on a new, simpler set of indicators.

51 For the uptake of Copernicus services, the Commission monitors key parameters, such as the increasing number of Copernicus users registered with the ESA or the other entrusted entities, data volumes downloaded, or the number of trainings or promotion events organised. However, there is only partial information on the number of users, given that they may also register with national data distribution platforms or other third parties. It is also difficult for the ESA and the other entrusted entities to collect information on who actually uses Copernicus data and for what purposes. The Commission did not clearly define uptake-related key performance indicators of the Copernicus entrusted entities and their reporting was not harmonised. It was also difficult to conclude on the actual uptake of services from the number of training or promotion events organised.

52 Regulation 377/2014 required the Commission to monitor the use of Copernicus data and information by specific result indicators. This included core users, such as national, regional or local authorities, market penetration, the expansion of the existing markets, creation of new markets, and competitiveness of the European

³⁴ Articles 12 and 34 of Regulation (EU) No 1285/2013 and Article 4(3) of Regulation (EU) No 377/2014. Article 101 of the future Regulation establishing the space programme of the EU (see footnote 4).

downstream operators³⁵. However, the diversity of possible applications of Copernicus makes it difficult for the Commission to gather suitable aggregated data supporting these indicators. In 2019, the Commission published a market report, which indicated that in 2017 around 72 % of Earth observation companies in Europe already used Copernicus data or services, compared to 66 % in 2016³⁶, but there was very little information on the extent to which the core users used Copernicus, or the extent to which the services had contributed to strengthening the competitiveness of European downstream operators.

There is considerable progress in enabling the use of Galileo services but key features are not yet available to reap full benefits

53 After GPS and the Russian Glonass, Galileo is the third GNSS that provides navigation and timing services. When taking up initial services in 2016, Galileo had already eight years delay compared to the initial plans³⁷. GPS had a significant advantage as the first worldwide open GNSS, and is used by most receiver devices. Although Galileo services demonstrated higher accuracy than the other GNSS services, after a major adverse event in 2019 resulting in its unavailability for six days, the relevant parties (the GSA, the Commission and the ESA) had to consistently work on actions to increase Galileo's stability, robustness and resilience. Moreover, other providers may soon achieve a similar level of accuracy. A new generation of GPS satellites with improved accuracy is currently being deployed in space and expected to be operational in the coming years.

54 In this context, the GSA had to identify the most relevant market segments for Galileo services and design actions to develop these markets. We analysed whether the GSA had conducted an effective market research and whether its actions followed clearly established needs, were targeted at supporting uptake and had a measurable impact on the use of Galileo services.

³⁵ Article 4(3)(c) and (d) of Regulation (EU) No 377/2014.

³⁶ Copernicus Market Reports, 2016 and 2019, p. 8.

³⁷ See also Special Report No 7/2009: "[The management of the Galileo programme's development and validation phase](#)".

Further success of Galileo services depends particularly on the availability of key features

55 We found that the GSA had identified effectively current key market segments for GNSS services such as smartphones, automotive manufacturers, or producers of surveying equipment, and their requirements.

56 The GSA established close contacts with worldwide appliance manufacturers and promoted the availability of Galileo-ready chips and receivers on the market. A major achievement was that, by 2020, leading suppliers, representing more than 95 % of the GNSS chipset market, produced Galileo-ready chips and modules, Galileo compatible receivers are available in many market segments and are usually inter-operable with the other GNSS. This contributes to enhance overall accuracy of navigation, but does not mean that equipment or receivers give priority to Galileo for acquisition of signal. GPS has still a strong market penetration and it will take time until most users have adopted Galileo compatible technologies across the various market segments.

57 The High Accuracy Service (HAS) and a Navigation Message Authentication Service (OSNMA) are key features (“differentiators”) of Galileo. The OSNMA consists of a digital signature of the navigation signals to ensure their authenticity. A Commercial Authentication Service (CAS), which provides an encrypted Galileo signal, should be available to protect against signal replay attacks. Such services are not provided by other GNSS and are thus a unique selling point of Galileo. The CAS is also the only Galileo service that the Commission planned to make available against a fee and which thus may generate revenue for the EU budget.

58 Although planned to be fully operational by the end of 2020, Galileo has not yet achieved this status. The development of both the HAS and the OSNMA accumulated further delays. Testing is planned for 2021, to enable industries to validate compatible receivers but services may not be available before 2024. The CAS is still under definition and it is not clear when it will be operational. While this does not inhibit developing potential markets, it may hamper Galileo’s ability to gain the market for these services and thus capitalise on the respective investments in Galileo before other GNSS provide similar services.

Actions for supporting evolution and use of Galileo services are of good quality but risks for their effective uptake remain

59 Since 2014, the GSA incurred around €22 million for market development and supporting uptake of Galileo and EGNOS services. By mid-2020, the GSA also awarded

grants of €141 million for 79 projects under the Horizon 2020 programme and financed support of around €41 million for 14 projects under its Fundamental Elements programme.

60 We observed that from the publication of the calls for proposals of a project until the end of a project, more than four years can elapse. In fast changing technology markets, we see a general risk that the results of the projects are obsolete by the time they are available.

61 As part of our sample (see paragraph 21), we reviewed eight actions that the GSA had supported under the Horizon 2020 programme, the Fundamental Elements programme, or as part of its market development, that had been completed at the time of audit. We found that the actions generally addressed a clearly established technical need or targeted a promising market, were of appropriate technical quality, and achieved objectives in terms of output and timing. However, some markets are still developing and the contribution of projects to uptake can only be assessed in the longer term. In other cases, uptake can depend on potential customers of innovative solutions having the necessary funding (see [Box 4](#)).

Box 4

Factor hindering the uptake of EU funded actions supporting Galileo services

In one case, the GSA supported the development of a pre-commercial prototype to demonstrate the technical feasibility of using Galileo in smart transport systems and for monitoring urban infrastructures. However, three years after the end of the project, a product was still not available on the market. According to the GSA, municipalities interested in the project had financial limitations to implement new technologies within the intelligent transport domain.

Commission's actions to support the uptake of Copernicus data were fragmented and synergies were not exploited

Several key actions of the Commission had unclear objectives, were fragmented and lacked funding

62 Since 2014, the Commission supported directly the uptake of Copernicus with around €30 million. In addition, some €83 million was available for facilitating new

ways of access to Copernicus data. For supporting Copernicus uptake under the Horizon 2020 programme, grants of €194 million for 79 projects with a specific focus on the market uptake and evolution of Copernicus services were awarded. As part of our sample, we reviewed six key actions supported directly by the Commission (see paragraph 30) and eight projects funded under the Horizon 2020 programme, which aimed at supporting uptake and had been completed by the time of our audit.

63 To increase awareness about Copernicus, the Commission set up the Copernicus Academy and the Copernicus Relays networks. The objective of the Copernicus Academy is to support uptake by universities and research centres, through providing course material and dedicated information for public research organisations; the Copernicus Relays networks aims at better understanding user needs, increasing awareness at the national, regional and local levels, and spreading best practice.

64 We found that since 2017, the Commission successfully engaged with more than 160 Academy members in all 27 Member States, as well as in some third countries, and more than ninety Copernicus Relays partners including national authorities, government agencies, innovation clusters, companies operating in the space sector, as well as university institutes and not-for profit organisations. In 2019, the Copernicus Relays organised some 200 events to raise awareness. However, the partners do not receive direct funding and there is no information on whether they contribute to a structured user uptake with long-term impact on the national, regional or local levels.

65 As set out in its 2016 Space Strategy for Europe, the Commission also supported start-ups. To this end, it organised or supported financially prizes to support innovative ideas (“Hackathons” or “Masters”) and set up Accelerator and Incubation Programmes. While the Copernicus Accelerator financed annually the coaching of around 40 innovative companies by experienced mentors, the Copernicus Incubation Programme supported some 20 innovative companies using Copernicus with a grant of €50 000 on top of support they already received from other incubation initiatives, for example, the ESA’s own business incubators. However, the number of start-ups supported was small, and the Commission has not clarified its goals in supporting these programmes. There was no further monitoring of the progress made by the start-ups after the end of the acceleration or incubation period. Therefore, it is not yet possible to assess whether these two initiatives contributed to supporting start-up companies in an effective and efficient manner.

66 Another key action, the Caroline Herschel Framework Partnership Agreement (FPA) aimed at closer cooperation with interested Member States. Under the FPA, public entities, such as space agencies or research institutes in 22 Member States,

propose projects to the Commission and award grants to support actions under three specific objectives (“tiers”), whereby the EU budget supports up to 85 % of the costs (see [Table 2](#)).

Table 2 – Objectives and actions of the Caroline Herschel Framework Partnership agreement

Tier	Objective	Actions
1	Support national user uptake	National information, training or innovation events, dialogue with actors, developing downstream actions and services.
2	Support global uptake, including European cross-border and international user uptake	Multi-national information, training or innovation events, dialogues with actors, piloting of downstream applications and services.
3	Support business solutions and innovative applications	Developing downstream applications and services, promoting national and multi-national innovation actions.

Source: European Commission.

67 The FPA enables the Commission to directly support uptake together with national partners and thus leverage its actions. However, with numerous smaller and isolated actions such as workshops, trainings or projects under the various tiers, its implementation was fragmented. The expected overall impact and the relationship with national strategies for supporting uptake remained largely unclear. For example, the programme included actions aimed at developing a best practice catalogue to serve as inspiration for potential new users of Copernicus in the public sector, or to raise awareness about how Copernicus services could support public administrations. As the use of Earth observation data is complex and requires expertise, actions supported by the FPA require complementary measures such as hiring experts in the national administrations, which is not ensured.

68 For the first year of the programme, 2018, the Commission budgeted a contribution of €6 million. However, at the time of our audit, many projects were delayed, mainly due to the late signature of grant agreements or contracts and delayed pre-financing arrangements. For the actions taken up in the 2019 annual work programme, the planned EU funding of €8 million only occurred after a significant delay. Specific grant agreements could thus only be signed in September 2020, at which time, the financing of the actions for the work programme 2020 was still unsure.

Projects funded under the Horizon 2020 programme are generally of good quality but their impact on Copernicus uptake cannot be assessed

69 The Horizon 2020 programme was an important pillar in the Commission's efforts to support the uptake of Copernicus. Targeted actions were included in the part of the programme dedicated to space, but applicants using Earth observation data were also eligible under non-space related parts of the Horizon 2020 work programmes³⁸.

70 We reviewed the calls for proposal on Copernicus uptake of the 2014/15 and 2016/17 Horizon 2020 work programmes and analysed for eight completed projects, whether they had contributed to a significant uptake of Copernicus services.

71 The projects we reviewed were technically plausible and met most of the objectives defined in the work programmes. However, for three of six projects specifically targeted at market uptake, it was unclear if the beneficiaries had succeeded in developing services capable of generating a significant turnover for the participants, or achieve a significantly wider use of Copernicus. We also noted that for some calls for proposals, the expected impact was very ambitious, as the small number of projects awarded made it unlikely to achieve this objective (see [Box 5](#)).

³⁸ See Chapter 5 iii) of the bi-annual Horizon 2020 work programmes.

Box 5

Ambitious objectives but limited impact

Under the call for proposals EO-1-2016 *Downstream applications*, the Commission wanted to enhance the European industry's potential to take advantage of market opportunities and establish leadership in the field, and to boost business activity. However, only five projects were supported. In spite of promising results from some, due to their small number and limited scope, they are unlikely to have a significant impact on Europe's industry as a whole.

Public authorities are core users of Copernicus. Under call EO-2-2016 *Downstream services for public authorities*, the Commission wanted to launch demand-driven innovation actions by public authorities aiming at customising Copernicus information. The intention was to establish:

- (a) buyer groups for Earth observation services;
- (b) Copernicus-enabled national, regional or local applications, in support of public authorities, promoting EO-based actions; and
- (c) sustainable supply chains for the delivery of downstream EO-based services to public authorities.

However, following this call, the Commission received only two project proposals out of which one grant could be awarded to a project in marine Earth observation.

The Commission facilitates access to Copernicus data, but the potential for synergies is not being exploited

72 Appropriate access to Copernicus data and products is key for an effective uptake of services. We examined whether the Commission had a cost effective and synergetic approach in providing such access to Copernicus data and services.

73 The ESA and EUMETSAT set up data hubs where users could download the Sentinel raw data. As part of the infrastructure, thirteen EU Member States financed and operated national mirror sites for Copernicus data, the collaborative ground segments (CollGS)³⁹, some of them with additional services for their users. The entities

³⁹ Belgium, Czech Republic, Germany, Estonia, Ireland, Greece, France, Italy, Luxemburg, Austria, Portugal, Romania, and Finland. Spain, Hungary and Poland were developing or planning to set up national platforms as well.

entrusted with the service components made the Copernicus products available via their own solutions for data access.

74 As the amount of data and information generated by the Copernicus programme were challenging for the traditional downloading of data, in 2016, a task force comprised of representatives from the Commission, ESA, EUMETSAT, Member States and Copernicus participating countries was established. This task force proposed putting in place solutions for improving the availability of Copernicus data and products⁴⁰. As part of this initiative, the Commission has financed the creation of the Data and Information Access Services (DIAS). However, an integrated ground segment has not been achieved, and Copernicus data is still made available on a range of platforms operated by the ESA, the Copernicus entrusted entities, Member States and private operators.

75 The DIAS are innovative, digital cloud-based platforms, located in the EU, which enable users to exploit large volumes of Copernicus and other space data, without having to transfer and store them on their own computer networks. The purpose was to enhance competition among these platforms, and with existing services, and combine them with additional commercial services to make the platforms economically sustainable and independent from public funding in the long term.

76 When setting up the DIAS platforms, there was uncertainty about the number of potential users who would be willing to pay for services and thus ensure the economic sustainability of the platforms. The Commission eventually decided to support five such platforms until 2021. However, their number made it more difficult to attract a sufficient number of users, in order to achieve critical mass, benefit from network effects and thus compete effectively with non-EU operators providing similar services. Since the DIAS platforms became operational in mid-2018, the use of their services has remained very low compared to the overall number of active Copernicus users, with only a small number of users currently paying for some of them. Furthermore, the Commission did not sufficiently promote the use of the services under other dedicated instruments supporting uptake, such as Horizon 2020, by encouraging beneficiaries to use this new tool for processing their data.

77 The Commission does not yet have a strategy on how to integrate further access to Copernicus data and processing, in a cost efficient manner: Only one of the thirteen

⁴⁰ [Operational Implementation Plan - Proposed approach to implement the roadmap and annexes of the Integrated Ground Segment and Big Data Governance Task Force](#), 15.6.2016.

CollGS has been implemented using a DIAS infrastructure and thus showing interest towards convergence. The Commission has also not yet clarified how access to, and processing of, Copernicus and other space data would be integrated into its European Open Science Cloud initiative⁴¹. This initiative seeks to address the fragmentation of data infrastructures in the EU in general, by developing facilities for storing, sharing and re-using scientific data and cross-fertilisation of different data sets, including Earth observation data.

Regulatory measures can facilitate the uptake of EU space services but gaps remain

78 In its 2016 Space Strategy for Europe, the Commission also committed to take regulatory measures (where justified and beneficial), to introduce Galileo into specific markets or areas and, in the longer term, to encourage the uptake of space solutions through standardisation measures.

79 We assessed whether the Commission had effectively identified such opportunities for regulatory or standardisation actions for supporting the uptake of space services and had acted upon them. As existing legal provisions can also inhibit the use of space services (for example, public administrations rules prohibiting the use of space data or services), we also examined whether the Commission and the Member States selected had taken steps to identify and remove such barriers.

Regulatory action facilitated the use of Galileo compatible devices, but further action is required

80 Satellite navigation and timing services are subject to numerous technical standards and regulation. These can be EU rules, national rules or standards set by international agreements or standardisation organisations. Such measures can support the uptake of space services, because they allow equipment manufacturers standardise their products and ensure interoperability of systems. As satellite navigation systems use radio frequencies, standards are also necessary to protect signals from interferences.

⁴¹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Cloud Initiative – Building a competitive data and knowledge economy in Europe, COM(2016) 178 final of 19.4.2016.

81 The Commission already adopted regulatory measures to facilitate the uptake of Galileo services in the domain of road safety and emergency⁴². These initiatives effectively supported equipping new cars and mobile phones with Galileo compatible chipsets, enabling emergency responders to get to the scene of an accident faster. Moreover, in 2020, a relevant international standard, which had privileged the use of GPS as the preferred navigation signal of devices, was updated, now allowing device manufacturers to choose the preferred GNSS, which is likely to support a more widespread use of Galileo services.

82 In 2017, a Commission study identified gaps and future needs for standardisation to support market penetration of Galileo and EGNOS and proposed roadmaps for different market segments⁴³. The Commission also elaborated a European Radio Navigation Plan, which provides an inventory of existing and emerging radio navigation systems and gives an overview of the EU legislation relevant for radio navigation⁴⁴. After consultation with Member States, the Commission defined three priority areas, where regulation or standardisation could be beneficial⁴⁵:

- Intelligent transport and mobility: manned aviation, unmanned and autonomous aircrafts, intelligent road transport systems, maritime transport, and rail transport;
- Intelligent interconnectivity: Location based services (for example in smartphones), connected devices, known as Internet of Things (IoT), and interaction with public administrations; and
- Intelligent infrastructures: timing and synchronisation services in critical infrastructures such as energy, telecommunication or transport.

83 At the conclusion of this audit, moderate progress has been made: A mapping of activities of the Commission and of the GSA, concerning Galileo compatible downstream standards development were included in the 2020 Galileo work programme and studies and projects in the area of air traffic, road transport and maritime applications are ongoing. However, to be effective, complementary sector-

⁴² See [Annex III](#).

⁴³ [Overview of EGNSS downstream standardisation and assessment of gaps and future needs](#), 1.2.2018.

⁴⁴ [European Radio Navigation Plan](#), 9.3.2018.

⁴⁵ Commission Staff Working Document – EGNSS downstream standards development, SWD(2019) 454, 20.12.2019.

specific regulatory action is required in these sectors. For important fields of application of GNSS, standards must be agreed by international bodies, which can be complex and time consuming. In relevant areas, sector-specific regulation, for example, for road transport and logistics, autonomous cars or drones, is still incomplete or missing. The Commission currently monitors these challenges, but no time schedule exists for issuing suitable regulation or standards for each policy or market segment and thus further facilitating the adoption of Galileo.

84 We also observed little progress in the field of intelligent interconnectivity and connection of public administrations (outside the PRS): There are no standards yet to strengthen the position of Galileo in relevant IoT or artificial intelligence applications. For connecting citizens to the public administration, the Commission's actions have been limited to farmers using satellite navigation, as part of a digital platform project.

The Commission does not sufficiently promote the use of Earth Observation in its regulations

85 A finding of the Commission's 2015 mapping exercise (see paragraph 32) was that EU legislation could help to implement EU policies more efficiently and reduce administrative burden. A significant step forward was the adoption of a legal base, encouraging Member States to use Earth observation for monitoring the implementation of the common agricultural policy⁴⁶. However, we observed only little progress in other sectors, where legislation could help to better promote the use of Copernicus and other Earth observation data. To date, only very few EU legal provisions, such as Regulation 2018/841 on land use and forestry monitoring for purpose of meeting the EU greenhouse gas emission reduction target, require that best use be made of Copernicus and Galileo for data collection⁴⁷. Moreover, the Commission has not conducted a comprehensive analysis on where EU legislation could better promote the use of Earth observation data.

⁴⁶ Commission Implementing Regulation (EU) 2018/746 of 18 May 2018 amending Implementing Regulation (EU) 809/2014 as regards modification of single applications and payment claims and checks, OJ L 125, 22.5.2018, p. 1.

⁴⁷ Regulation (EU) 2018/841 of the European Parliament and of the Council of 30.5.2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU, OJ L 156, 19.6.2018, p. 1.

There has been little action in identifying regulatory or administrative barriers for the uptake of space services

86 Apart from technical standards that could prevent using the full potential of the EU space programmes (see paragraph [81](#)), there can also be regulatory or administrative barriers against the use of Earth observation and navigation services, for example, in law enforcement, or where procurement rules do not allow the use of such services. Moreover, the use of new technologies based on Sentinel data can require significant changes to administrative procedures and IT systems⁴⁸.

87 We found that the Commission had no systematic overview about how Member State administrations used space data and whether there were any regulatory barriers preventing their use. In Italy, the national authorities had set up a high-level working group to identify possible national and European regulatory barriers that may affect the uptake of products and services provided by Copernicus and Galileo, but results of this work were not yet available. In the Czech Republic, Germany and France, the national authorities had not yet conducted such an analysis.

⁴⁸ Special Report No 4/2020: “Using new imaging technologies to monitor the Common Agricultural Policy: steady progress overall, but slower for climate and environment monitoring”.

Conclusions and recommendations

88 Our overall conclusion is that the EU space programmes Galileo and Copernicus provide valuable services and data, which the Commission promoted in various ways but it has not done enough to fully harness their potential. More efforts are needed to capitalise on the significant investment made to achieve the expected societal and economic benefits and thus to strengthen the EU Internal Market.

89 In its 2016 Space Strategy for Europe, the Commission endeavoured to maximise the economic and societal benefits provided by the European Space programmes but did not set clear targets and priorities, explaining what could be realistically expected under “maximisation” and did not set a timeframe for achieving these objectives (paragraphs [24](#) to [26](#)).

90 There is no comprehensive strategy yet for promoting the uptake of the EU space programmes, and the Commission’s approaches are only partly linked to specific, measurable, accepted, realistic and time-bound strategic objectives that clearly explain what should be achieved (paragraphs [27](#) to [31](#)).

91 Internally, the Commission makes good use of Copernicus data in policy monitoring. However, it does not fully exploit the potential of the data and it has not yet developed a strategy to further enhance their use within the Commission and other EU institutions or bodies (paragraphs [32](#) and [33](#)).

92 The Commission has not clearly defined the role of the Copernicus entrusted entities in supporting uptake. Consequently, not all of them had a dedicated strategy and their approaches in supporting uptake varied (paragraphs [34](#) and [36](#)).

93 The Commission and the GSA only received little information on Member State strategies and approaches in supporting uptake. The approaches of the Member States selected varied but in spite of promising initiatives to better connect the space sector with non-space actors, there were no comprehensive analyses of where Copernicus services could enhance efficiency and effectiveness of public administrations. Moreover, the Commission has not yet addressed the fragmented structure of the markets for space services in its own approach (paragraphs [37](#) to [42](#)).

Recommendation 1 – Develop a comprehensive strategy for supporting the uptake of EU space services

In order to support the further uptake of EU space services more effectively, the Commission should:

- (a) develop a comprehensive strategy for supporting the uptake of Galileo and Copernicus services that include all relevant actors and entities at their various levels, clarify their roles and define realistic and measurable targets to be achieved;
- (b) identify together with Member States where EU space services could enhance the efficiency and effectiveness of public administrations with a view to address the fragmented structure of markets.

Timeframe: 2023

94 The provision of space services is associated with a number of economic and societal benefits, but there is no generally recognised conceptual and statistical framework for estimating such benefits. This makes it challenging to reliably quantify these benefits and put them in perspective, relative to the costs of the space programmes (paragraphs [43](#) to [45](#)).

95 The benefit estimations of the Commission have shortcomings in terms of methodology and coverage. The assessment of the benefits of both programmes were not comparable and some benefits may be over- or underestimated (paragraphs [46](#) to [48](#)).

96 The Commission has to monitor regularly the results achieved with the implementation of the programmes by relevant key performance indicators. While for Galileo, the GSA has an overall consistent system of output and result indicators, the large number of indicators adds complexity and their interpretation is sometimes difficult. For Copernicus, indicators provide only very basic information on the uptake of services and do not inform about the achievement of key objectives of the programme (paragraphs [49](#) to [52](#)).

Recommendation 2 – Develop a conceptual framework for estimating the benefits of the EU space programmes and improve performance measurement

In order to estimate economic and societal benefits of space services in a more reliable and consistent manner and to monitor more effectively the achievement of key objectives, the Commission should:

- (a) develop a conceptual framework for estimating the economic and societal benefits of the EU space programmes, involving other stakeholders such as the OECD, the ESA and Member States, and harmonise the assessment of benefits of the EU space programmes, on the basis of sound methods and reliable data; and
- (b) monitor the achievement of the objectives defined by the space programmes on the basis of a set of appropriate performance indicators.

Timeframe: 2024

97 Good progress has been made in enabling Galileo compatible receivers and uptake in many relevant market segments, but the availability of key features of Galileo is significantly delayed, which may hamper its ability to gain the market for these services (paragraphs 55 to 58).

98 Actions taken to support the uptake of Galileo services were of appropriate technical quality, and achieved objectives in terms of output and timing. However, for many of the projects reviewed it is not yet known whether the development of innovative products will lead to significant market uptake, which can only be assessed in the longer term (paragraphs 59 to 61).

99 The Commission's key actions for Copernicus aimed at raising awareness on the programme, support start-ups and cooperate more closely with Member States to enhance uptake. However, the objectives and the impact of several of these actions were not clearly defined, their contribution to a structured user uptake unclear, and some of them lacked funding (paragraphs 62 to 68).

100 For Copernicus-related actions, under the Horizon 2020 programme, the Commission supported generally good quality projects, but their small number made it unlikely to achieve the expected impact. For some projects, their contribution to uptake was unclear (paragraphs 69 to 71).

101 The Commission facilitated access to Copernicus data and cloud-based services, but data is currently provided through a number of channels. The potential for synergies is not yet being exploited and the Commission has not clarified the integration of Copernicus in the European Open Science Cloud initiative (paragraphs 72 to 77).

Recommendation 3 – Ensure full readiness of Galileo and better targeted action on uptake of the EU space services

In order to better support uptake and provide efficient access to space data and products, the Commission should:

- (a) make the technical and legal arrangements needed for full readiness of the Galileo differentiators;
- (b) for key actions, define clearly the objectives and the expected impact and pursue complementarity with Member State actions; and
- (c) develop, in cooperation with Member States and other relevant actors, a long-term framework for a more sustainable and integrated approach of access to Copernicus data and products, and seek the integration of Copernicus in EU cloud-based infrastructures.

Timeframe: 2024

102 Commission regulation contributed in the domain of road safety and emergency to the compatibility of devices with Galileo, which promises a more widespread use of Galileo services. However, other actions in priority areas are still under preparation and there is still no time schedule showing when regulation or standards can be expected in each policy area or market segment (paragraphs 80 to 84).

103 In Earth observation, the Commission has not sufficiently promoted the use of Copernicus data in EU legislation, and has not yet conducted a comprehensive analysis where EU legislation could better promote its use (paragraph 85).

104 Regulatory or administrative barriers may inhibit the use of space services. However, the Commission and the Member States selected had no systematic overview about such barriers and how they could be removed (paragraphs 86 and 87).

Recommendation 4 – Better use the regulatory framework to support the uptake of EU space services

In order to encourage and facilitate further uptake of services under the EU space programmes, the Commission should:

- (a) conduct an analysis where EU legislation or standards could promote making best use of Copernicus data and products;
- (b) identify, together with Member States, regulatory and administrative barriers inhibiting the uptake of EU space services and support them to remove such barriers; and
- (c) define time schedules for each relevant market segment, where regulation or standardisation can facilitate the use of Galileo and closely monitor them.

Timeframe: 2024

This Report was adopted by Chamber IV, headed by Mr Alex Brenninkmeijer, Member of the Court of Auditors, in Luxembourg on 23 March 2021.

For the Court of Auditors

Klaus-Heiner Lehne
President

Annexes

Annex I – Budget for the EU Space Programmes

Galileo and EGNOS			
(in million €)	before 2014	2014-2020	TOTAL
Galileo development phase	1 380		1 380
Galileo deployment phase	2 473	2 825	5 298
Galileo exploitation phase		2 940	2 940
EGNOS exploitation	426	1 514	1 940
GNSS Research	240	426	666
European GNSS Agency	58	206	265
Other administrative and operational expenditure	34	79	113
Other costs	82		82
Total Galileo and EGNOS	4 693	7 990	12 684
Copernicus (EU financed part)			
Copernicus infrastructure	778	3 503	4 281
Copernicus services	512	764	1 276
Administrative expenditure		96	96
Total Copernicus	1 290	4 363	5 653
Total all space programmes	5 983	12 353	18 336

Annex II – Key actions in the 2016 Space Strategy for Europe

Objectives	Main actions
1. Maximising the benefits of space for society and the EU economy	
1.1. Encouraging the uptake of space services and data	— promote the uptake of Copernicus, EGNOS and Galileo solutions in EU policies where justified and beneficial, including in the short term, with measures introducing the use of Galileo for mobile phones, and critical infrastructure using time synchronisation.
	— facilitate the use of Copernicus data and information by strengthening data dissemination and setting up platform services, promoting interfaces with non-space data and services.
	— stimulate the development of space applications with a greater involvement of new actors from different domains.
1.2. Advancing the EU space programmes and meeting new user needs	— remain committed to the stability of the EU space programmes and prepare the new generations, on a user-driven basis, to continue delivering state-of-the-art services. To this end, the Commission will explore alternative business models and take account of technological progress.
	— address emerging needs related, in particular, to climate change, sustainable development and security and defence.
2. Fostering a globally competitive and innovative European space sector	
2.1. Supporting research and innovation and development of skills	— step up efforts to support space research and development activities, in cooperation with Member States and ESA, and review its strategic approach to boosting the competitiveness of the European space sector.
	— strengthen the use of innovative procurement schemes to stimulate the demand-side of innovation and explore new approaches to leverage private sector investments and partnerships with industry.
	— together with Member States and ESA, promote the use of common technology roadmaps to ensure greater complementarity of research and development projects.
	— include space/Earth observation in the blueprint for sectoral cooperation on skills addressing new skills requirements in the sector.
2.2. Fostering entrepreneurship and new business opportunities	— step up support to space entrepreneurs through EU funding programmes to facilitate further financing of investments in the space sector.
	— engage in a dialogue with the EIB and EIF on the support of investment in the space sector as part of the overall Investment Plan for Europe.
	— support space start-ups, including by exploring synergies with the upcoming Fund of Funds, and facilitate the emergence of space hubs and clusters across Europe.

Annex III – Regulatory measures facilitating the uptake of Galileo services

Regulation	Area
Directive (EU) 2019/520 of 19.3.2019 on the interoperability of electronic road toll systems and facilitating cross-border exchange of information on the failure to pay road fees in the Union	Road transport
Commission Delegated Regulation (EU) 2019/320 of 12 December 2018 supplementing of Directive 2014/53/EU of the European Parliament and of the Council with regard to the application of the essential requirements referred to in Article 3(3)(g) in order to ensure caller location in emergency communications from mobile devices	Localisation of persons in case of an emergency
Commission Implementing Regulation (EU) 2016/799 of 18.3.2016 laying down the requirements for the construction, testing, installation, operation and repair of tachographs and their components	Localisation of vehicles having a mass of more than 3,5 tonnes (in goods transport) and carrying more than 9 persons including the driver (in passenger transport)
Regulation (EU) No 2015/758 of 29.4.2015 concerning type-approval requirements for the deployment of the eCall in-vehicle system based on the 112 service and amending Directive 2007/46/EC	Emergency assistance for cars and light commercial motor vehicles

Acronyms and abbreviations

AWP: Annual work programmes

C3S: Copernicus Climate Change Service

CAMS: Copernicus Atmosphere Monitoring Service

CEMS: Copernicus Emergency Services

CLMS: Copernicus Land Monitoring Services

CMEMS: Copernicus Marine Environment Monitoring Service

CoIGS: Collaborative Ground Segment

CORINE: EU programme for coordination of information on the environment

COSME: EU programme for small and medium sized enterprises

DIAS: Data and Information Access Services

ECMWF: European Centre for Medium-Range Weather Forecasts

EGNOS: European Geostationary Navigation Overlay Service

EIB: European Investment Bank

EIF: European Investment Fund

ESA: European Space Agency

EUMETSAT: European Organisation for the Exploitation of Meteorological Satellites

EUSPA: European Union Agency for the Space Programme

GIS: Geographic Information System

GLMS: Copernicus Global Land Monitoring Service

GNSS: Global Navigation Satellite System

GSA: European GNSS Agency

IoT: Internet of Things

JRC: Joint Research Centre

OECD: Organisation for Economic Co-operation and Development

PRS: Public Regulated Services

Glossary

Copernicus: The EU's Earth observation and monitoring programme, which collects and processes data from satellites and Earth-based sensors to provide environmental and security information.

Copernicus core users: For the purpose of the Copernicus regulation, an EU institution or body, or a European, national, regional or local authority entrusted with defining, implementing, enforcing or monitoring a public service or policy.

European Geostationary Navigation Overlay Service (EGNOS): Satellite based system that enhances signals from GPS and makes them suitable for safety critical applications such as aviation.

Galileo: European global satellite based navigation system.

Ground segment: All the ground-based elements of a spacecraft system, used to control the spacecraft and relay data.

Sentinels: Fleet of satellites providing Earth observation data under the Copernicus programme.

REPLIES OF THE EUROPEAN COMMISSION TO THE EUROPEAN COURT OF AUDITORS SPECIAL REPORT: “EU SPACE PROGRAMMES GALILEO AND COPERNICUS: SERVICES LAUNCHED, BUT THE UPTAKE NEEDS A FURTHER BOOST”

EXECUTIVE SUMMARY

I. Common Commission reply to paragraphs I to IV.

Europe is a global power in space. Space policy, along with a strong and dynamic space sector, is essential to implementing EU's climate and digital strategies. Space has a direct impact on EU's geopolitical goal of strategic autonomy. Space is an enabler for a wide range of industrial and technological activities.

The Union has made significant investments in EU space programmes, which enabled progress that no Member State could have achieved on its own. The Union's flagship space programmes are excellent. Copernicus is a leading provider of Earth observation data across the globe. Galileo, Europe's own global navigation satellite system, is the most accurate satellite navigation system that exists and with almost 2 billion users is one of the most successful EU services.

These EU space programmes already deliver services that have become indispensable in everyone's daily lives. Space data is needed in using mobile phones, driving cars with a navigation system or taking the plane. It allows farmers to plan ahead. It helps to protect the environment and monitor climate change. Space data is important for our security and defence. It is also central to the protection of key infrastructures such as power plants, smart grids and for managing borders. It improves EU's response to earthquakes, forest fires and floods.

In 2016, the European Commission adopted the Space Strategy for Europe, a cornerstone for a vision and direction of the EU's space policy. Its first strategic goal is to maximise the benefits of space for society and the EU economy. It set up main actions for the Commission to encourage the uptake of space services and data.

Since 2014, the Commission has taken various specific measures to promote the market and user uptake of Galileo and Copernicus services. While these measures were conceived separately for Galileo and Copernicus services given their different legal framework, the new EU space programme for 2021-2027 will for the first time provide a common framework for all space data and services. The new EU space programme puts great emphasis on the downstream sector, the market uptake and the exploitation of space data. This will allow for streamlining the market and user uptake activities of all space data and services.

V. The Commission acknowledges the importance to carry on the promotion and uptake of the Galileo and Copernicus services and to further capitalise on these investments.

VI. For market uptake of the Galileo services, the Commission's role was to assess the possibilities for promoting and ensuring the use of these services across various sectors of the economy. The European GNSS Agency was in charge of the promotion and marketing of the Galileo services, by carrying out the market analysis, by establishing close contacts with users and by drawing up an action plan for the uptake by user communities of the services.

VII. The Commission is aware of the fragmented nature of the services market and therefore proposed several pieces of EU legislation on the uptake, for example, in the area of road safety and emergency services.

IX. The objectives for Galileo and Copernicus programme were defined in their respective legal bases and detailed actions were included in the annual work programmes. The impact of the actions was measured by Key Performance Indicators defined in the respective legal basis and monitored in the programme statements accompanying the draft budget proposal.

The Commission will continue its work to improve the coherence of all these activities.

X. The Commission points out that it is also engaged in market segments other than road safety and emergency services and is introducing Galileo and Copernicus in EU legislation related to the Green and Digital Agenda.

XI. The Commission accepts all recommendations.

INTRODUCTION

6. Second bullet point - The Commission notes that the provision of high-level information (e.g. Copernicus Services) can also be defined as “midstream”.

OBSERVATIONS

24. In the period 2014-2020, the flagship space programmes Galileo/EGNOS and Copernicus were based on two distinct legal frameworks with different objectives and a different pace for their implementation. The provision of EGNOS services started in 2009, of Copernicus services in 2014 and of Galileo services in 2016.

With regard to market uptake, the two legal frameworks did not foresee any provisions for merging the market uptake activities of these programmes during the period of 2014-2020. Each of the programmes developed a separate user and market uptake strategy.

Furthermore, both programmes were not operational at the same time and had initially very different primary user target groups (institutional/research for Copernicus; mass market/private for Galileo). Given this context, the Commission has not yet been in a position to develop a strategy targeting both EU space programmes.

The new regulation establishing the Space Programme of the Union will be a basis for developing a strategy for the uptake of all EU space services in the future.

25. The 2016 Space Strategy is a political document the purpose of which is to set a vision and direction of the EU's space policy. The first goal of the Space Strategy is to maximise the benefits of space for society and it indicates key actions for encouraging the uptake of space services and data. These key actions were then translated into specific actions in the individual annual work programmes of Galileo/EGNOS and Copernicus, as well as into a specific market development strategy of the European GNSS Agency.

26. The Commission underlines that the 2016 Space Strategy was conceived as a political document setting up a vision and direction of the EU's space policy, not as an Action Plan for uptake of space services. The Space Strategy is not considered to be a framework against which the performance of the EGNSS and Copernicus programmes are to be measured.

It needs to be noted that the two separate mid-term evaluations of the programmes carried out in 2017 (ref.: COM(2017) 616 final and COM(2017) 617 final) demonstrated considerable achievements in uptake of services.

27. The Commission adopts the annual work programme in a form of an implementation plan of the actions required to meet the specific objectives of the Galileo and Copernicus programmes. The purpose of the annual work programme is to decide on the spending of the commitment appropriations and to provide certain detail on the budget implementation. In this context, annual work programmes do not foresee a monitoring objective.

28. The Commission adopted the annual work programme, which in addition to general objectives such as “Reinforce market uptake and standards”, contained a part called “Main actions and milestones” that describes the actions in detail together with the timeline.

The results on these actions and their progress was closely monitored through Quarterly Progress Reports, where progress of the actions under each objective was tracked.

29. In cooperation with the Commission, the European GNSS Agency developed and implemented a detailed market development strategy with detailed targets, actions and key performance indicators.

With regard to the geographical coverage of the market, it needs to be noted that Europe has been the most important and the largest market for Galileo and EGNOS services.

30. In 2016 the Commission conducted a detailed gap analysis, which provided a solid basis for an effective user engagement approach for the Copernicus programme. Key recommendations of the gap analysis were broadly translated into actions in the annual work programme.

The new Space Programme Regulation will provide a coherent framework for the Commission to promote and ensure the uptake and use of data and services provided by the programme components.

The Commission supports the Member States in their user uptake activities. It encourages and fosters a dynamic bottom-up approach in close collaboration with the Member States.

31. To foster the European space sector, the Commission intends to continue and further scale up these initiatives in 2021-2027, making use of the various Union programmes from Horizon Europe, to the EU Space Programme and InvestEU. The Commission also intends to launch a new space entrepreneurship initiative CASSINI for the period 2021-2027 to increase the number and improve the market penetration of space-based start-ups and to facilitate their access to public and private capital.

32. Commission's common reply to paragraphs 32 and 33.

The use of Copernicus data and services has followed the evolution of both the space and services component. As new Copernicus features become available more policy areas are being targeted for uptake.

In 2019, the Commission carried out a survey and assessment on the use of Earth Observation and Copernicus data and information in different EU policies. The recommendations are documented in a public report¹. One concrete follow-up to this discussion has been the setting up of a Knowledge Centre on Earth Observation (KCEO) to be officially launched in 2021 to boost the use of Copernicus within the Commission and other EU institutions/bodies.

35. The Commission acknowledges the ECA's observation. However, the Entrusted Entities organised a number of uptake and outreach activities targeting their specific constituencies.

In accordance with this, Entrusted Entities have organised a significant number of awareness/user support, appreciated by the stakeholders. At programme level, the promotion of Copernicus is coordinated by the Commission within the so-called Copernicus Ecosystem Team network, which serves as a platform for Entrusted Entities and the Commission to present their plans and identify potential synergies to avoid duplication of costs and efforts for horizontal events.

For Copernicus 2.0, the Commission will seek to ensure a better alignment and streamlining across the different contribution agreements for the tasks and budgets in supporting uptake.

36. While recognising that EEA had a limited budget to promote the Copernicus services under the current Delegation Agreement with the Commission (ending in 2021), the Commission considers that this situation should improve with the future agreement between the Commission and EEA.

Moreover, exploiting the full potential of Copernicus is emphasised in the new EEA/Eionet Strategy 2021-2030 recently adopted by the EEA Management Board. EEA has a key role to play in enhancing the Copernicus user uptake through its network (Eionet) and stakeholders, including Environmental Protection Agencies and public organisations involved in monitoring and implementation of environmental policies.

37. Neither the Commission nor the European GNSS Agency has a competence to impose coordination of national space strategies. Member States have no obligation to coordinate their own space strategies or measures with the Commission or with the European GNSS Agency.

¹ Kucera, J., Janssens-Maenhout, G., Brink, A., Greidanus, H., Roggeri, P., Strobl, P., Tartaglia, G., Belward A., M. Dowell, Copernicus and Earth observation in support of EU policies - Part I: Copernicus uptake in the European Commission, EUR 30030 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-14559-2, doi:10.2760/024084, JRC118879.

39. The Commission recalls that it has no competence to act directly at national level. The uptake of Copernicus at national level is the responsibility of the Member States. Enforcing a top-down approach is not acceptable for the Member States.

Nevertheless, in order to support the bottom-up approach and based on the 2016 analysis, the Commission set up various actions to address needs at the local, regional and national level. Examples include the creation of the Copernicus Relay and Academy Networks, the organisation of national info days in Member States, hackathons, university sessions, a Framework partnership agreement or thematic workshops to support best practice exchanges on national and regional levels, as well as a dedicated workshop on complementarity between EU and Member States user uptake strategies in 2019².

40. The Commission acknowledges that the demand for downstream products is very different and fragmented mainly due to different Member States' and users' needs. The private sector is better suited to respond to specific request of their geographical area of activity and the downstream sector itself provides tools for public authorities and Member States as a marketplace to discover tailor-made solutions.

41. The Commission acknowledges that different Members States may have different approaches towards Earth Observation solutions. The delegates to the Copernicus user forum and Copernicus Committee are regularly encouraged to share their national experience with other national delegates.

42. The Commission has facilitated best practice exchanges of national initiatives in the context of the Copernicus User Forum and Copernicus Committee, and through workshops with Member States.

44. As there is no existing recognised conceptual framework for estimating benefits in the domain of space, the Commission in cooperation with the European GNSS Agency considers that it developed a sound methodology for determining the socio-economic benefits from Galileo and EGNOS.

45. The market-related input data used in this methodology and published in the bi-annual Market Report have become the global reference point in this domain. The calculated value of benefits is comparable to those estimated in other regions (Economic Benefits of the Global Positioning System to the U.S. Private Sector Study published by NIST in 2019³) and other space programmes.

The Commission considers that although improvements may be further achieved, the estimates of the benefits from space services are useful.

47. The methodologies used in the Commission's studies for calculating economic benefits are recognised and used in Europe in several other industrial sectors; they are not in disagreement with any of the indications provided by the OECD Handbook.

The assessment of the Copernicus downstream industry was based on a thorough literature review to identify the most suitable methodologies. It highlighted the main difficulty in assessing the benefits derived from the use of Earth Observation (EO) data, namely the extent to which the benefits could be directly attributed to or associated with Copernicus data.

48. The Commission underlines the very challenging nature of calculations for estimating benefits on elements like mitigation of climate change or on number of lives that could have been saved by observations in disaster events.

Societal and wider impacts include wider social benefits like increased safety and security, national prestige, environmental impacts, outreach impacts. Those impacts are extremely important to assess, as they complement the view of the monetary (GDP and catalytic) impacts. Regarding Galileo and EGNOS, they have been established in line with the Commission's impact assessment guidelines.

² Copernicus Workshop: Fostering synergies in Copernicus user uptake activities at European and national level, 19 June 2019.

³ <https://www.nist.gov/news-events/news/2019/10/economic-benefits-global-positioning-system-us-private-sector-study>

Box 3 - Examples for shortcomings in the calculation of benefits resulting from the EU space programmes

For Galileo, public entities such as universities, national space agencies and non-profit organisations are already considered only insofar as they receive funding through the Horizon 2020 Calls on Space and the related spill over effect is taken into account.

The economic benefits enabled by public investments in space activities are mostly intangible and complex to capture. The changing nature of spin-off requires a micro-economic approach rather than a macro-economic one in order to understand a complex phenomenon at the scale of the firm.

The aim of this micro-diffusion approach is to show the existence of the phenomenon rather than providing an exact figure to prevent overestimation of benefits. The complexity of the economic phenomenon in the case of the use of Copernicus data & products justifies the use of a micro-diffusion model to understand at the level of the firm how the data & products are used and are creating specific knowledge leading to sales increase or cost reduction.

In the opinion of the Commission, other methodologies such as the GDP impact assessment methodology are less able to capture the complexity of this type of phenomenon and assess accurately such economic impact.

49. The legal frameworks for Galileo and Copernicus programmes provide specific objectives and performance indicators for each of the programmes, including some related to market uptake.

51. The heterogeneity of the Copernicus user uptake key performance indicators (KPIs) was due to differences in individual delegation agreements with the various Copernicus entrusted entities.

For communication actions specifically, the Commission harmonised the KPIs between the entrusted entities. This has allowed quarterly aggregation of results and monitoring of certain trends.

For the next programming phase, the Commission seeks to further streamline the definition of the KPIs across the different Entrusted Entities.

53. After the 2019 incident, which affected Galileo performance and service availability, the system has been largely reinforced and improved.

While other providers are working on increasing their accuracy levels, Europe already started to build Galileo's second generation infrastructure to remain at the forefront of satellite navigation. First satellites are foreseen to be launched as from 2024.

60. The Commission highlights that research and innovation projects can develop over their lifetime, and adjust their actions to technological developments. There are also dedicated mechanisms, for innovation projects in particular, to exploit the potential of latest innovations. For instance, in some projects “open calls” can be launched (so-called grants to third parties) by the consortia themselves.

61. The Commission highlights that also projects funded under other segments of Horizon 2020, also support the uptake of Galileo and EGNOS services. In the portfolio of Horizon 2020 actions, end user orientation and the development of business models play an important role.

While the development of innovative solutions developed for the market also depends on the resources of potential customers, the Commission aims at capitalising the results of research and innovation actions, through a strong research-policy interface and dedicated follow-up actions.

Box 4 - Factor hindering the uptake of EU funded actions supporting Galileo services

The Commission points out that selling products to institutional users is more difficult than selling products to private entities.

The Commission also underlines that it is not from the outset clear that an R&D project will lead to successful or marketable products.

65. The Commission considers that the support to start-ups via financial prizes was well defined and well monitored by identifying at the start of each Accelerator round the objectives, needs,

expectations of the start-up and its mentor. During the coaching period, the progress of the objectives achieved was monitored, as well as a feedback about the usefulness of the coaching.

Building upon these initiatives, the Commission prepares the launch of a new space entrepreneurship initiative CASSINI (Competitive Space Start-ups for INnovation) for the period 2021-2027 to improve the market penetration of space-based start-ups.

67. The ambition of the Caroline Herschel Framework Partnership Agreement was to be a comprehensive uptake tool addressed to Member States, responsive to their needs, and with an inclusive grass-root approach.

The limited resources available to the instrument would make support for long-term expert employment difficult, but it has to be noted that many actions supported have capacity building effect, influencing Member State's agencies in hiring such professional figures on their own.

68. The initial delays in implementation were also due to the need for clarifying a few legal aspects related to the functioning of this new instrument. They have since then been absorbed, with all specific grant agreements from 2019 work programme approved in 2020; the first specific grant agreements from the 2020 work programme were submitted late 2020 and were in the process of being approved. The 2021 work programme needs to follow the adoption schedule of the Space Programme Work programme.

Box 5 - Ambitious objectives but limited impact

The Commission underlines that demand-driven innovation actions by public authorities are amongst the most difficult Research & Innovations actions to develop and promote. The Commission received two proposals following the call on Earth Observation "EO-2-2016" and this is rather to be considered a success.

The Commission underlines that a very limited number of grants awarded is not unusual at all for these types of action.

76. The option regarding the number of Data and Information Access Services (DIAS) was proposed to Member States in the "Operational Implementing Plan" and the solution retained by Member States was to have more than one DIAS.

In Copernicus, the DIAS are the only services provided to users at a cost. Copernicus had no metrics for paying services since the data and information are provided on a free basis. There has been a continuous uptake of such paying services per users. The Commission did promote the use of the DIAS in Horizon 2020 and research project have on-boarded on the DIAS. ESA and EUMETSAT also promoted the use of the DIAS, for example in the Network of Resources scheme. The DIAS helped relieve archive infrastructures.

77. Actions to reduce cost in a cloud environment have been implemented in all of the DIAS. They consist of a balance between online data and near line data. In the Commission's opinion, these actions are cost-efficient since the cost driver is the size of the archive to be made available online. The Commission is working on the rationalisation and improvement of the Copernicus data access and exploitation infrastructures.

While one Member State is already using DIAS related infrastructures, it needs, however, to be noted that Member States in general aim to be independent in the setting up of their collaborative ground segments.

Copernicus strategy is to offer facilities to any users (citizens, public authorities, businesses as well as researchers) and will be integrated in a number of data spaces as referred to in the Commission communication on a European strategy for data⁴.

83. The regulatory and standardisation activities undertaken so far focused on major market segments (smartphones, road applications, aviation) and have already contributed to the Galileo and EGNOS

⁴ COM(2020) 66 final of 19.2.2020.

penetration in the market. The Commission undertook major efforts for the development of aviation standards for Galileo and EGNOS, which were adopted in 2020 at ICAO Navigation Systems Panel and EUROCAE.

84. With regard to activities in the area of intelligent connectivity, the possible critical standards were analysed. Currently, the Alliance for the Internet of Things Innovation (AIOTI) architecture is too high level and there are no requirements related directly to satellite navigation.

With regard to the public administrations, in addition to the Farm Sustainability Tool (FaST) used in agriculture, a study was carried out to identify in the current clearing procedures involving containers and shipments. Follow up activities were initiated to introduce Galileo in data exchanges in the electronic freight transport information and in DATEX II (data exchange standard), a standardised electronic language to exchange road traffic and road-related travel related information.

85. With regard to the EU legislation, the Commission underlines that the most important application fields of Copernicus were targeted and Copernicus successfully integrated in that legislation: land use, forestry and agricultural policy.

In order to capitalise on the benefits of Copernicus in other areas, the Commission took the initiative to create the Knowledge Centre on Earth Observation (KCEO), which will enhance the further use of Copernicus data within the institutions.

87. The Commission underlines that an analysis of regulatory barriers has been a basis for introducing Galileo and Copernicus in several pieces of legislation.

CONCLUSIONS AND RECOMMENDATIONS

88. The Commission welcomes the conclusion of the ECA on the value of services and data provided by Galileo and Copernicus (and EGNOS).

The progress of the service uptake for both Galileo and Copernicus was steady. The service uptake is in particular striking in case of Galileo services. Galileo went from zero users in 2016 to almost 2 billion users with Galileo-enabled smartphones today.

For Copernicus, the number of users has equally shown good progression. According to annual statistics, there were more than 500,000 Copernicus registered users at the end of 2020. As many of these are institutional, the actual outreach to end users is several times higher. The new Space Regulation will provide the legal framework to further enhance the societal and economic benefits of Galileo and Copernicus.

89. The Commission underlines that the 2016 Space Strategy was conceived as a cornerstone for a vision and direction of the EU's space policy, not as an Action Plan for uptake of space services. The Space Strategy is not considered to be a framework against which the performance of the EGNSS and Copernicus programmes are to be measured. The strategic goals of the Space Strategy were flown down into specific actions in the individual annual work programmes of Galileo/EGNOS and Copernicus as well as into specific market development strategy of the European GNSS Agency.

90. The new Space Regulation foresees a pivotal role for the future space agency (EUSPA) in this area, for both navigation and earth observation. The Commission is confident that this will help to better streamline the overall strategy.

91. The Commission agrees that further efforts are needed in order to fully explore the potential of the Copernicus data. Yet, the Commission underlines that a lot of progress has been achieved already, in particular within the Commission where many departments use Copernicus data and consider their use as part of their strategy.

To enhance the further use of Copernicus data within EU institutions or bodies, the Commission plans to set up a Knowledge Centre on Earth Observation in 2021.

92. The user uptake strategies varied from one Copernicus Entrusted Entity to another. Some of them, in particular those with tasks related to security and emergency have only few authorised users and user uptake is obviously limited to them.

The Commission will look further into this aspect, in particular by working more closely with the future Entrusted Entities.

93. The Commission underlines that neither the Commission nor the European GNSS Agency has a competence to coordinate national space strategies. Also, the Member States have no obligation to coordinate their own space strategies or measures with the Commission or with the European GNSS Agency.

Recommendation 1 – Develop a comprehensive strategy for supporting the uptake of EU space services

The Commission accepts recommendation 1 (a).

The Commission underlines that it is its prerogative – in line with its right of initiative – to decide which form such a strategy shall take.

The Commission accepts recommendation 1 (b).

94. The Commission highlights that there is no recognised conceptual framework for the estimation of benefits in the domain of space.

To address this, the Commission, in cooperation with the European GNSS Agency (GSA) considers that it developed a sound methodology for determining the socio-economic benefits from Galileo and EGNOS.

This methodology is now used in the bi-annual Market Report published by the European GNSS Agency and these market reports have become the global reference point in this domain.

The Commission acknowledges that some benefits are very difficult to estimate, for instance in topics such as Climate Change adaptation aspects or Disasters prevention and management, with a very difficult quantification.

95. The Commission recognises that there are differences in methodology between the Galileo and Copernicus programmes for calculating their benefits. Yet the Commission did its utmost for the estimation of these benefits, in the absence of a recognised conceptual framework.

The new role of the European GNSS Agency (GSA, future EUSPA) i.e., to monitor the market of both programmes, should lead to more consistent and coherent approach for the estimation of benefits for both space programme components.

96. The new Space Regulation defines in its Annex a set of key indicators to report on progress of the programme. These key indicators are related to the achievement of the objectives of the regulation.

The Commission would like to underline that the quantitative information from indicators should be analysed in conjunction with qualitative information. Also, the analysis of the quantitative indicators should be put in the right context. Therefore, indicators are only one element to monitor the implementation.

Recommendation 2 – Develop a conceptual framework for estimating the benefits of the EU space programmes and improve performance measurement

The Commission accepts recommendation 2 (a).

The Commission accepts recommendation 2 (b).

The set of appropriate performance indicators are defined in the new Space Regulation. The reporting on these indicators is done annually through the programme statements in the draft budget proposal. These quantitative indicators need to be accompanied by qualitative information/analysis.

99. The Commission recalls that many activities have been put in place to support user uptake, previously not sufficiently supported in the beginning of the programme: relays, academy, “hackathons”, info sessions, accelerators, incubators, etc.

All these activities responded to specific needs and requests of support expressed by Member States. The Commission will continue its work to improve the coherence of all these activities.

101. The Commission agrees that the synergies between various channels providing Copernicus data can be better exploited.

Recommendation 3 – Ensure full readiness of Galileo and better targeted action on uptake of the EU space services

The Commission accepts recommendation 3 (a).

The Commission accepts recommendation 3 (b).

The Commission accepts recommendation 3 (c).

103. A study was conducted by the JRC around 2018, which provided a new insight into the use of Copernicus data in EU legislation.

The newly created Knowledge Centre on Earth Observation will strengthen the links between Copernicus and all policy areas of the Commission thus increasing the links between the different EU policies and the relevant legislation.

Recommendation 4 – Better use the regulatory framework to support the uptake of EU space services

a) The Commission accepts recommendation 4 (a).

The Commission underlines that it undertook an important step forward to stimulate the uptake of Copernicus and Galileo data, services and signals by making their use mandatory in the future Horizon Europe programme where Earth Observation and navigation play a role. It is the first time that this close link between research and space has been made.

The Commission accepts recommendation 4 (b).

The Commission accepts recommendation 4 (c).

In relation to the ‘time schedules’ for development of standards, the Commission is dependent on the work and actions of European and international standardisation organisations or other external actors.

REPLIES OF THE EUROPEAN GNSS AGENCY TO THE EUROPEAN COURT OF AUDITORS
SPECIAL REPORT: “EU SPACE PROGRAMMES GALILEO AND COPERNICUS: SERVICES
LAUNCHED, BUT THE UPTAKE NEEDS A FURTHER BOOST”

EXECUTIVE SUMMARY

Common reply to paragraphs V to X.

The European GNSS agency (GSA) has significantly contributed to the uptake of Galileo by building a solid knowledge of the market and the users, by designing and implementing uptake roadmaps with user communities and by fostering the development of user technologies and applications. Galileo has achieved almost two billion users by the end of 2020. The GSA agrees that Galileo market and user uptake activities should continue to ensure that Galileo continues to be used, to complete the uptake in markets with slower cycles and for differentiators. The GSA will become EUSPA and will extend its role on Copernicus market development, fostering synergies with Galileo.

The GSA acknowledges that there is not a common conceptual and statistical framework for estimating the benefits of space services in the EU. Therefore, GSA developed a methodology in the area of GNSS. The GSA recognises that such a methodology has shortcomings linked to the availability of statistical information at national level but considers it is still sound. The creation of EUSPA will foster a closer methodological alignment of the market monitoring activities and benefits estimation for all space programme components.

OBSERVATION 29

The GSA welcomes the ECA observation on the market development strategy that indeed contributed to the current significant uptake of Galileo.

The GSA confirms the focus on Europe, according to its mandate, but would like to underline that many GSA activities were addressed with an international dimension. The GSA worked with stakeholders from around the world, such as chipset manufacturers, car makers, airlines, no matter if their location was in Europe or outside of Europe.

OBSERVATION 37

It is relevant to note that Member States have no obligations to coordinate their national strategies with the GSA.

OBSERVATION 44

The GSA is aware that there is not a common conceptual and statistical framework for estimating the benefits of space services in the EU. Therefore, the GSA, in close cooperation with the European Commission, developed a methodology in the area of GNSS.

OBSERVATION 47

With respect to Galileo, following exchanges with ECA the approach to estimating Gross Value Added (GVA) has been updated and is now, in the opinion of the GSA, more in line with the conceptual framework to calculate the Gross Domestic Product (GDP) in the EU. Prior to the exchanges with ECA, the GSA developed a specific approach to calculate this type of benefits in an effort to overcome the issue of non-existence of national category for downstream GNSS.

OBSERVATION 48

With respect to Galileo, the GSA monetised the societal benefits such as the reduction of emissions, the time drivers saved in traffic jams, thanks to navigation systems, or the number of lives saved, according to the European Commission rules on Impact Assessment and using always the most reliable source for the monetisation. As a result, despite some shortcomings, in the GSA's opinion, the benefits estimation is still sound, exhaustive and produced estimations in line with the ones of similar GNSS systems.

OBSERVATION 56

The GSA highlights that receiver and equipment prioritise signals for navigation usually based on optimal geometry of satellites.

CONCLUSION 90

With respect to Galileo, the GSA adopted a market development strategy as described in paragraph 29 of the ECA's report.

CONCLUSION 93

Please see GSA reply to paragraph 37.

CONCLUSION 94

Please see GSA reply to paragraph 44.

CONCLUSION 95

Please see GSA reply to paragraph 48.

Audit team

The ECA's special reports set out the results of its audits of EU policies and programmes, or of management-related topics from specific budgetary areas. The ECA selects and designs these audit tasks to be of maximum impact by considering the risks to performance or compliance, the level of income or spending involved, forthcoming developments and political and public interest.

This performance audit was carried out by Audit Chamber IV Regulation of markets and competitive economy, headed by ECA Member Alex Brenninkmeijer. The audit was led by ECA Member Mihails Kozlovs, supported by Edite Dzalbe, Head of Private Office and Laura Graudina, Private Office Attaché; John Sweeney, Principal Manager; Sven Kölling, Head of Task; Agnieszka Plebanowicz, Maria-Isabel Quintela and Aleksandar Latinov, auditors.



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Timeline

Event	Date
Adoption of Audit Planning Memorandum (APM) / Start of Audit	22.10.2019
Official sending of draft report to Commission (or other auditee)	27.1.2021
Adoption of the final report after the adversarial procedure	23.3.2021
Official replies of the Commission received in all languages	16.4.2021
Official replies of the European GNSS Agency received in all languages	14.4.2021

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The global navigation satellite system Galileo and the Copernicus Earth observation programme are flagships of the EU space policy. They provide valuable services that enable more accurate navigation and timing and deliver valuable data about the Earth.

There is, however, no comprehensive strategy yet for promoting the uptake of these services and no conceptual statistical framework to reliably assess the benefits of the programmes.

We found shortcomings in the monitoring of uptake and noted that some key features of Galileo are not yet available. The objectives and the impact of several key actions supporting the uptake of the services provided by Galileo and Copernicus were not clear, and the Commission has only partly taken advantage of the potential to promote these services in EU legislation or standards.

We make recommendations to remedy these issues.

ECA special report pursuant to Article 287(4), second subparagraph, TFEU.



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