sesar
JOINT UNDERTAKING

SESAR 3 JU CONSOLIDATED ANNUAL ACTIVITY REPORT 2022

EUROPEAN PARTNERSHIP

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Luxembourg: Publications Office of the European Union, 2023

PDF ISBN 978-92-9216-193-4 ISSN 2467-4133 doi:10.2829/737820 MG-AF-23-001-EN-N

This consolidated annual activity report (CAAR), established in accordance with Article 26 of Council Regulation (EU) 2021/2085 of 19 November 2021 and with Article 23 of the Financial Rules of the SESAR 3 JU, provides comprehensive information on the implementation of the Joint Undertaking's work programme, budget, staff policy plan, management and internal control systems in 2022.

The consolidated annual activity report will be made publicly available after its approval by the SESAR 3 JU Governing Board.

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FACTSHEET

Name	Single European Sky ATM Research (SESAR) 3 Joint Undertaking (JU)
Legal basis	▪ Article 187 of the Treaty on the Functioning of the European Union ▪ Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and repealing Regulations (EC) No 219/2007, (EU) No 557/2014, (EU) No 558/2014, (EU) No 559/2014, (EU) No 560/2014, (EU) No 561/2014 and (EU) No 642/2014 (OJ L 427, 30.11.2021, p. 17) (the single basic act (SBA))
Objectives	The mission of the SESAR 3 JU is to accelerate, through research and innovation, the delivery of an inclusive, resilient and sustainable Digital European Sky. The general objectives of the SESAR 3 JU are defined in Articles 4, 5 and 142(1) of the SBA. The specific objectives of the SESAR 3 JU are defined in Article 142(2) of the SBA. The tasks of the SESAR 3 JU are defined in Article 143 of the SBA.
Executive Director	Andreas Boschen (as of 1 July 2022) Richard Frizon, Executive Director *ad interim* (up to 30 June 2022)
Governing board	The SESAR 3 JU Governing Board is responsible for the strategic orientation and the operations of the JU, and supervises the implementation of its activities. Chaired by the Commission (Directorate-General for Mobility and Transport), it is composed of 55 founding members in addition to permanent observers from strategic partners.
Other bodies	Bodies of the SESAR 3 JU: ▪ States' Representatives Group ▪ Scientific Committee ▪ Advisory Body to the Executive Director: SESAR 3 JU Programme Committee
Staff numbers	37 temporary agents 1 contract agent 2 seconded national experts
Total budget (2022) ([1])	Commitment appropriations: EUR 159 712 690 ([2]) Payment appropriations: EUR 147 798 001 ([3])
Budget implementation/ execution	**Commitment appropriations (% of the committed amount/budget)** Total consumption: EUR 143 540 827 (87 %) ▪ Title 1: EUR 5 313 213 (93 %) ▪ Title 2: EUR 3 476 329 (100 %) ▪ Title 3: EUR 6 339 219 (98 %) ▪ Title 4: EUR 128 412 066 (100 %) ▪ Title 5: no consumption **Payment appropriations (% of the paid amount/budget)** Total consumption: EUR 36 280 966 (25 %) ▪ Title 1: EUR 5 029 646 (93 %) ▪ Title 2: EUR 3 009 270 (81 %) ▪ Title 3: EUR 28 241 600 (54 %) ▪ Title 4: EUR 450 (0 %) ▪ Title 5: no consumption

([1]) The total budget comprises the operational budget (used for funding selected projects) and the administrative budget (used for funding programme office activities).

([2]) Initial commitment appropriations were EUR 138 075 000, which was subsequently amended to include unused appropriations from prior years. Commitment appropriations include the EUR 926 226 resulting from the recovery of amounts of an administrative or operational nature (such as recovery of insurance and *ex post* audits on projects).

([3]) Initial payment appropriations were EUR 143 433 311, which was subsequently amended to include unused appropriations from prior years. Payment appropriations include the EUR 926 116 resulting from the recovery of amounts of an administrative or operational nature (such as recovery of insurance and *ex post* audits on projects).

Grants/tenders/ prizes	0 grants signed with a total value of EUR 0 22 contracts signed with a total value of EUR 30 635 322 (as detailed in Sections 1.3 and 2.6) 2 prizes signed with a total value of EUR 6 500 (as detailed in Section 1.3) Total value: EUR 30 641 822
Strategic research and innovation agenda	Strategic research and innovation agenda for the digital European sky
Call implementation	Number of calls launched in 2022: 2 Number of proposals submitted: 127 Number of eligible proposals: 121 Number of proposals granted: N/A Number of global projects as of the end of 2022 (since the setting up; signed grant only; for evolution overview): 70 Horizon 2020 projects
Participation, including participation of small and medium-sized enterprises (SMEs) (projects active in 2022)	Total number of participations in funded projects: 1 014, of which: ▪ 11 % were SMEs, which received 8.3 % of the EU funding; ▪ 67 % were private for-profit/large companies, which received 69 % of the EU funding; ▪ 1.3 % were non-associated, non-EU members' entities (openness). % of newcomer entities: N/A.

FOREWORD

For the SESAR 3 JU and its members and partners, 2022 proved to be a very eventful year. Over the course of 12 months, we successfully put in place the full governance structure of the partnership, enabling us to move forward with the Digital European Sky programme and the publication of the first calls within the framework of Horizon Europe for exploratory and industrial research, and fast-track to innovation and market uptake. From the 127 proposals received, 50 projects were selected in 2023, representing a total investment of EUR 374 million. We also successfully activated the full innovation pipeline, with the launch of five new Digital Sky Demonstrators under the Connecting Europe Facility, on green aviation and urban air mobility, while a second call for demonstrators was published in the areas of automation and virtualisation.

At the same time, we brought to a close a sizeable portion of the SESAR 2020 programme, consolidating the results from over 40 projects and delivering a further 16 solutions ready for industrialisation, and in doing so produced a wealth of innovative concepts for further advancement.

Furthermore, we took the decision to move our offices to the EUROCONTROL site in Haren, Brussels, which will increase synergies.

All of the above represented a significant workload, for the staff of the joint undertaking and for its members and partners, who continue to grapple with uncertainties and disruptions caused by the pandemic and the Russian war of aggression against Ukraine. The pages of this report pay testament to the numerous fruits of that labour and the unwavering commitment of our community to deliver an inclusive, sustainable and resilient Digital European Sky. They also demonstrate clearly how the partnership is bringing added value, especially around key strategic priorities of the European Union, notably the European Green Deal, a Europe fit for the digital age and a stronger Europe in the world.

I hope you enjoy the read.

Andreas Boschen
Executive Director of the SESAR 3 JU


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D47-D49

EXECUTIVE SUMMARY

In 2022, the Single European Sky ATM Research (SESAR) Joint Undertaking (JU) made considerable progress in completing the research and innovation (R & I) activities of the SESAR 2020 programme while enabling the new SESAR 3 JU partnership to become fully functional and the Digital European Sky R & I programme to get up and running. The activities highlighted in this report illustrate the JU's contribution to the European Commission's strategic priorities and initiatives, namely the single European sky, the European Green Deal and a Europe fit for the digital age.

A partnership ready to deliver

In 2022, the SESAR 3 JU established its full governance structure and membership framework, enabling it to move forward with the Digital European Sky programme. Major milestones included the establishment of the States' Representatives Group, enabling Member States to have a direct advisory role with regard to the partnership's priorities, planning and activities; the establishment of the SESAR 3 JU Programme Committee, which steers the R & I activities; and the establishment of the Scientific Committee, which provides independent scientific advice on all matters relating to the programme. Other significant achievements were the finalisation and approval of the membership agreement between members on their collective engagement in the programme, and the administrative agreement signed with EUROCONTROL, which sets out the organisation's renewed role in and commitment to the partnership. The latter also contained provisions for office space for the partnership at EUROCONTROL's headquarters in Brussels. Preparations for the move began in 2022, and the SESAR 3 JU moved to its new home in early 2023. The SESAR 3 JU Governing Board appointed Andreas Boschen as Executive Director, with his mandate starting in July 2022.

Digital European Sky programme gets off the ground

The Digital European Sky programme commenced in 2022 with the approval of the multiannual work programme and the first biannual work programme, and the launch of the first two calls within the framework of Horizon Europe for (1) exploratory and industrial research and (2) fast-track to innovation and market uptake. Of the 127 project proposals received, 48 have been selected, representing a total investment of EUR 350 million. The SESAR innovation pipeline was fully activated in 2022 with the launch of five Digital Sky Demonstrators under the Connecting Europe Facility, on green aviation and urban air mobility, while a second call for demonstrators was published in September covering the areas of automation and virtualisation. The SESAR 3 JU provided technical expertise to the European Climate, Infrastructure and Environment Executive Agency for the preparation and evaluation of the call, which continues during the implementation of the five selected projects.

Delivering tangible results and solutions for market uptake

The SESAR 3 JU members and partners were successful in advancing new technologies and procedures through the SESAR innovation pipeline release process, in accordance with the timeline set by the European air traffic management (ATM) Master Plan – Europe's roadmap for the digital transformation of ATM. In 2022, the SESAR 3 JU members and partners delivered 15 new solutions ready for industrialisation, targeting airport operations, air traffic services and the performance of the aviation network as a whole. Altogether, close to 120 solutions have been given the green light since the start of SESAR, with many now in deployment. At the same time, the JU brought to a close more than 40 projects, mainly from the exploratory research strand of the programme. The most promising and mature technologies are being fed back into

the Digital European Sky programme to progress them further. Recognising the ongoing effects of the COVID-19 pandemic on the sector, the JU implemented a number of measures, including extending the duration of grants where necessary, to allow projects to conclude their validation activities and deliver the technical outcomes in accordance with the timelines of the European ATM Master Plan.

Getting engaged and strengthening ties

Collaboration and face-to-face engagement with stakeholders are critical to the success of the partnership. With the lifting of COVID-19 restrictions, the SESAR 3 JU resumed its face-to-face outreach through a number of hybrid and fully physical events, convening the community in order to address some pressing topics, with climate change topping the list. In October, the JU held its first annual conference in Brussels, gathering industry leaders and EU policymakers to discuss the aviation sector's digitalisation efforts. In November, urban air mobility and transport were the focus of the EU Drone Days, a 2-day conference co-organised by the European Commission and the JU. The year closed with the SESAR Innovation Days in Budapest, hosted by HungaroControl, during which Europe's leading researchers convened to discuss the latest developments in the ATM and aviation domains and to celebrate new talents with the SESAR Young Scientist Award.

The SESAR 3 JU also continued to enhance its bilateral cooperation and synergies with a range of European stakeholders, including the Clean Aviation JU, Europe's Rail JU, SESAR Deployment Manager, the European Union Aviation Safety Agency, the European Organisation for Civil Aviation Equipment, the European Defence Agency, the European Union Agency for the Space Programme, the Civil Air Navigation Services Organisation and organisations representing airlines, airports and professional staff. In addition, at the end of the year, the SESAR 3 JU joined the European Commission's Alliance for Zero Emission Aviation, an initiative that aims to ensure that air transport contributes to the EU's 2050 climate neutrality objective. The SESAR 3 JU was also active in the international arena during 2022, contributing to discussions in various forums of the International Civil Aviation Organization and engaging bilaterally with counterparts in Japan, the Republic of Korea, Singapore and the United States. At the end of 2022, the SESAR 3 JU joined 60 global partners in the Civil Air Navigation Services Organisation's Complete Air Traffic System initiative, working towards delivering the shared vision of what our skies will look like in 2045.


DUBLIN

1 Implementation of the 2022 annual work programme

1.1 Key objectives, associated risks and corrective measures

The Single European Sky ATM Research (SESAR) 3 Joint Undertaking (JU) met all of its objectives with regard to operations and the support provided to operations. Detailed explanations for each strategic area of operation and for the support provided to operations, governance, financial management and internal control are provided in the boxes at the beginning of each corresponding section of this document.

In addition, measurements of key performance indicators (KPIs) for Horizon 2020 are provided in Annexes 3, 4 and 6. Section 1.7 describing the progress against such KPIs.

The SESAR 3 JU ran its annual risk assessment, and the outcome is reported in Section 4.3.2.

1.2 Research and innovation activities/achievements

1.2.1 Strategic area of operation 1: provide strategic steering to the SESAR 2020 programme and the Digital European Sky programme

In 2022, the SESAR 3 JU met all of its objectives related to the provision of strategic steering to the SESAR 2020 programme and the Digital European Sky Programme, as set out in Section 2.2.1.3 of the 2022–2023 biannual work programme (BAWP). This includes the following achievements and results.

- Supervise and close the transversal activities (Engage, NOSTROMO, PJ19-W2 and PJ20-W2).
  - As regards the call H2020-SESAR-2019-2 (ER4 call for proposals), NOSTROMO was successfully closed.
  - As regards the call H2020-SESAR-2019-1 (IR VLD wave 2 call for proposals), the projects PJ19-W2 and PJ20-W2 were successfully closed.
  - As regards the call H2020-SESAR-2016-2 , Engage, following an extension, will continue its activities until 2023.

Contributions of transversal steering projects

Two projects carried out within the industrial research and validation (IR) strand supported the JU in providing strategic steering: PJ19-W2, on content integration, performance management and business case development, and PJ20-W2, covering the maintenance of the European air traffic management (ATM) Master Plan.

In November 2021, an initiative was launched regarding three practical improvement packages that aimed to simplify and strengthen the European ATM Master Planning (MP) processes (i.e. Master Plan update; planning and monitoring of development; and planning and monitoring of deployment). This initiative is expected to facilitate decision-making at the level of the SESAR 3 JU Governing Board (GB) and ensure alignment with the regulatory responsibilities set out in Article 155(1) of the single basic act (SBA).

On 15 December 2022, the GB unanimously adopted a proposal entitled 'A simplified and strengthened Master Planning (MP) approach'. This decision also encompassed the set-up of a technical coordination group, with all the main entities contributing at European level to the execution of the SESAR project, with the aim of steering, at technical level, the roll-out of the strategic deployment objectives defined in the Master Plan and facilitating accelerated market uptake of SESAR solutions.

Coordination in the field of exploratory research is being ensured through the SESAR knowledge transfer network project (Engage) and Next-generation open-source tools for ATM performance modelling and optimisation (NOSTROMO), in addition to the two projects providing transversal steering to IR projects.

Table 1 lists the four transversal projects active in 2022 (in alphabetical order), providing short descriptions of the projects and links to the dedicated project web pages (which include the latest news).

TABLE 1: OVERVIEW OF TRANSVERSAL PROJECTS ACTIVE IN 2022

Project reference	Project title	EU contribution (EUR)
Engage	**SESAR Knowledge Transfer Network**	**3 971 875**
The network aimed to stimulate the transfer of exploratory research results towards ATM application-oriented research. The network has established a knowledge hub, in which members across the research community are continuously involved. This knowledge hub included an observatory and has the role of devising and maintaining long-term roadmaps for innovative and interdisciplinary ATM concepts beyond SESAR 2020. It is intended to be the one-stop shop and the go-to source for ATM research information in Europe.		
Nostromo	**Next-generation open-source tools for ATM performance modelling and optimisation**	**1 771 361.25**
NOSTROMO aimed to develop new approaches to ATM performance modelling able to reconcile model transparency, computational tractability and ease of use with the sophistication required for a realistic representation of the ATM system.		
PJ19-W2 CI	**Content integration, performance management and business case development (wave 2)**	**4 473 968.99**
PJ19-W2 CI continues the work of the SESAR wave 1 PJ19 content integration project. It aims to integrate the SESAR Solutions into the integrated European ATM system in order to achieve the objectives set in the ATM Master Plan. This integrated European ATM system provides the overall European ATM concept; the high-level architecture options; the services; the supporting solutions and the performance achievements associated with them. PJ19-W2 CI produces a set of deliverables that consolidate the SESAR 2020 Programme outcomes. It also provides yearly integrated reference material.		
PJ20-W2 AMPLE	**Master Planning**	**2 011 277.60**
This project aims to ensure the maintenance, update and alignment of the three levels in the ATM Master Plan. Under the leadership of EUROCONTROL, through facilitated access to information-rich performance-based civil–military ATM data, it brings together contributions of 24 SESAR 2020 members, ensuring the broad ATM representativeness required and covering air navigation service providers, airports, the airborne and ground industry, and the Network Manager.		

1.2.2 Strategic area of operation 2: deliver exploratory research

In 2022, the SESAR 3 JU met all of its objectives related to Exploratory Research, as set out in Section 2.2.2.3 of the BAWP 2022-2023. This includes the following achievements and results:

- Regarding the supervision of call H2020-SESAR-2019-2 (ER4 call for proposals), 40 projects had completed their research activites and started their administrative closure by the end of December 2022. The European concept of operations for higher airspace operations (ECHO) project completed its research activities by the end of January 2023 following an extension.
- The open call Digital European Sky HORIZON-SESAR-2022-DES-ER-01 (ER1 call for proposals) was launched in April 2022, with a deadline in October 2022. In 2022, the SESAR 3 JU initiated the evaluation of the submitted proposals, and this was concluded in February 2023.
- Building on the commitment of the scientific community regarding the SESAR topics:
  - the SESAR Young Scientist Award event took place in December 2022 as part of the SESAR Innovation Days;
  - the SESAR 3 JU maintained active cooperation with the association for the Scientific Development of ATM in Europe. The SESAR 3 JU did not engage further with the European Aeronautics Science Network as its focus is on aeronautics. The SESAR 3 JU expects this to change in 2023 as the network intends to extend its reach to ATM.
- The SESAR 3 JU maintained the SESAR Digital Academy, which organised events aiming to develop the skills of the future ATM workforce.

1.2.2.1 Status of exploratory research 4 call (H2020-SESAR-2019-2)

The fourth open call for exploratory research proposals (ER4) took place in 2019, covering two work areas.

- **Work area 1 (ATM excellent science and outreach)** aimed to bridge the gap between ATM research and the wider research community and to provide the necessary scientific support to ATM change either directly or through connecting with research areas in other disciplines or sectors. Consequently, the purpose of this work area was to investigate which new technologies, methodologies, concepts or validation methods developed outside the ATM sector could be introduced in the context of ATM and, in particular, could serve the identified SESAR business needs and the *Flightpath 2050* ([4]) vision, or identify new ATM business opportunities.
- **Work area 2 (ATM application-oriented research)** was intended to identify concepts for ATM not already identified in the European ATM master plan, including emerging technologies and methods, bringing these to the level of maturity required to feed the applied research conducted in the JU.

A total of 41 grants have been signed, with 22 and 19 projects addressing work areas 1 and 2, respectively. All projects have completed their research activities and were closed by December 2022 with one exception; ECHO closed at the end of January 2023.

Of the 41 projects under this call, the two transversal activities (NOSTROMO and Engage) are summarised in Table 1. Table 2 lists the 40 ER4 projects active in 2022 (in alphabetical order), providing short descriptions of the projects and links to the dedicated project web pages (which includes the latest news).

([4]) *Flightpath 2050* is a report of the High-Level Group on Aviation and Aeronautics Research – established by the European Commission in December 2010 – setting out a new vision for the aviation sector to be achieved by 2050.

TABLE 2: **OVERVIEW OF ER4 PROJECTS ACTIVE IN 2022**

Project reference	Project title	EU contribution (EUR)
AEON	**Advanced engine off navigation**	**1 444 525**
AEON aimed to define a new concept of operations to make best use of green taxiing techniques. Specifically, TaxiBots, WheelTugs, e-Taxi and single-engine taxiing were investigated to address airport ground operations in medium- to long-term planning and execution phases. In the medium- to long-term planning phase, AEON integrates a supporting algorithm into the airport collaborative decision-making platform to evaluate the taxiing technique most appropriate for each flight. Then, in the execution phase, an algorithm for tug allocation and path planning is integrated into the advanced surface movement guidance and control system.		
AIchain	**A platform for privacy-preserving federated machine learning using blockchain to enable operational improvements in ATM**	**996 505**
This project developed privacy-preserving solutions to help overcome the stakeholders' reluctance to share sensitive data that contain valuable information for ATM operations to enrich operational machine learning applications.		
AISA	**AI situational awareness foundation for advancing automation**	**990 125**
This project analysed an artificial situational awareness system created by the project team using situational awareness among ATCO team members and AI.		
ALARM	**Multi-hazard monitoring and early warning system**	**991 268.75**
ALARM developed an integrated platform for the nowcasting and forecasting of multiple meteorological hazards, including climatic impact, and a multihazard monitoring and early warning system platform.		
ARTIMATION	**Transparent artificial intelligence and automation to air traffic management systems**	**999 375**
ARTIMATION addressed the improvement in terms of prediction of air traffic conflict resolution and delay propagation resulting from explainable AI.		
ASPRID	**Airport system protection from intruding drones**	**1 235 195**
ASPRID dealt with the problem of protecting airport operations from drone intrusion (careless or malicious) under a holistic and operationally oriented approach. It investigated the vulnerability of airports under the different types of threat, and possible responses, and studied the interrelations between all those aspects involving different scenarios.		
BEACON	**Behavioural economics for ATM concepts**	**996 593.75**
BEACON investigated the inclusion of concepts from behavioural economics in microsimulators aiminged at assessing the impact of new mechanisms and solutions in ATM.		
BUBBLES	**Defining the building basic blocks for a U-space separation management service**	**1 606 108.75**
This project aimed to define separation minima and methods for unmanned air systems flying in the very low-level airspace, to improve the overall performance and safety therein.		
CADENZA	**Advanced capacity and demand management for European network performance optimization**	**1 158 123.75**
CADENZA aimed to develop a detailed trajectory broker concept for the European network, incorporating advanced DCB mechanisms.		
CREATE	**Innovative operations and climate and weather models to improve ATM resilience and reduce impacts**	**998165**
CREATE delivered solutions to evaluate the 'greenness' of aircraft trajectories (CO_2, non-CO_2, contrail formation) during the TMA / en route flight phases and to support the reference business trajectory revision process		

Project reference	Project title	EU contribution (EUR)
DACUS	Demand and capacity optimisation in U-space	1 739 617.50
DACUS aims to develop a service-oriented DCB process for drone traffic management. It intends to integrate in a consistent DCB solution the relevant demand and capacity influences (such as CNS performance availability), definitions (such as airspace structure), processes (such as separation management) and services (such as strategic and tactical conflict resolution).		
DYNCAT	Dynamic configuration adjustment in the TMA	989 298.50
This project addressed greener and more predictable flight profiles during approach by supporting the pilots in configuration management.		
ECHO	European concept of operations for higher airspace operations	1 968 865
ECHO aimed to deliver a comprehensive demand analysis and a comprehensive, innovative and feasible concept of operations, enabling near-term and future higher airspace operations in a safe and orderly manner.		
FACT	Future all aviation CNS technology	1 850 500
This project addressed ATM/CNS modernisation and performance improvements by proposing and validating an integrated CNS (iCNS) functional architecture. It aimed to build the bridge between future U-space and conventional ATM considering both technological perspectives and the user's perspective, with a particular focus on coexistence of drones and general aviation in low-altitude airspace.		
FARO	Safety and resilience guidelines for aviation	999 558.75
FARO aimed to contribute to the existing knowledge about how safety and resilience are addressed in ATM, with four main objectives: (1) capitalisation on the existing safety knowledge, (2) quantification of the impact of increasing the level of automation on ATM safety levels, (3) analysis of the impact of higher levels of automation on ATM resilience and (4) provision of design guidelines and identification of future research needs.		
FlyATM4E	Flying air traffic management for the benefit of environment and climate	999 765
This project investigated innovative meteorological services to provide information on the climate effect of flight operations (CO2 and non-CO2 effects) and extension of aircraft trajectory planning processes to consider the overall climate impact.		
FMPMet	Meteorological uncertainty management for flow management positions	849 000
This project addressed the use of probabilistic weather forecasts to enhance flow management position processes.		
HAAWAII	Highly automated air traffic controller workstations with artificial intelligence integration	1 825 000
HAAWAII aimed to research and develop a reliable, error-resilient and adaptable solution to automatically transcribe voice commands issued by both air traffic controllers and pilots.		
ICARUS	Integrated common altitude reference system for U-space	1 144 587.50
This project aimed to propose an innovative solution to the challenge of the common altitude reference inside very low-level airspace with the definition of a new U-space service and its validation in a real operational environment. In manned aviation, the methods of determining the altitude of an aircraft are based on pressure altitude difference measurements (e.g. QFE, QNH and FL) referred to a common datum.		
IMHOTEP	Integrated multimodal airport operations for efficient passenger flow management	1 999 805
The goal of IMHOTEP was to develop a concept of operations and a set of data analysis methods, predictive models and decision support tools that allow information sharing, common situational awareness and real-time collaborative decision-making between airports and ground transport stakeholders.		

Project reference	Project title	EU contribution (EUR)
INVIRCAT	**IFR RPAS control in airports and TMA**	**1 416 055**
The main goals of INVIRCAT were the creation of a concept of operations for remotely piloted aircraft systems in the TMAs of airports, and assessing it through simulations, and drafting a set of recommendations for decision-makers and standardisation bodies.		
ISOBAR	**Artificial intelligence solutions to meteo-based DCB imbalances for network operations planning**	**1 908 797.50**
ISOBAR aimed to provide an AI-based network operations plan, by integrating enhanced convective weather forecasts for predicting imbalances between capacity and demand and exploiting AI to select mitigation measures at local and network level in a collaborative air traffic flow and capacity management operations paradigm.		
ITACA	**Incentivising technology adoption for accelerating change in ATM**	**999 937.50**
This project designed a policy assessment framework aiming to support the design of measures and regulations intended to accelerate the adoption and deployment of new ATM technologies.		
MAHALO	**Modern ATM via human/automation learning optimisation**	**997 212.50**
This project developed a machine learning modelling system supporting the resolution of en route ATC conflicts and also provided guidelines for the design of future AI systems.		
Metropolis 2	**A unified approach to airspace design and separation management for U-space**	**1 692 760**
Metropolis 2 aimed to provide the fundamentals for concrete solutions for U-space U3/U4 services needed to enable high-density urban aerial operations, with a unified approach to the following U-space services: strategic deconfliction, tactical deconfliction and dynamic capacity management.		
Modus	**Modelling and assessing the role of air transport in an integrated, intermodal transport system**	**998 875**
Modus developed a modelling approach for the assessment of seamless door-to-door multimodality and passenger experience in Europe.		
NewSense	**Evaluation of 5G network and mmWave radar sensors to enhance surveillance of the airport surface**	**943 960**
NewSense aimed to improve the safety and efficiency of operations primarily in secondary airports through innovative low-cost surface surveillance solutions, based on 5G cellular networks for the long term and wave radar for the medium term, allowing the implementation of affordable advanced surface movement guidance and control systems.		
SAFELAND	**Safe landing through enhanced ground support**	**1 978 137.50**
SAFELAND aimed to support flight and landing of aircraft operated by a single pilot, in case of partial or total incapacitation of the pilot. It focuses on the ground side and in particular on the role ATM could have in managing the transition from a single-pilot-operated flight to a situation with reduced or absent contribution of the on-board pilot to landing. This project investigated the interaction of the ATCO with on-board automation and/or a ground-based pilot operating through a remote cockpit position to manage the flight.		
SafeOPS	**Strengthening safe and scalable ATM services through automated risk analytics based on operational data from aviation stakeholders**	**997 750**
SafeOPS investigated the potential use of go-around predictions as decision support for tower controllers.		
SIMBAD	**Combining simulation models and big data analytics for ATM performance analysis**	**999 937.50**
SIMBAD analysed a performance modelling framework to facilitate a more comprehensive, accurate and efficient assessment of the performance impact of new ATM solutions/concepts.		

Project reference	Project title	EU contribution (EUR)
SINAPSE	**Software defined networking architecture augmented with artificial intelligence to improve aeronautical communications performance, security and efficiency**	**853 300**
SINAPSE aimed to accelerate the transition towards intelligent connectivity using AI. It proposed an intelligent Internet Protocol network capable of predicting service outages, enabling flexible network resources adjustment and robust protection against digital attacks.		
SINOPTICA	**Satellite-borne and in-situ observations to predict the initiation of convection for ATM**	**999 285**
SINOPTICA aimed to exploit the untapped potential of assimilating remote-sensing-derived datasets (derived from earth observation and ground-based radar), datasets derived from global navigation satellite systems and in situ weather station data into very high-resolution, very short-range numerical weather forecasts to provide improved prediction of extreme weather events to the benefit of ATM operations.		
SlotMachine	**A privacy-preserving marketplace for slot management**	**1 937 738.75**
SlotMachine aimed to employ a blockchain technology and secure multiparty computation to extend the existing user-driven prioritisation process solution with the possibility of maintaining the confidentiality of participating airlines' confidential information such as the cost structure of flights. The technology allows for secure, auditable transactions without the need for a central broker, with stakeholders being able to enter slot-swapping transactions without disclosing information to other participants.		
START	**Stable and resilient ATM by integrating robust airline operations into the network**	**1 999 411.25**
The overall goal of START was to develop, implement and validate optimisation algorithms for robust airline operations that result in stable and resilient ATM performance even in disruptive event scenarios.		
SYN AIR	**Synergies between transport modes and air transportation**	**997 250**
This project developed the concept of a smart contracts framework, aiming to facilitate the generation of contractual agreements, known as smart contracts, among transport service providers.		
TAPAS	**Towards an automated and explainable ATM system**	**997 410**
This project used explainable AI techniques to provide automated action decision and implementation in both air traffic flow and capacity management and ATC conflict detection and resolution functions.		
TRANSIT	**Travel information management for seamless intermodal transport**	**999 950**
This project developed an intermodality assessment framework, an intermodal timetable synchronisation and an intermodal disruption management tool.		
URClearED	**A unified integrated remain well clear concept in airspace D-G class**	**1 631 767.50**
This project aimed to support current study activities on the remain well clear functionalities by defining and analysing operational scenarios that enable the assessment of requirements and assumptions made in current standards and applicable documents, and then paving the way to future industry-level activities regarding a remain well clear system.		
USEPE	**U-space separation in Europe**	**1 999 308.75**
USEPE aimed to explore potential separation methods to ensure the safety of drone operations in urban environments, with a particular focus on densely populated areas.		
X-TEAM D2D	**Extended ATM for door2door travel**	**997 375**
This project researched a concept for the seamless integration of ATM and air transport into an intermodal network, including other available transportation means.		

NB: AI, artificial intelligence; ATC, air traffic control; ATCO, air traffic controller; CNS, communications, navigation and surveillance; DCB, demand–capacity balancing; TMA, terminal manoeuvring area.

1.2.2.2 Status of Digital European Sky Exploratory Research 1 (HORIZON-SESAR-2022-DES-ER-01)

HORIZON-SESAR-2022-DES-ER-01, The Digital European Sky open call for proposals, was launched on 7 April 2022, with a deadline of 13 October 2022. A total of 72 proposals were received, with 68 considered eligible. The evaluation phase was initiated in November 2022 with the aim of selecting the proposals and launching the grant preparation phase by mid-February 2023.

The call content **covered the following three work areas**.

- **Work area 1 (fundamental science and outreach)** comprised the exploratory research necessary to develop new concepts for ATM beyond those identified in the European ATM Master Plan. It will help in the development of emerging technologies and methods to the level of maturity required for the applied research conducted by the SESAR 3 JU. This part of the research was structured around the same flagships identified in the rest of the programme to ensure that there was a flow of ideas and results in a structured manner across the whole programme.
- **Work area 2 (ATM application-oriented research)** comprised exploratory research aiming to bridge the results of excellent ATM science and outreach and the higher-maturity ATM research performed with the wider research community, as part of the SESAR 3 JU's industrial research activities. It also aimed to provide the necessary scientific support to ATM change.
- **Work area 3 (knowledge transfer network)** aimed to provide support for the SESAR 3 JU to continue maintaining the overarching view across ATM exploratory research that was established in SESAR 2020, to provide a coordinated exchange of research knowledge across a wide range of relevant themes and, within the context of this coordination, helped to further foster the future ATM skilled workforce. The challenge was to support and encourage collaborative research on future and emerging innovative ideas, expertise and knowledge for the benefit of the future evolution of the European ATM system and its workforce.

1.2.2.3 Other exploratory research activities

1.2.2.3.1 SESAR Innovation Days

SESAR Innovation Days are the main vehicle through which the SESAR 3 JU shares progress and disseminates the results of its exploratory research programme. SESAR Innovation Days focus explicitly on long-term and innovative research, giving students and researchers the opportunity to present their work to peers and to submit scientific papers for formal publication.

The 12th edition of the SESAR Innovation Days took place in Budapest on 6–8 December 2022 in close cooperation with HungaroControl.

The event was preceded, on 5 December, by an opening ceremony at the HungaroControl premises. The participants visited the operational facilities and learned about the latest developments in remote towers.

This in-person conference, following 2 years of online conferences necessitated by COVID-19, brought together 400 participants, and featured some 39 posters and 51 papers, covering data-driven methods for safety and resilience prediction, climate-optimised trajectories, drone traffic management and airport operations, among other research areas.

Much of the research presented during the conference stems from the 41 exploratory research projects, including the SESAR knowledge transfer network project, Engage. The conference brings together academic and industry partners. To mark the closure of the SESAR 2020 exploratory research projects, three plenary sessions looked at the important topics of U-space (the enabling framework for drone integration), the environment and artificial intelligence (AI).

1.2.2.3.2 SESAR Young Scientist Award

The open call for the 2022 SESAR Young Scientist Award was launched on 20 May and closed on 4 September. The award had two categories: one for PhD scientists, with a prize of EUR 5 000, and one for undergraduate or master's students, with a prize of EUR 1 500. The open call attracted a total of 12 applications across both categories.

Applications were open to citizens or residents of an EU Member State or a country associated with the Horizon 2020 research and innovation (R & I) framework programme. Up to three shortlisted candidates for each category were invited to the 2022 SESAR Innovation Days, during which the winner of each category was publicly announced in a dedicated ceremony.

The shortlist of three ranked applicants per category was as follows.

PhD scientists' category

- **Omar García Crespillo,** German Aerospace Center and Swiss Federal Institute of Technology Lausanne, was awarded first place for his work on global navigation satellite system (GNSS) / inertial navigation system (INS) Kalman filter integrity monitoring with uncertain time-correlated error processes. The jury praised him for a very well-structured and well-written thesis, which demonstrated excellent scientific rigour and innovation in terms of the simulation approaches used to validate and assess the availability and continuity of GNSS/INS systems, taking into account airport locations and aircraft trajectories.
- **Jan Evler,** Institute of Logistics and Aviation, TU Dresden, was awarded second place for his thesis on an integrated schedule recovery model that enables airlines to define their optimal flight priorities for schedule disturbances arising from air traffic flow management capacity constraints. In its evaluation, the jury said that the identified approach is sound and had been presented convincingly, and the work was helping to fill a gap in air traffic flow management slot regulations during capacity constraint and was therefore very relevant to ATM and aviation.
- **Raúl Sáez García,** Technical University of Catalonia, was awarded third place for his work on traffic synchronisation with controlled time of arrival for cost-efficient trajectories in high-density terminal airspace. The jury commented positively on the originality of the work, which focused on the energy neutrality of these trajectories.

Undergraduate or master's students' category

- **Marie-Christine Névir,** TU Dresden, was awarded first place for her work developing and initially validating a new workload model for sectorless airspace (i.e. flight-centric air traffic control (ATC)). The jury praised her for the very high level of innovation demonstrated in her work tackling controller organisation in light of this relatively new operational concept. In addition, the approach used was considered outstanding, as it included model calibration and validation and basic physiological measurements.
- **Maximilian Simonetti,** Technical University of Munich, was awarded second place for his modelling of barometric altimeter measurements to support geodetic altitude navigation, an enabler for urban air mobility (UAM). The jury commended the very thorough theoretical and experimental analysis, and the scientific excellence that Simonetti demonstrated in his work.
- **Georgios Papadopoulos,** University of Piraeus, was awarded third place for his application of deep reinforcement learning for conflict detection and resolution. The jury found his thesis to be innovative in terms of the solution proposed.

1.2.2.3.3 SESAR Digital Academy

The SESAR Digital Academy benefited from the activities of the Knowledge Transfer Network project (Engage) in previous years. While the project closed in 2022, the positive benefits and legacy of the network and the digital academy have been realised and recognised.

As a result of the SESAR 3 JU's efforts to expand its outreach in 2022, the SESAR Digital Academy organised five online and hybrid events aiming to unpack its performance measurement framework.

1.2.3 Strategic area of operation 3: deliver industrial research and validation

In 2022, the SESAR 3 JU met all of its objectives related to IR, as set out in Section 2.2.3.3 of the 2022–2023 BAWP. This includes the following achievements and results.

- As regards the call H2020-SESAR-2019-1 (IR VLD wave 2 call for proposals), the Horizon 2020 reporting and payments, including the projects' reviews, were completed.
- As regards the call H2020-SESAR-2020-2 (IR VLD wave 3 call for proposals), the Horizon 2020 reporting and payments, including in relation to the projects' reviews, were completed.
- Validation exercises were carried out, release 11 was completed and the SESAR 3 JU circulated the close-out report to the Programme Committee, which agreed with the outcomes.
- Validation exercises for release 12 were carried out. The SESAR 3 JU Programme Committee approved the release 12 plan in December 2021, and the validation exercises took place in 2022 as per the plan. Release 12 was closed in December 2022.
- The Release 13 plan was approved by the SESAR 3 JU Programme Committee in December 2022.
- The Digital European Sky open call HORIZON-SESAR-2022-DES-IR-01 (IR1 call for proposals) was launched in April 2022 and closed in October 2022. The evaluation of the submitted proposals was concluded in February 2023.

1.2.3.1 Status of industrial research and validation projects under the wave 2 call (H2020-SESAR-2019-1)

The wave 2 call for proposals resulted in 12 Industrial Research grants being awarded and the corresponding projects being launched. These projects will deliver their final results by June 2023.

Of these 12 projects, two (PJ19-W2 and PJ20-W2) addressed transversal activities and are summarised in Table 1. Table 3 lists the 10 IR wave 2 ongoing projects in 2022, providing short descriptions of the projects and links to the dedicated project web pages (which include the latest news).

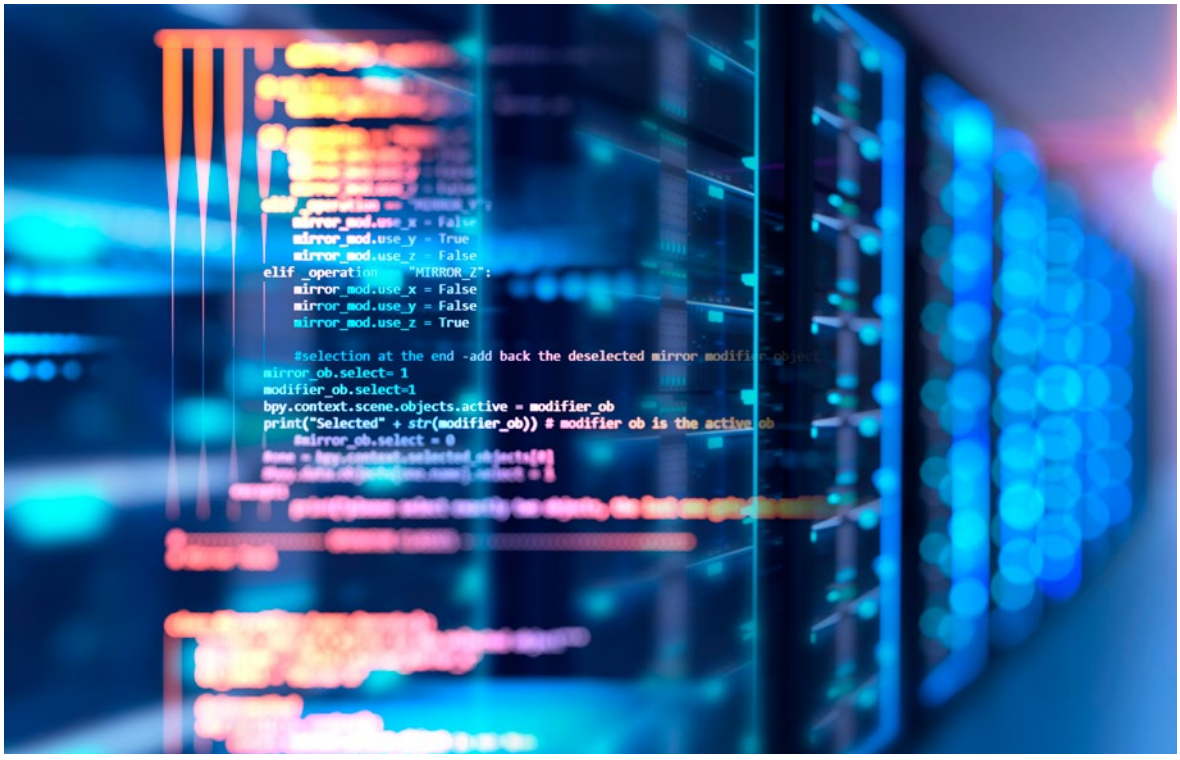


TABLE 3: **OVERVIEW OF IR WAVE 2 PROJECTS ACTIVE IN 2022**

Project reference	Project title	EU contribution (EUR)
PJ01-W2 EAD	**Enhanced arrivals and departures**	**7 806 581.77**
This project aims to develop concepts, tools and procedures to ensure that terminal manoeuvring areas are managed in a more sustainable and fuel-efficient manner while also ensuring the capability to manage a future increase in capacity. This will be achieved by taking advantage of the latest technological developments from both an airborne perspective and a ground system perspective and through the secure sharing of data.		
PJ02-W2 AART	**Airport airside and runway throughput**	**41 624 488.27**
This project aims to improve the efficiency and resilience of arrival and departure operations at capacity-constrained airports and access to secondary airports by delivering operational and technical improvements to enhance infrastructure and increase traffic throughput while providing environmental benefits and preserving safety.		
PJ04-W2 TAM	**Total airport management**	**16 212 101.21**
This project aims to improve airport/network integration for large and medium-sized or regional airports, improve airport airside/landside integration, reduce the impact of meteorological aspects on airport operation and, make further investigations about how environmental aspects could be monitored and managed in day-to-day airport operations. It develops concepts, tools and procedures that increase the predictability and resilience of airport operations, improving the punctuality of flights in a safe and environmentally sustainable manner.		
PJ05-W2 DTT	**Digital technologies for tower**	**9 217 244**
This project aims to provide shorter travel times and better point-to-point connections, and to increase flight safety and controller productivity. A large group of international partners focuses on multiple solutions for future airports.		
PJ07-W2 OAUO	**Optimised airspace users operations**	**4 674 640.25**
This project addresses both civil and military airspace users, further improving their processes and tools in relation to their interaction with ATM network operations. At its heart it is an improved collaborative decision-making process that takes into account the evolving business needs of airspace users.		
PJ09-W2 DNMS	**Digital network management services**	**6 735 749.66**
This project aims to improve network traffic predictability and shared complexity representation for all actors associated with demand–capacity balancing, dynamic airspace configuration, integrated network management, ATC planning and collaborative network performance management.		
PJ10-W2 PROSA	**Separation management and controller tools**	**20 057 736.17**
This project aims to advance automation technology solutions and procedures that will help controllers to handle traffic in a smooth and efficient way.		
PJ13-W2 ERICA	**Enable RPAS insertion in controlled airspace**	**13 150 435.87**
ERICA aims to define the operational and technical capabilities that allow remotely piloted aircraft systems to operate in controlled airspace safely, during nominal and emergency conditions. In particular, ERICA aims to provide the basis for defining, developing and validating the key operational and technological enablers necessary to assure the proper integration of remotely piloted aircraft systems into non-segregated airspace.		
PJ14-W2 I-CNSS	**Integrated CNSS**	**18 467 875.99**
This project aims to develop an integrated suite of communications, navigation and surveillance solutions to meet the operational requirements of ATM in the short, medium and long terms. It aims to ensure that these solutions are interoperable globally, as outlined in the International Civil Aviation Organization global air navigation plan.		
PJ18-W2 4D Skyways	**Improving trajectory management for European air transport**	**18 336 854.44**
This project is researching trajectory management solutions in support of the roll-out of trajectory-based operations.		

1.2.3.2 Status of industrial research and validation projects under the wave 3 call (H2020-SESAR-2020-2)

The wave 3 call for proposals resulted in five grants being awarded and the corresponding projects being launched. These projects will deliver their final results by June 2023. Of these five projects, three are IR projects (summarised in Table 4) and two are very large-scale demonstration (VLD) projects (summarised in Table 7).

TABLE 4: **OVERVIEW OF IR WAVE 3 PROJECTS ACTIVE IN 2022**

Project reference	Project title	EU contribution (EUR)
PJ32-W3 VC	**Virtual centre**	**5 579 565.38**
This project further investigates the air traffic flow and capacity management aspects of airspace delegation among air traffic service units.		
PJ33-W3 FALCO	**Flexible ATCO endorsement and LDACS complement**	**5 315 206.77**
This project is investigating solutions for making ATM and the deployment of air traffic controllers more flexible, cost-efficient and responsive to changing traffic demands and conditions. This project will also trial an L-band digital aeronautical communications system, a technology offering spectrum-efficient data link connectivity and digital voice communications between air and ground.		
PJ34-W3 AURA	**ATM U-space interface**	**7 978 319.51**
The overall objective of AURA is to lay the foundations for the integration of new entrants in current and future air traffic environments, to develop the required concept of operations and to validate U-space service information exchanges with ATM systems.		

1.2.3.3 SESAR solutions delivery: release process in 2022

1.2.3.3.1 Release 11 outcome

Release 11 was completed in 2022. The main outcomes of release 11 are summarised below, by phase of the SESAR 2020 research pipeline. The 2022 validation/demonstration activities and maturity gates are also summarised in the below lists.

Exploratory Research

During 2022, one Exploratory Research project completed its technical activities.

- **FARO,** 'Safety and resilience guidelines for aviation', is an excellence science and outreach exploratory research project that successfully completed technology readiness level (TRL) 1. A short description of the project and a link to the website are provided in Table 2.

Industrial Research

Four SESAR industrial Research solutions successfully completed validation phase (V) 1 / TRL2 in 2022 as part of release 11.

- **Solution PJ04-W2-28.2,** 'Collaborative management at regional airports', addresses the lack of communication between and information shared among stakeholders operating in regional airports, which causes unforeseen deterioration of airport performance, with potential knock-on effects for the ATM network. This solution investigates the development of a "lite" airport operations centre, aiming to improve inbound, turnaround and outbound predictability. The approach is simple, cost-efficient and algorithm oriented, and focuses on the use of Network Manager digital services provided to airports.
- **Solution PJ.01-W2-06,** 'Advanced rotorcraft operations in the TMA', addresses the procedural means and technical capabilities of instrument flight rules (IFR) rotorcraft operations, assuming that these are supported by dual-frequency multiconstellation (DFMC) GNSS technologies, in order to improve access in several rotorcraft-suitable locations inside high-density/constrained terminal manoeuvring areas (TMAs).
- **Solution PJ01-W2-08A2, '**Automatic controlled time of arrival (CTA) for management of arrival in en-route and on the ground', enables digital the synchronisation of arrivals and departures in high density/complexity environments through the automation of controlled time of arrival. The candidate solution uses a "what-if"

tool to automate the process through provision and insertion of an airborne trajectory modeller evaluating the expected aircraft behaviour with these constraints.

- **Solution PJ14-W2-81b,** 'Long-term alternative position, navigation and timing (A-PNT)-enhanced DME', develops alternative position, navigation and timing (A-PNT) as a technical enabler to support performance-based navigation / required navigation performance operations in case of extended GNSS degradation or outage. The solution comprises enhanced distance measuring equipment able to support more stringent A-PNT requirements.

Seven SESAR Industrial Research solutions have successfully been completed V2/TR4 in 2022 as part of release 11.

- **Solution PJ10-W2-93,** 'Delegation of ATM services provision amongst ATSUs', enables air traffic service units (ATSUs) to delegate a portion of their airspace to another ATSU based on a particular condition. The solution investigates some use cases for the delegation of air traffic services and contingency in conjunction with the virtual centre technology where the ATM data service provider is geographically separated from the virtual centre ATSU providing air traffic services.
- **Solution PJ13-W2-115,** 'IFR RPAS accommodation in airspace class A to C', addresses existing remotely piloted aircraft system (RPAS) accommodation as general air traffic under IFR, recognising that these RPASs are not fully compliant with International Civil Aviation Organization (ICAO) standards.
- **Solution PJ14-W2-84f,** 'Surveillance performance monitoring – end-to-end', aims to enable improved performance monitoring of surveillance systems in line with the performance-based surveillance approach. This solution focuses on the development of surveillance performance monitoring tools for end-to-end surveillance chains.
- **Solution PJ02-W2-21.3,** 'Digital surface management for airport vehicles', exploits the extension of data-link-based information sharing of requests, orders and assigned mission (route) operations to vehicle management. Vehicles are seen as additional users of the control and guidance services, and this solution supports ATC and drivers in challenging operating environments such as peak hours and/or in low-visibility conditions.
- **Solution PJ02-W2-21.4,** 'Full guidance assistance to mobiles using "follow-the-greens" procedures based on airfield ground lighting (aprons/taxiways/runways)', automates the prioritisation of mobiles along their cleared route in the whole airport movement area. The guidance service takes into account other traffic to guide the mobile as it progresses along its assigned route and at the holding points. It allocates priorities between mobiles based on local operating rules and known constraints from the surface management system.
- **Solution PJ02-W2-21.5,** 'Enhanced safety in LVP through use of dynamic virtual block control', makes use of real stop bars and virtual stop bars appropriately placed on the manoeuvring and movement areas to reduce the size of control blocks while enhancing safety between taxiing aircraft or taxiing aircraft and vehicles in low-visibility conditions.
- **Solution PJ02-W2-21.6,** 'Surface route planning and management operations', involves air traffic controllers (ATCOs) being advised on the most suitable ground routes for all mobiles on the movement area (runways, taxiways and aprons), taking into account users' preferences and known constraints (taxiway closures, aircraft types, etc.).

1.2.3.3.2 Release 12 execution and outcome

The release 12 plan, which was endorsed by the Programme Committee in December 2021, initially covered all SESAR 2020 activities up to June 2023. At the end of 2022, the Delivery Management Subcommittee agreed to better align the release process with the programme reporting needs: release 12 will focus on activities executed in 2022, while release 13 will focus on activities executed in 2023. The lists below summarise the activities that took place in 2022. Short descriptions of each project and links to each project web page are provided in Table 2.

Exploratory Research

Eighteen excellence science and outreach exploratory research projects completed their technical activities in 2022, achieving at least TRL1 maturity, and are expected to continue their development through exploratory research or industrial research activities focusing on follow-up applications:

- **X-TEAM D2D,** 'Extended ATM for door2door travel',
- **TAPAS,** 'Towards an automated and explainable ATM system',

- **AISA, '**AI situational awareness foundation for advancing automation',
- **MAHALO** 'Modern ATM via human/automation learning optimisation',
- **ITACA,** 'Incentivising technology adoption for accelerating change in ATM',
- **FMPMet,** 'Meteorological uncertainty management for flow management positions',
- **FlyATM4E, '**Flying air traffic management for the benefit of environment and climate',
- **DYNCAT,** 'Dynamic configuration adjustment in the TMA',
- **TRANSIT,** 'Travel information management for seamless intermodal transport',
- **AICHAIN,** 'A platform for privacy-preserving federated machine learning using blockchain to enable operational improvements in ATM',
- **CREATE,** 'Innovative operations and climate and weather models to improve ATM resilience and reduce impacts',
- **BEACON,** 'Behavioural economics for ATM concepts',
- **SYN AIR,** 'Synergies between transport modes and air transportation',
- **ALARM,** 'Multi-hazard monitoring and early warning system',
- **SIMBAD,** 'Combining simulation models and big data analytics for ATM performance analysis',
- **SafeOPS,** 'From prediction to decision support – strengthening safe and scalable ATM services through automated risk analytics based on operational data from aviation stakeholders',
- **Artimation,** 'Transparent artificial intelligence and automation to air traffic management systems',
- **Modus, '**Modelling and assessing the role of air transport in an integrated, intermodal transport system'.

In 2022, 18 applications-oriented exploratory research projects completed their technical activities, achieving TRL2 maturity level, and are expected to continue their development in follow-up industrial research activities:

- **SINOPTICA** 'Satellite-borne and in-situ observations to predict the initiation of convection for ATM',
- **ICARUS** 'Integrating UAS detection technologies with the aviation and airport security systems',
- **BUBBLES,** 'Defining the building basic blocks for a U-space separation management service',
- **URClearED,** 'A unified integrated remain well clear concept in airspace D-G class',
- **INVIRCAT,** 'IFR RPAS control in airports and TMA',
- **HAAWAII, '**Highly automated air traffic controller workstations with artificial intelligence integration',
- **SAFELAND,** 'Safe landing through enhanced ground support',
- **NOSTROMO,** 'Next-generation open-source tools for ATM performance modelling and pptimisation',
- **IMHOTEP,** 'Integrated multimodal airport operations for efficient passenger flow management',
- **ASPRID,** 'Airport system protection from intruding drones',
- **ISOBAR,** 'Artificial intelligence solutions to meteo-based DCB imbalances for network operations planning',
- **NewSense,** 'Evaluation of 5G network and mmWave radar sensors to enhance surveillance of the airport surface',
- **CADENZA,** 'Advanced capacity and demand management for European network performance optimization',
- **DACUS,** 'Demand and capacity optimisation in U-space',
- **AEON, '**Advanced engine-off navigation',
- **SINAPSE,** 'Software defined networking architecture augmented with AI to improve aeronautical communications performance, security and efficiency',
- **FACT,** 'Future all aviation CNS technology',
- **Slotmachine, '**A privacy-preserving marketplace for slot management'.

In 2022, three applications-oriented exploratory research projects could not reach their target maturity level (TRL2) and will require further exploratory research activities.

- **USEPE, '**U-space separation in Europe'. This project developed a very innovative separation method for drones in the urban environment – based on the dynamic density corridor concept – aiming to ensure the safe separation of drones (from each other and from manned aviation) in the U-space environment. Despite the positive results, the maturity

gate concluded that further work and more validation activities on the concept definition need to be carried out to fully achieve V1/TRL2 (e.g. cascade effects during the tactical phase need to be addressed, and an exploration of machine learning results combined with the dynamic density corridor concept is required).

- **Metropolis 2, 'A unified approach to airspace design and separation management for U-space'.** Despite the substantial progress made by the project on the definition of U-space U3 and U4 strategic and tactical resolution services, the maturity gate concluded that further work is required on these services before TRL2 can be achieved, in particular on the joint definition of the strategic planning of traffic flows using tactical separation management to ensure the maintenance of a sufficient level of safety in high-density urban airspace.
- **START, 'A stable and resilient ATM by integrating robust airline operations into the network'.** Although most of the TRL2 maturity criteria have been successfully achieved, others have not, in particular the definition of benefit mechanisms and assessment of performance cost and benefits; these would require additional activities before the achievement of TRL2.

Industrial Research

Two SESAR industrial research solutions successfully completed V1/TRL2 in 2022.

- **Solution PJ14-W2-61, 'Hyper connected ATM'.** Aircraft safety-critical communications are currently supported using legacy systems such as very high-frequency (VHF), high-frequency and authorised L-band satellite systems operating within dedicated and protected spectrum bands. In parallel, non-safety commercial communications systems relying for instance on public cellular networks such as 4G (and soon 5G) or commercial Ku/Ka-band satellite communication services are increasingly used on aircraft for passenger internet browsing or pilot–airline interactions. These systems benefit from technological advances in the public wireless telecommunications markets, evolving towards enhanced and cheaper services, unlike legacy aviation communications. This solution developed a concept of operations, identified use cases, captured high-level requirements and assessed architecture options for integrating commercial public network services into the future communications infrastructure.
- **Solution PJ18-W2-57, 'Study of benefits of increased automation in ATM (SONIC)'.** This solution is driven by the need for improved trajectory-based operations (TBOs) and the desire to achieve a shared and common situational awareness in the air and on the ground by specifically looking into the potential role of increased automation of the tools used by pilots and ATCOs. Automation has the potential to provide both pilots and controllers with tools that have increased levels of automation, enabling more dynamic collaboration and decision-making between air and ground operations. This can help reduce workload, the number of interruptions and the potential for human error, thus allowing both ground and airborne operations to focus on more important activities. The solution aims to support a continuous increase in the amount and the usefulness of information shared between air and ground and in the level of automation support available to controllers and pilots (e.g. towards the automatic uplink of clearances with or without previous controller validation and towards increased use of the autoload to flight management system of uplinked clearances and of managed/automatic mode by the flight crew).

Ten SESAR industrial research solutions successfully completed V2/TRL4 in 2022.

- **Solution PJ01-W2-06, 'DFMC GNSS service to support improved IFR rotorcraft operations in the TMA',** addressed the procedural means (e.g. required navigation performance 0.1) and technical capabilities (both ground and airborne sides) of IFR rotorcraft operations, assuming that these are supported by DFMC GNSS technologies, in order to improve access in several rotorcraft-suitable locations inside high-density/constrained TMAs, including airports close to dense urban areas (city edges, hospital helipads, congested and hostile environments, etc.). This solution also covers technical performance improvements, which create the potential for enhancing pilots' and ATCOs' situational awareness, bringing significant operational benefits to the ATM system.
- **Solution PJ01-W2-08B2,** 'Seamless optimised descent profiles through enhanced ground to air sharing', focused on air–ground intention sharing to improve optimised descent operations.
- **Solution PJ01-W2-08B4,** 'Traffic optimization within the systemised TMA', focused on the use of predicted demand information in order to optimise the flow of climbing and descending traffic.

- **Solution PJ02-W2-04.1,** 'Advanced curved approach operation in the TMA with the use of barometric altitude', validated a system support tool for ATC to enable the mixing of advanced curved approach operations with legacy straight in approach operations. Using curved flight trajectories in the approach phase in medium- and high-complexity TMAs based on barometric altitude optimises flight efficiency and lowers gaseous emissions and noise while maintaining runway throughput. It also provides a means to comply with environmental constraints. A spacing support tool for ATC is required to manage this complex and dynamic concept of operations in an efficient manner.
- **Solution PJ02-W2-04.2,** 'Advanced curved departure operations in the TMA', involves a new concept: using fixed radius turn as soon as the departing aircraft crosses the departure runway end. This enables new, improved standard instrument departure routes. By initiating these advanced curved operations after departure, more efficient TMA and runway operations are made possible. This has a positive impact on gaseous emissions, noise of TMA operations and flight efficiency.
- **Solution PJ02-W2-04.3, '**Advanced curved approach operation in the TMA with the use of geometric altitude', involves a new concept: using geometric altitude in the initial, intermediate and final phases of instrument approach operations, combined with curved operations. This enables optimum flight trajectories and increased safety, efficiency and predictability, while reducing the workload of ATCOs and flight crews compared with today's operations.
- **Solution PJ18-06b1,** 'NM profile improvement using ADS-C', studied the possible improvements brought by the automatic dependent surveillance – contract (ADS-C) report data elements in order to improve the Network Manager profiles.
- **Solution PJ14-W2-81b,** 'Long-term alternative position, navigation and timing (A-PNT)-enhanced DME', comprised enhanced distance measuring equipment with the capability to support more stringent A-PNT requirements. The technology is based on a coupling of the on-board interrogator and ground-based transponder equipment to provide a smooth and seamless implementation path and improved frequency band usage. The enhanced distance measuring equipment is expected to support more stringent navigation performance requirements and improve spectrum efficiency, for example by reducing L-band congestion.
- **Solution PJ14-W2-100, '**SWIM TI purple profile for air/ground safety-critical information sharing', consists of open-standards-based, reliable and secure system-wide information management (SWIM) technical infrastructure enabling the distribution (uplink and downlink) of safety-critical information through air–ground SWIM infrastructure over, for instance, aeronautical telecommunications network / Internet Protocol suite networking, rather than legacy point-to-point contracted services. The solution represented a technical enabler (SWIM infrastructure layer only) for the integration of aircraft into the SWIM network, giving aircraft access to air–ground safety-critical SWIM services. SWIM-enabled aircraft, flight crews and ground-based systems will benefit from the SWIM concept and principles.
- **Solution PJ33-W3-02,** 'LDACS digital voice capability', addressed the use of the future terrestrial air–ground data-link solution (the L-band digital aeronautical communications system) to exchange digital voice services. Digital voice is expected to replace VHF radio completely in the long term in all continental operational environments: en route (flight centric or with geographical sectors, continental high and low density), TMA and tower, including ground and platform control.

Three industrial research solutions could not successfully achieve V2/TRL4 and will require additional activities to reach this maturity level.

- **Solution PJ14-W2-79b,** 'DFMC GBAS – GAST F', focused on the DFMC ground-based augmentation system (GBAS), which is a landing system that enables the support of operations under category II/III conditions. While ground aspects have achieved TRL4, airborne aspects could not be addressed, and the work carried out on the ground station may need to be reviewed when airborne aspects are addressed (in particular architecture discussions that are taking place on GBAS approach service type F versus GBAS approach service type X, and RTCA's further studies). The main goal was to develop a global solution capable of supporting landing operations in challenging conditions.
- **Solution PJ01-W2-08A2,** 'Automatic controlled time of arrival (CTA) for management of arrival in en-route and on the ground', investigated the concept of automatic controlled time of arrival in order to validate the implications for both the ground side and the airborne side regarding automation of controlled time of arrival constraints. The arrival constraints are to be implied in the en route phase but also in the

ground phase for 'in-horizon' airports prior to start-up. To complete V2/TRL4, further work is required on the definition of technical enablers, cost feasibility of flight management system updates, benefit assessment and identification of standardisation needs.

- **Solution PJ01-W2-08B6,** 'Vertical guidance mode to support optimised profile climbs', focused on departure operations in three-dimensional tubes to develop and validate a new vertical guidance mode supporting 'profile climbs'. The solution did not intend to complete V2 within the SESAR 2020 time frame, but the solution team agreed with the SESAR 3 JU that a formal maturity gate would be performed to identify the gaps preventing the completion of V2/TRL4. In summary, additional validation exercises are required (e.g. real-time simulations with realistic traffic samples and participation of actual ATCOs), and the development of additional cockpit tools for monitoring climb performance with respect to the altitude constraints is recommended for increased situational awareness.

Sixteen SESAR industrial research solutions successfully completed V3/TR6 and were transferred to the deployment phase.

- **Solution PJ02-W2-14.2,** 'Second runway aiming point (SRAP)', introduced the second runway aiming point (SRAP) as a new concept of enhanced approach operations. The distance between the second threshold and the nominal one is at least 1 100 m. SRAP increases runway performance by using two active thresholds on a single runway. By doing so, the environmental impact (e.g. noise, fuel consumption) should be reduced. In addition, runway throughput may be increased (e.g. via optimisation of runway occupancy time and/or wake turbulence separations).
- **Solution PJ02-W2-14.3,** 'Increased second glide slope (ISGS)', introduced increased second glide slope as a new concept of enhanced approach operations. Increased second glide slope helps reduce environmental impact through the use of two glide slopes that are simultaneously active. By doing so, the environmental impact should be reduced, as aircraft flying on the higher slope should generate less noise.
- **Solution PJ02-W2-14.5,** 'Increased glide slope to a second runway aiming point (IGS-to-SRAP)', introduced increased glide slope (IGS)-to-SRAP as a new concept of enhanced approach operation. The distance between the second threshold and the nominal one is at least 1 100 m. IGS-to-SRAP increases runway performance by using two active thresholds on a single runway, with an increased glide slope to the second one. As a result, the environmental impact (e.g. noise, fuel consumption) should be reduced. In addition, runway throughput may be increased (e.g. via optimisation of runway occupancy time and/or wake turbulence separations).
- **Solution PJ04-W2-28.1,** 'Connected regional airports', aimed to improve the connectivity between regional airports and the Network Manager Operations Centre through the provision of departure planning information messages based on target times. Ground handler workload is reduced as a result of automatic determination of the aircraft-ready time based on the aircraft event-based milestones and the status of passenger boarding provided by the local airport system. The overall expected benefits relate to predictability, flexibility and efficiency for all airport stakeholders.
- **Solution PJ13-W2-115,** 'IFR RPAS accommodation in airspace class A to C', addressed existing provisions for RPAS accommodation as general air traffic, under IFR, recognising that these RPAS are not fully compliant with ICAO standards. RPAS accommodation relies on the existing mechanisms and systems already in place, with minor improvements if necessary. The solution will define specific provisions on flight planning and RPAS management by establishing harmonised procedural improvements. The time frame is the short to medium term. The target operating environment is low-/medium-complexity and low-/medium-density European airspace with low RPAS numbers. The solution covers RPAS flying transit segments in non-segregated controlled class A–C airspace, whereas mission-specific profiles and departure/arrival remain as currently performed (i.e. they are outside the solution's scope).
- **Solution PJ14-W2-77,** 'FCI services', consists of an air–ground communication infrastructure capable of supporting future air traffic services in addition to flight operations centres (or military wing operations centres). The SESAR work includes completion of specifications for the future communications network infrastructure, in order to support aeronautical telecommunications network / Internet Protocol suite multilink capability and complete mobility between different data-link systems such as satellite communications systems,

L-band digital aeronautical communications systems and aeronautical mobile airport communication systems. It also addresses civil–military interoperability requirements for ground–ground network interfaces and safety and security requirements. The solution will improve safety and security, enhancing the efficiency and flexibility of the overall datalink system through the provision of resilient multilink and mobile communications capabilities to the aircraft.

- **Solution PJ14-W2-79a,** 'GBAS – GAST D extended scope', completed GBAS (GBAS approach service type D) as a technical enabler, building on SESAR solution #55, to take full advantage of the operational benefits that GBAS can provide. GBAS enables improved precision approach, landing and departure in operations in all weather conditions, thereby improving operational efficiency and capacity and reducing environmental impact. This solution addresses large and complex airports, high and low latitudes and measurement equipment.
- **Solution PJ14-W2-84a,** 'Multi sensor data fusion', aims to ensure that the interfaces between sensors and subsequent processing stages (the multisensor trackers) are correct and fit for purpose. The two main objectives are to adapt multisensor tracker systems for the new input data characteristics, especially multistatic primary surveillance radar and automatic dependent surveillance – broadcast (ADS-B) data sourced from satellite, and to improve the multisensor data fusion. This SESAR solution aims to develop performance-based data fusion based on advanced monitoring of the tracker coherence.
- **Solution PJ14-W2-84b,** 'Multi remote surveillance module', provided a basic surveillance service for a small to medium-sized airport performing below the level specified in ED-87D. It had a range of around 20 nautical miles, and augmented the performance of existing surveillance equipment to increase situational awareness for the multiremote tower controller in a cost-effective way.
- **Solution PJ14-W2-84c,** 'Secured surveillance systems (single and composite systems)', consisted of secured surveillance systems (with a focus on cooperative and cooperative-dependent sensors) enabling the operational use of security functions. The scope covered the sensor-based radio-frequency-related threat detection and validation capabilities, performance assessment and identification of interoperable detection forwarding mechanisms by a specific All-purpose Structured Eurocontrol Surveillance Information Exchange (Asterix) target validation message (Asterix CAT 246).
- **Solution PJ14-W2-84d,** 'Phase overlay for ADS-B', validated a new phase overlay for ADS-B, enabling the transmission of extra information. The improvement of the new ADS-B version's transmission bit rate will allow the transmission of new data that could be used for diverse applications (weather information, authentication of ADS-B transmissions to avoid threats such as spoofing or eavesdropping).
- **Solution PJ14-W2-84e,** 'Surveillance performance monitoring tool for cooperative sensors', aimed to enable improved performance monitoring of surveillance systems in line with the performance-based surveillance approach. This solution focuses on the development of surveillance performance monitoring tools for cooperative sensors such as ADS-B, wide-area multilateration and airport multilateration. Using offline and continuous quasi-real-time processes, the solution supports monitoring by ensuring the correct functioning of the ATM surveillance function (e.g. by spotting degradation trends early in the process).
- **Solution PJ14-W2-84f,** 'Surveillance performance monitoring – end-to-end', developed surveillance performance monitoring tools for the end-to-end surveillance chain to ensure the harmonisation of the tools. Recognising that there is a harmonisation trend in the standards, the various metric assessment methods were also harmonised. This solution aims to align tool specification with existing and developing surveillance standards and to develop quasi-real-time functionality. Tool verification results are a potential input to standardisation, in particular ESASSP specifications for ATM surveillance system performance. Quasi-real-time operation enables continuous automated monitoring to identify performance degradation and increases the robustness of the overall surveillance chain.
- **Solution PJ14-W2-101,** 'SWIM TI green profile for G/G civil military information sharing', aimed to enable ground–ground civil–military SWIM-based coordination at SWIM technical infrastructure level through SWIM profiles to provide the quality of service, including (cyber) security / (cyber)resilience, needed by military stakeholders and agreed by civil stakeholders. The solution also aims to make improvements

in safety and civil–military cooperation and coordination key performance areas. The green profile is based on extensions/restrictions on top of the EUROCONTROL specification for SWIM technical infrastructure yellow profile edition 1.1 in order to maximise the civil–military interoperability at minimum cost.

- **Solution PJ02-W2-21.4,** 'Full guidance assistance to mobiles using "follow-the-greens" procedures based on airfield ground lighting (aprons/taxiways/runways)' ([5]), aims to automate the prioritisation of mobiles along their cleared route in the whole airport movement area. It allocates priorities between mobiles based on local operating rules (e.g. runway exit versus parallel taxiways, aircraft versus vehicle, aircraft converging or crossing at intersections and taxiways passing close to push-back routes or other taxiways where insufficient wing tip separation exists) and known constraints from the surface management system. Automatic guidance is provided using the 'follow-the-greens' concept for the airfield ground lighting infrastructure. Benefits are expected in increased safety performance in all weather conditions; improved predictability through guidance; and reduced workload and stress for ATCOs, pilots and vehicle drivers. The solution has reached V3 under the condition that evidence is provided that it is acceptable to flight crew.
- **Solution PJ07-W2-40,** 'Initial 4D mission trajectory development with integrated DMA types 1 and 2 supported by automation and dynamic civil–military CDM') ([6]), aims to develop new operating methods that enable more flexibility and dynamism in the planning of airspace structure configuration and to develop mission trajectory for use by all actors performing activities in temporarily restricted/reserved airspace, involving the concept of dynamic airspace configuration. A key element of this solution is dynamic coordination between Wing Operations Centre and local dynamic airspace configuration actors, specifically national airspace management and local air traffic flow and capacity management, throughout collaborative decision-making on a single four-dimensional mission trajectory data set supported by automation of impact assessments. The solution has reached V3 under the condition that its architecture is clarified.

Very large-scale demonstrations

Considering that SESAR 2020 programme was limited to the delivery of TRL 6 Solutions, the very large-scale demonstrations were primarily designed to help bridge the gap between the development and operational implementation. So they were at the border in terms of maturity transition from the Industrial Research, the industrialisation and to the subsequent implementation. As such, SESAR 3 JU decided to perform a TRL 7 maturity gate for all VLDs to assess their achieved maturity target while TRL7 was not a requirement at the launch of the call.

The following VLD was completed during the reporting period.

- **VLD-02 project STAIRS** 'Airport surface management, airport safety nets and ATSAW' TRL7 for the SESAR Solution(s) under its scope (PJ03b-05, 'Traffic alerts for pilots for airport operations').

Another four VLD projects also completed their activities in 2022, but they did not achieve TRL7. The remaining gaps should be addressed in future projects.

1. **VLD-01 DREAMS 'Demonstration Of Runway Enhanced Approaches Made with Satellite Navigation'** addressed three solutions in demonstration activities: PJ02-W2-14.2, 'Second runway aiming point (SRAP)'; PJ02-W2-14.3, 'Increased second glide slope (ISGS)'; and PJ02-W2-14.5, 'Increased glide slope to a second runway aiming point (IGS-to-SRAP)'. In order to achieve TRL7 maturity, further demonstrations are required to address the elements missing in DREAMS (e.g. ATC involvement).
2. **GOF2.0,** 'Integrated urban airspace VLD', demonstrated U-space solutions in which ATC and other airspace managers (multistakeholder) are directly involved in the management of operation plans in airspace classes D and G, and altitudes from surface to 5 000 ft. The solutions

([5]) This solution's maturity gate was performed in 2022, and the outcome was V3/TRL6 conditional at the end of the reporting period. Since the solution completed the actions from the gate during the first quarter of 2023, the final conclusion is that the solution successfully achieved V3/TRL6 and will thus be included in the release 12 final report.

([6]) This solution's maturity gate was performed in 2022, and the outcome was V3/TRL6 conditional at the end of the reporting period. Since the solution completed the actions from the gate during the first quarter of 2023, the final conclusion is that the solution successfully achieved V3/TRL6 and will thus be included in the release 12 final report.

take into account drones, visual flight rules and IFR traffic. Human-carrying aircraft (air taxi covered by standardised European rules of the air, piloted aircraft) are direct stakeholders of U-space, and they file U-space operation plans for their flights. Other manned aircraft fly through airspace using dynamic geofences (no-fly zones) instead of dynamic reconfigurations of U-space airspace. The services under demonstration require further work before achieving TRL7.

3. **TINDAiR** 'Tactical instrumental deconfliction and in flight resolution', demonstrated solutions addressing the strategic and tactical conflict detection and resolution in a U-space airspace in which a single U-space service provider takes the role of common information service provider and provides the U-space services and solutions covering the tracking and position reporting by means of a system utilising C2 link in the C-band, for the provision of reliable position information through air and ground segments radio. The services under demonstration required further work before achieving TRL7.
4. **Uspace4UAM,** 'U-space for UAM', addressed delivery and aerial monitoring services conducted over sparsely populated areas as a specific category of automated flights, which are performed in class G airspace or in a segregated part of a controlled airspace, and short-range piloted electric vertical take-off and landing (eVTOL) air-taxi operations in controlled and uncontrolled airspace. The services under demonstration required further work before achieving TRL7.

These very large scale demonstration (VLD) activities were affected by the COVID-19 pandemic. DREAMS was particularly badly affected, as many flights had to be cancelled, and the availability of ATCOs was drastically reduced. However, thanks to the efforts of the project participants, the results are very close to reaching TRL7 and would require only some operational fine-tuning at ATC level should an airport decide to implement the enhanced arrival procedures.

Regarding the U-space VLDs, the target of TRL7 was too ambitious considering the lack of a clear set of solutions in the U-space area. However, the VLDs provided useful recommendations about the application of the U-space regulation (Commission Implementing Regulation (EU) 2021/664) and the drone regulation (Commission Implementing Regulation (EU) 2019/947), which were applicable at the launch of the U-space projects. It is expected that the remaining elements will be addressed by the SESAR 3 IR1 Fast Track Innovation & Uptake selected projects.

These very large-scale demonstration (VLD) activities have been impacted by the COVID-19 pandemic. In particular for DREAMS, a lot of flights had to be cancelled and the availability of the ATCOs was drastically reduced. However, thanks to the efforts of the project participants, the results are very close to TRL7 and would only require some operational fine-tuning at ATC level should an airport decide to implement the enhanced arrival procedures.

Regarding the U-space VLDs, the target TRL7 was too ambitious considering the lack of clear set of Solutions in the U-space area. However, they provided useful recommendations about the application of U-space regulation (EU) 2021/664 and drone regulation (EU) 2019/947) that were applicable at the launch of the U-space projects. The remaining elements to be addressed are expected to be considered in the SESAR 3 IR1 fast-track selected projects.

1.2.3.3.3 Release 13 planning

The release 13 plan was endorsed by the Programme Committee in December 2022. It includes all activities under ER4, IR waves 2 and 3 and VLD / open VLD projects that will complete a maturity level during 2023. The release plan may be enriched with new activities to be launched within the context of the calls launched by SESAR 3 JU.

In summary, release 13 covers:

- 1 exploratory research project;
- 38 SESAR industrial research solutions, of which are expected to complete the following maturity levels:
  - 2 are expected to complete V1/TRL2
  - 21 are expected to complete V2/TRL4
  - 15 are planning to complete V3/TRL6;
- 8 demonstration projects (both VLDs and open VLDs) that will complete their activities in 2023.

The output of release 13 will significantly contribute to progress towards the completion of the Airspace Architecture Study Transition Plan (AAS TP) objectives: 16 solutions in release 13 contribute to the transition plan, eight of which are planning to complete V3/TRL6.

1.2.3.4 Status of Digital European Sky Industrial Research 1 (HORIZON-SESAR-2022-DES-IR-01)

HORIZON-SESAR-2022-DES-IR-01, an open Digital European Sky call for proposals, was launched on 7 April 2022 and closed on 13 October 2022. A total of 55 proposals were received, with 53 considered eligible. The evaluation phase was initiated in November 2022 with the aim of selecting the proposals and launching the grant preparation phase by mid-February 2023.

The call content covered the following six work areas.

- **Work area 1** covers transversal activities, with a focus on master planning and performance management.
- **Work area 2** comprises the industrial research required to achieve the objective of net zero greenhouse gas emissions by 2050 set by the European Green Deal, in line with the EU's commitment to global climate action under the Paris Agreement, which requires an acceleration of the shift to smarter and more sustainable mobility. This implies a need for aviation to intensify its efforts to reduce emissions, in line with the targets set in *Flightpath 2050*.
- **Work area 3** focuses on the delivery of the next generation of enabling platforms and services with a view to achieving the ambition of the Digital European Sky and phase D of the European ATM Master Plan.
- **Work area 4** covers fast-track innovation and uptake activities addressing U-space and UAM.
- **Work area 5** covers fast-track innovation and uptake activities addressing capacity on demand and dynamic airspace; virtualisation and cybersecure data sharing; multimodality and passenger experience; and the aviation green deal.
- **Work area 6** comprises the industrial research activities required to achieve TRL6 for the key R & I solutions that make up the European ATM Master Plan 2020 phase C ambition, establishing a solid foundation for European ATM Master Plan phase D. The scope of this work area includes a number of elements that, although addressed in SESAR 2020 activities under waves 1 and 2, did not reach TRL6. It also covers the integration of solutions that, having achieved (or nearly achieved) TRL6 as part of previous SESAR programmes, still require integrated validation activities to facilitate and de-risk the industrialisation and deployment phases: these activities may target TRL7. This work area may also include activities for the early integration of less mature SESAR Solutions.

1.2.4 Strategic area of operation 4: facilitate an accelerated market uptake of SESAR Solutions

In 2022, the SESAR 3 JU met all of its objectives related to facilitating accelerated market uptake of SESAR Solutions, as set out in Section 2.2.4.3 of the BAWP 2022-2023 BAWP. This includes the following achievements and results.

- The SESAR 3 JU ensured compliance with the regulatory requirements on facilitating market uptake and in this regard closely coordinated with EASA and supported the relevant standardisation activities.
- As regards the call H2020-SESAR-2019-1 (IR VLD wave 2 call for proposals), the Horizon 2020 reporting and payments, including the project reviews, were completed.
- As regards the call H2020-SESAR-2020-2 (IR VLD wave 3 call for proposals), the Horizon 2020 reporting and payments, including the project reviews, were completed.
- As regards the call H2020-SESAR-2020-1 (open VLD2 call for proposals), three projects had been closed by the end of 2022 while five projects will finalise their demonstration activities by June 2023.
- As regards the Digital Sky Demonstrator (DSD) call CEF-T-2021-SIMOBGEN, managed by the European Climate, Infrastructure and Environment Executive Agency (CINEA), the SESAR 3 JU participated in the evaluation in March 2022. Five DSD projects were awarded and had their respective grants signed, enabling their launch in December 2022.
- As regards the DSD call CEF-T-2022-SIMOBGEN, managed by CINEA, the SESAR 3 JU provided the technical specifications, enabling the call to open in September 2022 with a deadline in January 2023.

1.2.4.1 Activities carried out under the Horizon 2020 framework

1.2.4.1.1 Status of very large-scale demonstration projects under the wave 2 call (H2020-SESAR-2019-1)

The wave 2 call for proposals (VLD wave 2) resulted in three grants being awarded for VLD activities and the corresponding projects being launched. These projects will deliver their final results by June 2023. Two of the three projects (VLD1-W2 DREAMS and VLD2-W2 STAIRS) completed their activities in 2022. The other (VLD3-W2 SORT) is expected to deliver its final results by June 2023. Table 5 lists the three VLD wave 2 projects active in 2022, providing short descriptions of the projects and links to the dedicated project web pages (which include the latest news).

TABLE 5: **OVERVIEW OF VLD WAVE 2 PROJECTS ACTIVE IN 2022**

Project reference	Project title	EU contribution (EUR)
VLD1-W2 DREAMS	**VLD1 Wave 2 Demonstration Of Runway Enhanced Approaches Made with Satellite Navigation**	**4 481 277.62**
The objective of this project was to bring enhanced arrival procedures operations to the next maturity stage (V4) through a proof of concept combining commercial and non-commercial flights along with flight trials tests.		
VLD2-W2 STAIRS	**Airport surface management, airport safety nets and ATSAW**	**3 948 760.09**
This project intended to demonstrate the use of specific avionics (validated in wave 1) that provide traffic alerts for pilots during runway operations to prevent runway incursion and aircraft collision. The demonstration will address both mainline and business aviation solutions.		
VLD3-W2 SORT	**Improving runway throughput in one airport**	**4 499 999.76**
This project aims to demonstrate fundamental reduction in wake turbulence separation minima, safe and efficient runway use tailored to the individual aircraft type using new technology and analytics, and reduced radar separation minima on final approach.		

1.2.4.1.2 Status of the very large-scale demonstration open 2 call (H2020-SESAR-2020-1)

The VLD open 2 call for proposals resulted in eight grants being awarded for VLD activities and the corresponding projects being launched. Three projects had been closed by the end of 2022, while five projects will finalise their demonstration activities by June 2023. Table 6 lists the eight VLD open 2 projects active in 2022 (in alphabetical order), providing short descriptions of the projects and links to the dedicated project web pages (which include the latest news).

TABLE 6: **OVERVIEW OF VLD OPEN 2 PROJECTS ACTIVE IN 2022**

Project reference	Project title	EU contribution (EUR)
ALBATROSS	**The most energy-efficient flying bird**	**3 996 330.63**
ALBATROSS is a wide-scale VLD initiative to demonstrate how the technical and operational R & I achievements of recent years can transform the aviation industry from fuel intensive to environmentally friendly.		
AMU-LED	**Air mobility urban – large experimental demonstrations**	**3 997 415.13**
AMU-LED proposes the design and delivery of a detailed concept of operations and definition of urban air missions followed by simulations and a large real-flight demonstration campaign to verify and validate the concept.		
CORUS-XUAM	**Concept of operations for European U-space services – extension for urban air mobility**	**3 999 389**
CORUS-XUAM aims to demonstrate how U-space services and solutions could support integrated UAM flight operations, allowing eVTOLs / unmanned aerial systems and other airspace users (unmanned and manned) to operate safely, securely, sustainably and efficiently in a controlled and fully integrated airspace, without undue impact on operations currently managed by ATM.		
GOF2.0	**Integrated urban airspace VLD**	**3 911 774.02**
GOF2.0 safely, securely and sustainably demonstrates operational validity of serving combined unmanned aerial system, eVTOL and manned operations in a unified, dense urban airspace using current ATM and U-space services and systems.		
SAFIR-Med	**Safe and flexible integration of advanced U-space services for medical air mobility**	**2 038 609.01**
SAFIR-Med's vision is to achieve safe, sustainable, socially acceptable and socially beneficial UAM.		
TINDAiR	**Tactical instrumental deconfliction and in flight resolution**	**3 269 883.88**
Tindair sets out to deliver a reliable tactical deconfliction service with a robust communication link to enable new aircraft types to be integrated safely into the skies alongside existing manned aviation and ATC. The ultimate objective of this VLD project is to deliver strategic and innovative technologies that can drive competitiveness and UAM growth using an impact-oriented approach and demonstrate the safe integration of UAM aircraft as additional airspace users.		
Uspace4UAM	**Uspace4UAM**	**3 999 966.38**
Uspace4UAM tackles issues of operational concepts, regulation and standards, while building confidence in a safe and orderly integration of UAM in everyday air traffic. It is set to deliver results that are of real interest to 'early movers', enabling them to bring a real market impact in the next few years.		
VLD2 – VOICE	**Reduced separations and improved efficiency based on VHF communications over LEO satellites**	**3 989 808.07**
VLD2 – VOICE aims to demonstrate that, with the use of satellite-based VHF systems providing voice and data link, air traffic service traffic in oceanic airspace can be handled in the same way as in continental airspace, and current separation minima can be reduced without compromising safety. In addition, it will perform some cross-border operations between adjacent flight information regions belonging to different countries.		

1.2.4.1.3 Status of the very large-scale demonstration projects under the wave 3 call (H2020-SESAR-2020-2)

As outlined in Section 1.2.3.2, the VLD projects PJ37W3 (ITARO) and PJ38-W3 (ADSCENSIO) were awarded funding and will complete their activities by June 2023. Table 7 lists the two VLD wave 3 projects active in 2022 (in alphabetical order), providing short descriptions of the projects and links to the dedicated project web pages (which include the latest news).

TABLE 7: **OVERVIEW OF VLD WAVE 3 PROJECTS ACTIVE IN 2022**

Project reference	Project title	EU contribution (EUR)
ADSCENSIO	**ADS-C enables and supports improved ATM operations**	**6 759 968.53**
As part of the goal to move to TBOs, this project focuses on improving various features of ATC in order to better anticipate how flights would behave if using TBO.		
ITARO	**PJ37-W3 ITARO – Integrated TMA, airport and runway operations**	**4 292 801.63**
ITARO aims to deliver a fast track towards deployment and to maximise network performance by combining solutions to facilitate greener aviation. It is demonstrating on a large scale, in the airport environment, several solutions that research has shown can bring efficiencies, both operationally and environmentally. It is conducting a number of real-time simulations and a live trial of two different operational environments.		

1.2.4.2 Activities carried out under the Connecting Europe Facility framework

1.2.4.2.1 Status of the Connecting Europe Facility call (CEF-T-2021-SIMOBGEN)

CINEA, in September 2021, launched a new call (DSD1a) under the Connecting Europe Facility (CEF) framework containing provisions for a series of DSDs in the areas of green aviation and UAM.

A total of five proposals (two addressing the Green Deal and three covering UAM) have been selected. The five related grants were prepared and signed by the end of October 2022. The SESAR 3 JU contributed to the evaluation of the proposals.

While the contractual management of the grants is the CINEA's responsibility, the SESAR 3 JU, steers the awarded projects from a technical perspective to ensure that the demonstration activities and the related outcomes will contribute to the SESAR programme ([7]).

Tables 8 and 9 list the five UAM and green aviation DSD projects active in 2022 (in alphabetical order), providing short descriptions of the projects and links to the dedicated project web pages (which include the latest news).

TABLE 8: **DSDs IN THE AREA OF UAM FOR WHICH THE SESAR 3 JU PROVIDED TECHNICAL EXPERTISE IN 2022**

Project reference	Project title	EU contribution (EUR)
BURDI	**Bene U-space reference design implementation**	**4 744 956**
BURDI aims to demonstrate the feasibility of managing dense and complex unmanned aircraft systems operations in controlled, uncontrolled and UAM environments. Multiple domains will be considered, such as the delivery of goods, inspections and support to medical and security operations, and the project will cover all of the U1 and U2 U-space services. It will establish U-space airspace in the civilian control zones of EBAW (Antwerp), EBLG (Liège) and EBBR (Brussels), and over the port and the densely populated city of Antwerp. Ultimately, the project aims to become a reference for best practices, standardisation, harmonisation and/or interoperability, fostering operational deployment of U-space airspace across Europe.		
EALU-AER	**Enhanced automation for U-space/ATM integration**	**2 776 500**
EALU-AER aims to demonstrate cutting-edge integrated systems and services that can illuminate the operational realities of U1 and U2 services. It will demonstrate a variety of UAM use cases intended to emulate local inspection operations, light-freight operations, long-distance logistics operations, air-taxi operations, etc. In particular, the project will see an integration of unmanned aerial vehicle and eVTOL operations over the cities of Limerick and Galway, and the town of Shannon, Ireland.		
U-ELCOME	**U-space European common deployment**	**6 985 843**
U-ELCOME aims to implement U1 and U2 U-space services through a set of demonstrations in various operational environments and European locations (Spain, France and Italy) in such a way that the project outcomes support the implementation of these services across Europe and contribute to U-space market uptake. The demonstration activities will also address the interface with the ATM system to ensure safe and fair access to airspace for all airspace users.		

([7]) As per the contribution agreement MOVE/E3/CA/SESAR3JU/662-2021/SI2.883337.

TABLE 9: **DSDS IN THE AREA OF THE GREEN DEAL FOR WHICH THE SESAR 3 JU PROVIDED TECHNICAL EXPERTISE IN 2022**

Project reference	Project title	EU contribution (EUR)
ECHOES	**Extended communications in VHF over enhanced satellite segment**	**14 946 141.60**
ECHOES aims to demonstrate the benefits of satellite-based VHF communications (voice and data link) in combination with satellite-based ADS-B technology to improve ATM services and produce positive environmental effects, reducing both CO_2 emissions and non-CO_2 impact derived from persistent contrails. ECHOES will launch two new satellites to provide these new operational services.		
HERON	**Highly efficient green operations**	**18 108 094**
HERON will foster the deployment of a set of ambitious solutions to mitigate CO_2 emissions from air transport and will offer mitigation through the development of meaningful and sustainable activities including more efficient aircraft operations from airport operation (green approaches, green taxiing), traffic management and trajectory optimisation, making use of the general principles of extensive use of automated ground processes and TBO. The demonstration will bring together mainline aircraft operators, airports and air navigation service providers, which will carry out some 1 000 flights across Europe.		

1.2.4.2.2 Status of the Connecting Europe Facility call (CEF-T-2022-SIMOBGEN)

CINEA launched a new call under the CEF framework in September 2022. It contained provisions for SESAR 3 JU DSDs for the following two flagships: connected and automated ATM, and virtualisation and cybersecure data sharing. More specifically, the DSD projects focus on the gradual transition towards higher levels of automation and on the virtual centres and ATM data service providers.

The deadline for the submission of proposals was 18 January 2023, which was to be followed by evaluation and grant preparation phases of the selected proposals by the summer and the launch of the projects in September 2023.

1.2.5 Strategic area of operation 5: deliver SESAR outreach

In 2022, the SESAR 3 JU met all of its objectives related to SESAR outreach, as set out in Section 2.2.5.4 of the 2022–2023 BAWP. This includes the following achievements and results.

- Global interoperability activities that were aligned with the European Commission's expectations, especially regarding ICAO, in close collaboration with the US Federal Aviation Administration (FAA) / Next Generation Air Transportation System initiative and other ATM modernisation initiatives, were strengthened. Activities were carried out in accordance with the BAWP.
- Links with the European Union Aviation Safety Agency and standards-making organisations such as the European Organisation for Civil Aviation Equipment (EUROCAE) were strengthened, with the involvement of SESAR 3 JU members, and SESAR material in support of standardisation was made available. Liaison with standardisation bodies took place in accordance with the BAWP.
- There was active cooperation with all European actors (Member States, regions and stakeholders), international actors and other modernisation initiatives in aviation relating to the SESAR definition and development phases. The cooperation activities took place in accordance with the BAWP.

1.2.5.1 Synergies

1.2.5.1.1 Across Horizon Europe

During 2022, the SESAR 3 JU carried out an initial internal exercise to define and scope potential synergies with other entities in the framework of Horizon Europe, such as the Clean Aviation JU and Europe's Rail JU. The intention is to progress this work in the first half of 2023 with a view to prioritising relevant partner organisations and establishing direct contacts.

1.2.5.1.2 With the European Climate, Environment and Infrastructure Executive Agency

The implementation of the DSDs, as part of the Digital European Sky programme, led to strong cooperation with CINEA, as detailed in Section 1.2.4.2.

1.2.5.1.3 With national (sectoral) policies, programmes and activities

The newly established States' Representatives Group (SRG) has a key role to play in supporting the SESAR 3 JU in seeking opportunities for coordination with national or regional initiatives with a view to ensuring complementarities with regard to the strategic research and innovation (R & I) agenda and the SESAR 3 JU's work programme. In 2022, initial discussions were held with the SRG and a template developed to elicit information on relevant national and regional initiatives. This will be followed up in 2023 with a view to identifying opportunities for coordination with any such initiatives. For more information, see Section 3.4.

1.2.5.2 Stakeholder engagement

1.2.5.2.1 Institutional stakeholders

European Union Aviation Safety Agency

In 2022, the SESAR 3 JU continued to strengthen its partnership with the European Union Aviation Safety Agency (EASA), aiming to foster its cooperation and coordination as part of the service-level agreement (SLA). Pursuant to this SLA, EASA is tasked with providing services to the SESAR 3 JU within the area of ATM / air navigation services, including the implementation of the single European sky.

The SESAR 3 JU and EASA came together in a strategic management seminar (24 May 2022), in biannual meetings (24 May 2022 and 8 November 2022) and through the steering committee at Executive Director level (11 November 2022).

The SESAR 3 JU and EASA sought to increase the visibility of their cooperation among decision-making bodies; the GB; EASA's technical committees; the EASA Member States' Advisory Body (MAB), in particular its research group; and the ATM / air navigation service technical body of the SESAR 3 JU). A further collaboration aimed to engage the SESAR 3 JU more proactively in the development of the European plan for aviation safety and the European aviation environmental report (for ATM-related aspects) in full alignment with the European ATM Master Plan. The SESAR 3 JU and EASA have also paved the way to boost

coordination at technical level with regard to the nine Digital European Sky R & I flagship activities as part of the SESAR 3 programme.

As part of the EASA–SESAR 3 JU 2022 work plan and according to the areas of activities defined in the SLA, EASA and the SESAR 3 JU agreed that EASA would provide support to the SESAR 3 JU through various contributions and participation in the SESAR maturity gates. In particular, it was agreed that EASA would:

- provide observations of the operational and technical maturity of a list of selected SESAR solution deliverables against the maturity criteria defined in the multiannual work programme (MAWP) of the SESAR 3 JU;
- contribute to the development of SESAR solutions' regulatory and standardisation overview by reviewing the regulatory and standardisation needs prior to the preparation of the data pack for SESAR Solutions stemming from the SESAR 2020 programme (wave 1);
- identify and describe the evolution of the technical regulatory framework concerning a selected SESAR Solution (TRL6 completed) for early identification and description of the required regulatory and standardisation needs;
- provide feedback on the demonstration report and on the regulatory recommendations regarding six SESAR 2020 VLD projects aiming to demonstrate advanced U-space services for UAM.

EUROPEAN DEFENCE AGENCY

European Defence Agency

In Europe, military aviation encompasses hundreds of military areas and dozens of military airfields. An estimated 30 % of European military flights adhere to general air traffic rules, while the remainder operate as operational air traffic. Military flights are carried out for a wide variety of reasons, including as training exercises, to ensure homeland security (including sovereignty missions) and for the management of cross-border crisis operations. Such missions often require immediate access to airspace, as they are frequently launched at short notice. This means that, by default, military use of airspace can be immediate and unpredictable, necessitating dynamic ATM arrangements if efficient military operations are to be secured without a negative impact on the efficient overall flow of air traffic. For this reason, widespread military involvement in SESAR Solutions is paramount to ensure that effective military missions and airspace use can be integrated with other uses of airspace across Europe.

The SESAR 3 JU and the European Defence Agency (EDA) have been engaged in close dialogue since 2011, and this relationship continued in 2022, with dialogue focusing in particular on military matters and inputs to the Digital European Sky programme. The EDA now serves as the main interface between the Digital European Sky programme on the one hand, and military aviation and ATM on the other, and is responsible for coordinating military views with regard to the single European sky and SESAR.

Cooperation in 2022 under the memorandum of cooperation (MoC) included agreement to establish an EDA–SESAR 3 JU task force designed to enhance coordination during the execution of the Digital European Sky programme. This task force will directly support the EU action plan on synergies between civil, defence and space industries and ensure complementarity between the work programmes of SESAR 3 JU and the European Defence Fund. In the meantime, the SESAR 3 JU and the EDA have continued to harmonise their RPAS research programmes to reduce duplication and to promote dual-use solutions. The SESAR 3 JU participated in reviews, discussions and events relating to the EDA RPAS activities, and the EDA reciprocated in the SESAR exploratory research and IR projects, notably PJ13. This cooperation supports a harmonised approach to RPAS standardisation and operational integration.

esa

European Space Agency

The European ATM Master Plan clearly identifies the need for space-based positioning for navigation and communication services in support of time-based operations, and for improved operations at less well-equipped airports or airports with differently equipped vehicles.

Coordination between the two organisations progressed in 2022, particularly in relation to European Space Agency / Inmarsat's Iris activities and project PJ14-W2-107 on satellite communications. This allowed the continued development of a shared view on the interdependencies between the programmes, although slight delays in the Iris programme have limited the opportunities to use satellite communications equipped aircraft within the

SESAR 2020 programme. Ultimately, this coordination with the European Space Agency and the finalisation of the Iris system are key to enabling four-dimensional operations worldwide, with finalisation to take place within Iris 3.

European Union Agency for the Space Programme

During 2022, the SESAR 3 JU entered into discussions with the European Union Agency for the Space Programme to explore the potential for closer collaboration with a view to establishing synergies between cluster 4 initiatives and cluster 5 initiatives under Horizon Europe. It was agreed in principle to establish a MoC between the two organisations, and the aim is for this to be put in place in 2023.

1.2.5.2.2 Industry stakeholders

SESAR Deployment Manager

During 2022, collaboration between the SESAR 3 JU and SESAR Deployment Manager continued. A new consortium took over as SESAR Deployment Manager on 1 June 2022, and the SESAR 3 JU and the new SESAR Deployment Manager entered into discussions on a new memorandum of understanding between them to replace the previous arrangement. The text of the new memorandum of understanding was finalised at the end of the year and is expected to be approved and become operational in early 2023. Increased coordination has been set up with SESAR Deployment Manager in particular in view of reaching the industrialisation target date of the CP1 AF6.

Advisory Council for Aviation Research and Innovation in Europe

During the reporting period, the SESAR 3 JU continued to support the activities of the Advisory Council for Aviation Research and Innovation in Europe. The SESAR 3 JU was represented at meetings of the council's General Assembly, at which the discussion focused on the ongoing reform of the organisation in response to a request from the European Commission. Representatives of the SESAR 3 JU also attended meetings of the council's Strategy and Integration Board, at which the agenda and supporting material for the General Assembly were discussed, under the direction of one of the council's chairs. The new 'Fly the Green Deal' vision was presented to the European Commission at ILA Berlin in July. This vision addresses ATM and the SESAR-related vision in a way that is consistent with the European ATM Master Plan and the scope of the SESAR 3 JU, this being assured by the proactive input by the SESAR 3 JU into the vision preparation activities.

Standardisation bodies

Collaboration between the SESAR 3 JU and the standards-making organisations continued, supporting the development of standards with the ultimate aim of accelerating the uptake of SESAR Solutions. Concrete recommendations to boost the technical coordination of the development of standards at strategic level were included in the action paper for a simplified and strengthened master planning process, which was endorsed by the GB in December. One of the key measures is the creation of a technical coordination group including EUROCAE and all EU entities involved in executing SESAR deployment activities at European level.

European Organisation for Civil Aviation Equipment

The SESAR 3 JU continued to ensure ongoing alignment between its work and proposed standards developments, EUROCAE working arrangements and EUROCAE planning through its active participation in the EUROCAE Council and Technical Advisory Committee under the terms of the 2012 MoC. In order to align more closely with the Digital European Sky programme, a new MoC between the SESAR 3 JU and EUROCAE was drafted, and was signed in February 2023. The SESAR 3 JU, through participation in the EUROCAE Technical Advisory Committee, contributed to drafting parts of the EUROCAE technical work programme to ensure alignment with SESAR planning and needs, in particular to address the needs identified in the strategic research and innovation agenda.

SESAR deliverables were made available to several EUROCAE working groups in 2022, to support the development of standards relating to several key areas of the Digital European Sky programme.

In 2022, EUROCAE published standards with contributions from and of direct relevance to SESAR solutions.

European Air Traffic Management Standards Coordination Group

In 2022, the SESAR 3 JU continued to be an active participant in the European Air Traffic Management Standards Coordination Group, chaired by EASA, with the objectives of coordinating standardisation activities, identifying their links with the R & I activities and providing a forum for discussion.

With the commencement of the Digital European Sky Programme, the SESAR 3 JU has implemented new mechanisms for making recommendations for standardisation to the European Air Traffic Management Standards Coordination Group and EUROCAE. These recommendations and conclusions remain a major input for the European ATM standardisation rolling development plan. This plan serves not only as the reference for ATM standardisation needs in Europe (including SESAR-specific needs), but also as the basis for European input into both the process and the content of the ICAO standardisation roadmap development.

European Unmanned Aerial System Standards Coordination Group

In 2022, the SESAR 3 JU continued as an active participant in the European Unmanned Aerial System Standards Coordination Group, with the objective of coordinating unmanned aircraft system (UAS)-related standardisation activities and needs. With U-space becoming more mature, and now that the Commission has published its regulatory framework on U-space, EASA has taken over as chair of the group. The focus of the European Unmanned Aerial System Standards Coordination Group, supported by the SESAR 3 JU, has been on defining means of compliance for the evolving U-space regulatory environment.

Air navigation service providers

The SESAR 3 JU maintained close contact with the Civil Air Navigation Services Organisation (CANSO) during 2022. This included discussions on how best to collaborate in showcasing the results of the SESAR 2020 programme during CANSO's Airspace World event in March 2023. In December 2022, the SESAR 3 JU joined CANSO's Complete Air Traffic System initiative, which involves over 60 organisations worldwide.

Civil and military airspace users and professional staff organisations

Civil airspace users are associated with a wide range of undertakings and carry out a wide spectrum of activities, including scheduled and charter flights, cargo flights, business and general flights, and rotorcraft operations.

According to Article 150(3) of the SBA, civil users of airspace are permanent observers of the GB, with voting rights.

Professional staff organisations comprise the International Federation of Air Traffic Controllers' Associations, the European Cockpit Association, the International Federation of Air Traffic Safety Electronics Associations, the European Transport Workers' Federation and the Air Traffic Controllers European Unions Coordination. These organisations represent the overwhelming majority of European aviation workers.

Due to prioritisation issues associated with the creation of the SESAR 3 JU and the Digital European Sky programme, there was no contracted activity between the SESAR 3 JU and either the civil airspace users or the professional staff organisations. Ad hoc liaison and communications continued to good effect. New contracts with both stakeholder groups will be put in place during 2023.

With regard to military airspace users, during the reporting period, the SESAR 3 JU benefited from the ongoing contribution, at project level, of experts from EUROCONTROL's military engagement plan.

SESAR 3 JU staff supported the professional staff organisations through several contributions to meetings of the European Commission's Expert Group on the Human Dimension of the Single European Sky.

European airports

Recognising the need for further airport integration, the SESAR 3 JU works closely with Airports Council International (ACI) Europe to raise awareness of SESAR among its airport partners, which include airport operators beyond those represented in the SESAR 3 JU's membership.

In 2022, the close cooperation between ACI Europe and the SESAR 3 JU was exemplified through a second specific contract implementing the framework contract signed at the very end of 2020. Through this specific contract, the following main activities were performed.

- ACI Europe surveyed its members to assess the level of implementation of the most relevant SESAR solutions at European airports. ACI Europe delivered a number of conclusions and recommendations that the SESAR 3 JU should use to better connect with the European airport community during the final steps of R & I and in particular in the demonstration phase.

- ACI Europe supported the SESAR 3 JU in a number of communication activities, including in the production of articles, video interviews and media partnerships to promote SESAR R & I activities to decision-makers and the general public.
- The SESAR 3 JU Executive Director *ad interim* gave a presentation on how SESAR supports airports in a post-pandemic world at the ACI Europe Annual Congress and General Assembly at Rome–Fiumicino International Airport. At the same event, a SESAR 3 JU-sponsored digital transformation award was presented to London City Airport recognising the airport as a pioneer in the deployment of digital and remote tower solutions.
- On behalf of the SESAR 3 JU, ACI Europe experts attended several airport-related communication and dissemination events organised by SESAR 2020 projects. They also reviewed several deliverables produced by PJ04-W2, 'Total airport management', providing a valuable operational and technical airport view on the activities of this project.

New entrants

The SESAR 3 JU's membership includes a number of organisations in the field of new entrants, which encompasses unmanned traffic management / U-space, UAS and high-altitude operations. The SESAR 3 JU is also actively involved in the Network of U-space Stakeholders, which it co-chairs together with the European Commission, EASA and EUROCONTROL. The SESAR 3 JU will consider during 2023 whether new mechanisms of cooperation might be appropriate.

Small and medium-sized enterprises and start-ups

The SESAR 3 JU held discussions with the European Aerospace Cluster Partnership during 2022 with a view to establishing a cooperative arrangement that would provide a platform to promote the involvement of small and medium-sized enterprises (SMEs) and start-ups in the SESAR 3 JU's activities and ensure the provision of timely information to them, particularly in relation to funding opportunities. This arrangement is expected to be put in place during 2023.

1.2.5.3 Cooperation with non-EU countries and international organisations

The SESAR 3 JU's strategy for cooperation with non-EU countries and international organisations is pursued within the framework of the EU's sustainable and smart mobility strategy. In close coordination with the European Commission, the SESAR 3 JU aims to secure its position as a global leader in ATM modernisation in support of the ICAO global air navigation plan (GANP), promoting SESAR solutions for global interoperability and harmonisation, and thereby supporting EU industrial leadership and competitiveness. Following the lull in international engagements during 2020 and 2021 due to the COVID-19 pandemic, international activities started to pick up in 2022.

At ICAO level, the principal focus was on the 41st assembly, which took place at the end of September. The SESAR 3 JU actively participated in the interinstitutional preparations of European positions and inputs, including contributions to a number of European working papers, and participated in the assembly itself as part of the EU delegation. The SESAR 3 JU also moderated one of the panel sessions at the ICAO 2022 Innovation Fair, which preceded the assembly. The SESAR 3 JU participated in a number of other ICAO activities, including the ICAO GANP Study Group, which oversees the future evolution of the ICAO GANP and is laying the groundwork for the next major update in 2025; the Unmanned Aircraft Systems Advisory Group, which organises the annual ICAO Drone Enable event and contributes to the development of ICAO's UAS framework document, building on experience gained in SESAR U-space projects; and the ICAO Integrated Communications, Navigation, Surveillance and Spectrum Task Force, which aims to further develop the communications, navigation and surveillance (CNS) systems roadmap and frequency spectrum access strategy in a performance-based and service-oriented manner. The SESAR 3 JU also provided a keynote speaker at the ICAO Drone Enable event in November 2022.

During 2022, the SESAR 3 JU continued to work with the US FAA – under the EU–US MoC on ATM modernisation, civil aviation R & I and global interoperability – to implement the new work structure for cooperation between SESAR and the Next Generation Air Transportation System initiative agreed in 2021. The Coordination Committee, co-chaired by the SESAR 3 JU and the FAA, met twice during the year to oversee the start of activities under the new 'Coordination Plans' (CPs) across the four focus areas:

four focus areas: the integration of new entrants, the evolution of performance-based technologies, advancing innovation in ATM and ICAO coordination. The focus was on scoping, planning and resourcing work under the various CPs.

Bilateral contacts with other international partners resumed in 2022. In particular, regular contacts were maintained between the SESAR 3 JU and the Civil Aviation Authority of Singapore under the MoC between the two. This included participation in the Changi Aviation Summit in May 2022, and a workshop held in December to hear from the Civil Aviation Authority of Singapore about the multiregional TBO demonstration in which it participated together with the FAA and the aviation authorities of other countries.

The SESAR 3 JU participated in the 2022 International Workshop on ATM/CNS, in Tokyo, to present the European vision for a Digital European Sky. Bilateral meetings were also held with the Japanese Civil Aviation Bureau and the Japanese drone community to exchange views on their respective activities and priorities. These meetings laid the foundation for deeper engagement planned for 2023.

The SESAR 3 JU continued to support EASA in its technical cooperation activities. This included support for a number of ATM-related activities under the EU–China and EU–Republic of Korea aviation partnership projects, and participation in the EU–Asia Symposium on UAS/UAM held in Singapore in October.

1.3 Calls for proposals, grant information and other funded actions (i.e. calls for tenders, prizes)

1.3.1 Calls for proposals and grant information

In 2022, the SESAR 3 JU managed 70 grants that were active at the beginning of the year following five calls for proposals conducted in previous years. All of these projects and the related grants were managed in accordance with the Horizon 2020 programme rules. More information about these projects is available in Section 1.2.

The first Digital European Sky calls (HORIZON-SESAR-2022-DES-ER-01 and HORIZON-SESAR-2022-DES-IR-01) were launched on 7 April 2022 and published on the funding and tenders opportunities portal. The SESAR 3 JU organised an information day on 22 April 2022. The online event presented the key elements of the calls, which cover a wide range of topics associated with making aviation smarter and more sustainable. The calls closed on 13 October 2022, with 127 proposals submitted, as outlined in Table 10.

TABLE 10: **PROPOSALS SUBMITTED IN RESPONSE TO THE DES-ER-01 AND DES-IR-01 CALLS (BREAKDOWN PER TOPIC)**

HORIZON-SESAR-2022-DES-ER-01	
Number of proposals submitted: 72	
HORIZON-SESAR-2022-DES-ER-01-WA1-1	8
HORIZON-SESAR-2022-DES-ER-01-WA1-2	5
HORIZON-SESAR-2022-DES-ER-01-WA1-3	3
HORIZON-SESAR-2022-DES-ER-01-WA1-4	4
HORIZON-SESAR-2022-DES-ER-01-WA1-5	9
HORIZON-SESAR-2022-DES-ER-01-WA1-6	7
HORIZON-SESAR-2022-DES-ER-01-WA1-7	3
HORIZON-SESAR-2022-DES-ER-01-WA2-1	4
HORIZON-SESAR-2022-DES-ER-01-WA2-3	6
HORIZON-SESAR-2022-DES-ER-01-WA2-4	8
HORIZON-SESAR-2022-DES-ER-01-WA2-5	1
HORIZON-SESAR-2022-DES-ER-01-WA2-6	2
HORIZON-SESAR-2022-DES-ER-01-WA2-7	3
HORIZON-SESAR-2022-DES-ER-01-WA2-8	7
HORIZON-SESAR-2022-DES-ER-01-WA3-1	2

HORIZON-SESAR-2022-DES-IR-01	
Number of proposals submitted: 55	
HORIZON-SESAR-2022-DES-IR-01-WA1-1	1
HORIZON-SESAR-2022-DES-IR-01-WA1-2	1
HORIZON-SESAR-2022-DES-IR-01-WA2-1	5
HORIZON-SESAR-2022-DES-IR-01-WA3-1	5
HORIZON-SESAR-2022-DES-IR-01-WA3-2	6
HORIZON-SESAR-2022-DES-IR-01-WA3-3	1
HORIZON-SESAR-2022-DES-IR-01-WA3-4	2
HORIZON-SESAR-2022-DES-IR-01-WA3-5	1
HORIZON-SESAR-2022-DES-IR-01-WA4-1	11
HORIZON-SESAR-2022-DES-IR-01-WA5-1	3
HORIZON-SESAR-2022-DES-IR-01-WA5-2	3
HORIZON-SESAR-2022-DES-IR-01-WA5-3	4
HORIZON-SESAR-2022-DES-IR-01-WA5-4	2
HORIZON-SESAR-2022-DES-IR-01-WA6-1	5
HORIZON-SESAR-2022-DES-IR-01-WA6-2	1
HORIZON-SESAR-2022-DES-IR-01-WA6-3	2
HORIZON-SESAR-2022-DES-IR-01-WA6-4	2

Tables 11 and 12 show a breakdown of participants in submitted proposals, including a breakdown by country where the legal entity is established, and by participant type.

TABLE 11: BREAKDOWN OF PARTICIPANTS IN THE DES-ER-01 CALL, BY PARTICIPANT TYPE AND COUNTRY

HORIZON-SESAR-2022-DES-ER-01						
Country	**Higher education institutions**	**Other**	**Private for-profit companies**	**Public bodies**	**Research organisations**	**Total**
Austria	1		4			5
Belgium	1	5	10		24	40
Canada			4			4
Croatia	7		3		1	11
Cyprus			1			1
Czechia	3		6		2	11
Denmark			1			1
Estonia			1			1
Finland	1		1			2
France	13	1	20	2	3	39
Germany	12		13		22	47
Greece	6	1	3	1	1	12
Hungary			2			2
Iceland			1			1
Ireland			8			8
Israel	1		2			3
Italy	13		41		18	72
Malta	1		1			2
Netherlands	11		4		5	20
North Macedonia	1					1
Norway	2			1	4	7
Poland	1		2		2	5
Portugal	3		1			4
Serbia	7					7
Singapore	2					2
Slovakia			1			1
Spain	27	1	29	7	26	90
Sweden	10		1	7		18
Switzerland	4	1	3		1	9
Türkiye	5	2	3	1		11
United Kingdom	13		5			18
United States				2		2
Total	**145**	**11**	**171**	**21**	**109**	**457**

TABLE 12: **BREAKDOWN OF PARTICIPANTS IN THE DES-IR-01 CALL, BY PARTICIPANT TYPE AND COUNTRY**

HORIZON-SESAR-2022-DES-IR-01						
Country	**Higher education institutions**	**Other**	**Private for-profit companies**	**Public bodies**	**Research organisations**	**Total**
Austria	1		19		1	21
Belgium		8	16		34	58
Bulgaria			3			3
Canada			1			1
Croatia			2			2
Cyprus			1			1
Czechia	1		15			16
Denmark	1		10	1		12
Estonia	1		4			5
Finland	1	1	2		3	7
France	12	3	101	17	5	138
Germany	1		38	1	29	69
Greece	2	1	10	3		16
Hungary		2	4	1	1	8
Iceland			5			5
Ireland			23			23
Israel			4			4
Italy	1		84	1	11	97
Latvia				2		2
Lithuania			10		1	11
Luxembourg			1			1
Malta			3			3
Netherlands	3	1	8		13	25
Norway			6		3	9
Poland	1		5	1	10	17
Portugal			6			6
Romania			4	5	2	11
Serbia	1					1
Slovakia			4	1		5
Slovenia			5			5
Spain	11	1	101	28	29	170
Sweden	2		10	10		22
Switzerland	2		21		3	26
Türkiye	4	1	7		1	13
Ukraine				1		1
United Kingdom	5		35		1	41
United States			1	1		2
Total	**50**	**18**	**569**	**73**	**147**	**857**

1.3.2 Other funded actions (operational procurement)

Due to its ramp-up activities, the SESAR 3 JU focused on the management of its existing contracts covered by operational appropriations and on selecting the providers of specific programme management services. As a consequence, the SESAR 3 JU decided to move the indicative dates of some operational procurements to the first quarter of 2023.

TABLE 13: **OPERATIONAL PROCUREMENT FOR 2022**

Subject of the contract	Type of contract	Contractor	Procedure (if applicable)	Signature date	Amount (EUR)
Provision of SESAR 3 JU development support services to the SESAR 3 JU for SESAR 3 programme management	Service contract	Sopra Steria Benelux / Egis Avia	Open procedure	12.12.2022	29 569 456.00
Provision of airport expertise for the execution of the SESAR 3 JU programme	Specific contract	ACI Europe	Framework contract implementa-tion	22.4.2022	291 450.00
Provision of airport expertise for the execution of the SESAR 3 JU programme	Amendment to framework contract ([8])	ACI Europe	Negotiated procedure	21.12.2022	250 000.00
Coordination with EASA	Service-level agreement	EASA	N/A		200 000.00
Prize for SESAR Young Scientist Award (student category)	Prize	N/A	Contest		1 500.00
Prize for SESAR Young Scientist Award (PhD category)	Prize	N/A	Contest		5 000.00
Total for 2022					**30 317 406.00**

([8]) The amendment to the framework contract is reported in this document because it resulted in an increase in the total operational procurement for 2022 by EUR 250 000.

1.4 Evaluation procedures and outcomes

The evaluation of proposals stemming from the two calls for proposals launched by the SESAR 3 JU (HORIZON-SESAR-2022-DES-ER-01 and HORIZON-SESAR-2022-DES-IR-01) was carried out between 10 November 2022 and 27 January 2023, by a panel composed of 50 external experts, including seven independent experts for ethics screening. In addition, the SESAR 3 JU contracted an observer to independently assess the quality of the evaluation.

The external experts were selected so as to ensure a high level of skills, experience and knowledge in the areas of the calls, and special attention was given to achieve an appropriately balanced composition (skills, experience, knowledge, geographical diversity, gender and private–public sector balance) and regular rotation.

The evaluators were briefed on applicable rules, processes, procedures, evaluation criteria, and the scope and objectives of the calls. During the individual evaluation phase, each proposal was independently evaluated against the award criteria by at least three evaluators.

The evaluators prepared, for each proposal, an individual evaluation report, with comments and scores for each criterion.

1.5 Follow-up activities linked to past calls

Refer to Section 1.2 for details of projects that were active during the reporting period and financed from past calls.

1.6 Openness, cooperation, synergies and cross-cutting themes and activities

Information on collaborations with other European programmes, and partnerships and synergies between the JU's actions and national or regional initiatives and policies, is provided in Section 1.2.5, in line with SBA Articles 17(2)(p) and 26(2)(d) and (f).

1.7 Progress against key performance indicators

During the reporting period, no project financed by Horizon Europe and managed by the SESAR 3 JU was active. Therefore, no measurement can be provided in this edition of the consolidated annual activity report (CAAR) for the Horizon Europe common key impact pathways, for the Horizon Europe partnership common indicators or for the Horizon Europe KPIs specific to the SESAR 3 JU.

However, in 2022, the SESAR 3 JU managed 70 grants financed under the SESAR 2020 programme. For this reason, this edition of the CAAR provides the measurement of the Horizon 2020 common KPIs, of the indicators for monitoring cross-cutting issues and of the SESAR 2020 KPIs specific to the SESAR 3 JU (Annexes 3 and 6).

In line with the previous editions of the CAAR, the yearly value for the reporting period has been provided in the aforementioned annexes, following the methodology set out by the European Commission ([9]). With the SESAR 2020 programme approaching its closure, for a number of indicators (i.e. those that sample projects by the start date of the reporting period) the methodology led to an empty sample, meaning a yearly measurement was not possible. Therefore, although not requested by the template, Annex 3 provides a cumulative overview of relevant categories of the Horizon 2020 common KPIs and of the indicators for monitoring cross-cutting issues ([10]).

([9]) Council Decision 2013/743/EU, Annexes II and III; Horizon 2020 Indicators – Assessing the results and impact of Horizon 2020; Guidelines on key performance indicators (KPI) for directors of EU decentralised agencies (SWD(2015)62); Communication from the Commission on the strengthening of the governance of Union bodies under Article 70 of the Financial Regulation 2018/1046 and on the guidelines for the single programming document and the consolidated annual activity report, COM(2020) 2297 (see the template for the consolidated annual activity report).

([10]) ( ) Industrial leadership; societal challenges; widening participation; SME participation; gender; international cooperation; moving from discovery to market; private sector participation; funding for public–private partnerships; communication and dissemination; and participation of research organisations and universities.

The analysis of the measured Horizon 2020 KPIs demonstrates that, in general terms, the implementation of the SESAR 2020 programme is proceeding according to plan and results are satisfactory.

Late payments (KPI 15) are the major exception to this positive trend. In 2022, out of 656 payments (+ 50 % compared with 2021), 126 were late (19.2 % compared with 7.7 % in 2021). Missions' payments represented almost half of such late payments (53 payments, representing 42 % of the total). Several causes have been identified: some late payments at the beginning of the reporting year were due to the closure of attribute-based access control (ABAC); some others were caused by delays in the process to enter the amended budget into ABAC. Corrective measures have already been defined and put in place. For the transcription of a budget amendment into ABAC, measures will be taken to get the signed GB decisions faster. The new accounting arrangements already represent an improvement. Finally, the implementation and use of the Speedwell software helps in systematically identifying and monitoring all pending payments in the workflow.

Positive developments are noted regarding audit activities during the reporting period. The rate of implementation of *ex post* audit results (KPI 39) shows a significant improvement (89 % compared with 59 % the previous year) mainly because in 2022 the Compass IT tool integrated a reporting module, which allowed better monitoring and timely implementation.

With regard to the residual error rate (KPI 38), reported percentages have stayed, in broad terms, within the average rates of previous years. The slightly higher percentage than that of 2021 is due to a beneficiary audited for the first time with a high error rate.

Regarding the in-kind contributions committed by the private members to SESAR 2020 projects selected for funding (KPI 40), it is worth noticing that, since 2022, the collective industry contribution to the JU, established at the outset of the programme and documented in the membership agreement, is expected to exceed the target total net contribution by almost 5 % ([11]). The total net contribution is defined as the sum of the validated in-kind and cash contributions.

1.7.1 Progress against general Horizon Europe key impact pathways

Not applicable, as there were no projects financed by Horizon Europe during the reporting period.

1.7.2 Progress against Horizon Europe common Joint Undertakings' key performance indicators

Not applicable, as there were no projects financed by Horizon Europe during the reporting period.

1.7.3 Progress against key performance indicators specific to the SESAR 3 Joint Undertaking

Not applicable, as there were no projects financed by Horizon Europe during the reporting period.

1.8 Dissemination and information about project results

In 2022, a series of actions were implemented aiming to raise awareness among beneficiaries about the importance of the dissemination of and provision of information about the projects' results. The activities implemented were tailored to the specific situation of the projects, depending on the different projects' implementation stages.

Project-specific information is available in Section 1.2 and Annex 3.

([11]) Total net contribution of SESAR 3 JU members (as defined in the membership agreement, excluding EUROCONTROL): EUR 297 125 484.13. Total net forecast of SESAR 3 JU members (excluding EUROCONTROL) as of December 2022: EUR 310 916 021.64.

2 Support provided to operations

In 2022, the SESAR 3 JU met all of its objectives related to support provided to operations, as set out in Section 3.1 of the 2022–2023 BAWP. This includes the following achievements and results.

- Promoted the Digital European Sky vision, the added value of the SESAR 3 JU partnership, through publications, events and online media. Communication and dissemination activities were carried out in accordance with the BAWP.
- Ensuring full compliance with programming and reporting requirements. The 2022–2031 MAWP and the 2022–2023 BAWP, and its subsequent amendments, were developed and submitted on time, as per the requirements. The 2021 CAAR and the report on the implementation of the delegation agreements on U-space and geofencing were adopted and submitted on time.
- Monitoring the efficiency and effectiveness of the SESAR 3 JU's legal and procurement activities. Activities were carried out in accordance with any plan agreed with the requestor and with the 2022–2023 BAWP procurement plan (Sections 2.4 and 3.3 of the plan).
- In 2022, the SESAR JU received no 'critical' observations and no 'very important' recommendations from the auditors.
- No files were sent to the European Anti-Fraud Office (OLAF) for investigation.
- With regard to the delivery of infrastructure services to enable the SESAR 3 JU to operate smoothly, the services were in general delivered in line with the plans. Business continuity measures were implemented, and the infrastructure services proved to be generally effective in this regard. However, the number of priority 1 incidents causing loss of at least one critical service to the whole organisation was higher than planned in the 2022–2023 BAWP: five against a target of zero. The SESAR 3 JU systematically assessed incidents recorded at that level and formalised the assessment in a report dedicated to avoiding the reoccurrence of such issues.
- In terms of monitoring the efficiency and effectiveness of human resources management, the career development review, the setting of objectives and the reclassification exercise were completed in line with the BAWP.

2.1 Communication activities

2.1.1 Events and conferences

2.1.1.1 Face-to-face events

Given the easing of COVID-19 social restrictions during 2022, SESAR 3 JU events could once again be held face to face. The SESAR 3 JU focused on five major events throughout the year, attracting an average of 300 participants per event.

SESAR 3 Joint Undertaking launch event, 5 May 2022, Brussels

The SESAR 3 JU gathered its founding members and staff, and representatives from the European institutions and key stakeholders, to mark the launch of the new partnership, which aims to accelerate, through R & I, the delivery of an inclusive, resilient and sustainable Digital European Sky. The event coincided with the announcement of the appointment of Andreas Boschen as the new Executive Director of the SESAR 3 JU.

World ATM Congress, 21–23 June 2022, Madrid

The 'Europe for Aviation' team, consisting of nine European aviation organisations working to promote the modernisation, sustainability and resilience of safe European aviation, united at the World ATM Congress. During the 3-day congress, these organisations showcased how, through collaboration, they can go much further in tackling the most pressing challenges facing the aviation industry.

The 'Europe for Aviation' stand and theatre hosted a wide range of briefings, exhibits and demonstrations illustrating the collaboration in action between the European aviation organisations working to implement the single European sky, namely the European Commission, EASA, the EDA, Eurocontrol, EUROCAE, the European Union Agency for the Space Programme, CINEA, the SESAR 3 JU and SESAR Deployment Manager. Visitors enjoyed:

- a series of briefings and panel discussions focusing on, among other topics, sustainability; AI; ATM network operations; civil–military cooperation; digitalisation; higher airspace operations; U-space implementation; space and ATM; the latest developments in SESAR; virtual centres; and ATM deployment;
- a dedicated stand for networking with the 'Europe for Aviation' partners – featuring live traffic updates, an airport approach tower, virtual reality demonstrations on space, drones and many other exhibits – and for promoting EU funding;
- the presentation of SESAR R & I results ([12]).

SESAR 3 Joint Undertaking Annual Conference, 10 October 2022, Brussels

More than 200 participants, including industry leaders, gathered alongside EU policymakers to discuss the aviation sector's digitalisation efforts at the first ever annual conference of the SESAR 3 JU. The conference featured panel discussions on the digitalisation of Europe's aviation sector, alongside the Digital European Sky marketplace, which showcased some of the latest SESAR innovations. The urgency to address climate change was a running theme throughout the day.

([12]) SESAR R & I results presented at the 2022 World ATM Congress.

'Building back better' was the leitmotif in the first morning session, in which panellists discussed the aviation industry's efforts to recover after successive crises, while tackling the sector's carbon footprint.

Digitalisation of the aviation ecosystem was discussed in a second morning panel, in which speakers stressed the opportunity to boost ATM's performance and unlock the potential to reduce the sector's CO2 emissions.

A standards and regulatory framework conducive to digital transformation was explored by speakers in the final panel discussion. There was common agreement on the need to embed standards and regulatory work much earlier within the innovation life cycle, something that the SESAR 3 JU will seek to do.

A closing panel reflected the day's discussions, summarising some of the key takeaways. Throughout the day, SESAR 3 JU projects and members pitched their innovations onstage and through a dedicated Digital European Sky marketplace exhibition.

The event was a big success, feedback received was extremely positive and the SESAR 3 JU community was eager for this event to be repeated.

EU Drone Days, 29–30 November 2022, Brussels

The Directorate-General for Mobility and Transport of the European Commission and the SESAR 3 JU organised the EU Drone Days. During the event, participants gained key insights into the Commission's drone strategy 2.0, and joined discussions on the readiness of the European drone sector to make U-space a reality. Over 400 participants also enjoyed an exhibition of the latest industry innovations in UAM and SESAR 2020 U-space projects.

Launch of the European drone strategy 2.0, 29 November

The EU Drone Days kicked off with the launch of the forward-looking European drone strategy 2.0, intended to foster uptake of drone technology, while ensuring safety, security and social acceptance. Panel discussions with industry and policy experts examined in detail the areas covered by the strategy, including innovative air mobility and aerial services, and strengthening European civil, security and defence industry capabilities.

SESAR 3 Joint Undertaking U-space showcase event, 30 November

On day 2, the SESAR 3 JU hosted a U-space showcase event ([13]). This was an opportunity for the European drone community to present and discuss progress towards making U-space a reality, and to explore the results of the SESAR 2020 programme of U-space research and demonstration projects.

SESAR Innovation Days, 6–9 December 2022, Budapest

After a 2-year hiatus, 400 of Europe's leading researchers in the ATM and aviation domains gathered to take stock and exchange on a wide variety of topics, from AI and energy-efficient flying to meteorology and drone traffic management. Results stemming from the showcased research have the potential to push the boundaries of ATM, making it smarter and more sustainable in the coming years, the participants heard.

Now in its 12th edition, the SESAR Innovation Days, a flagship event in the aviation research calendar, showcased some of the breakthrough concepts from the SESAR 3 JU's exploratory research portfolio, and novel outcomes from the broader ATM research community.

Altogether, the conference featured 31 posters and 51 papers, covering data-driven methods for safety and resilience prediction, climate-optimised trajectories, drone traffic management and airport operations, among other research areas. Special plenary sessions looked at the important topics of U-space, the enabling framework for drone integration, the environment and AI.

Much of the research presented during the conference stems from the 41 exploratory research projects – including the SESAR knowledge transfer network project, Engage – that ran from 2020 to 2022. The conference brought together academic and industry partners, such as universities, SMEs, research centres, airlines, manufacturers and air navigation service providers, from across the EU and from the EU Associated Countries.

The conference closed with the SESAR Young Scientist Award ceremony, celebrating the next generation of aviation and ATM researchers in two categories, student and PhD. The top prize among the students went to Marie-Christine Névir, TU

([13]) See more information on the U-space showcase event.

Dresden, who developed and initially validated a new workload model for sectorless airspace (i.e. flight-centric ATC). The jury praised her for the very high level of innovation demonstrated in her work tackling controller organisation in light of this relatively new operational concept.

Omar García Crespillo, German Aerospace Center and Swiss Federal Institute of Technology Lausanne, received first prize in the PhD category for his work on GNSS/INS Kalman filter integrity monitoring with uncertain time-correlated error processes. The jury praised him for a very well-structured and well-written thesis, which demonstrated excellent scientific rigour and innovation in terms of the simulation approaches used.

2.1.1.2 Online events

In light of the increased number of face-to-face events, online events were scaled back in 2022. They are summarised in Table 14.

TABLE 14: **SESAR 3 JU ONLINE EVENTS IN 2022**

Event	Date
SESAR Digital Academy webinars	
Unpacking SESAR's performance measurement framework	24.3.2022
Innovative solutions for ATM resilience	28.4.2022
Satellite communications webinars (in cooperation with SESAR Deployment Manager, Eurocontrol and EASA)	
Satellite communications for aviation: the stakeholders' perspective	25.1.2022
Iris satellite communications: a system designed for aviation	16.2.2022
Iris satellite-based data-link maturity and readiness for deployment aspects	28.3.2022
Webinars co-organised with ACI Europe	
Innovating for passengers during the COVID-19 crisis	16.9.2022
Multimodality	10.11.2022

2.1.2 Press

In 2022, the SESAR 3 JU continued its outreach to trade press and member/partner media channels, with some 23 feature articles and interviews published in a range of magazines and online media, including specialised media. Highlights included coverage by *ABC* (Spanish daily newspaper), *ATR Magazine*, ATC Network, Avionics International, *ERA Magazine*, Euronews, *The Parliament Magazine* and Yocova.

In 2022, the SESAR 3 JU was mentioned in 1 974 articles, highlights of which are available on the SESAR 3 JU website. Through its contract with ACI Europe, the SESAR 3 JU contributed an article to *The Brussels Times*, one of the city's most widely distributed English-language magazines, and ran two campaigns in *Politico* (mobility and sustainability insights). The media partnerships resulted in increased traffic to the SESAR 3 JU website.

2.1.3 Publications

The SESAR 3 JU published a number of publications throughout the year (Table 15), presenting the results of funded projects. The publications were promoted through online channels and at key events.

TABLE 15: SESAR 3 JU PUBLICATIONS IN 2022

The SESAR Innovation Pipeline 2021 brochure provides highlights of some of the SESAR R & I activities that took place in 2021. It features updates from each strand of the programme: exploratory research, industrial research and VLDs. Together, these strands form an innovation pipeline through which ideas are transformed into concrete solutions.

Demonstrating the Everyday Benefits of U-space presents the initial results of seven R & I projects, namely one industrial research project and six VLDs. From 2020 to 2022, these projects carried out tests and trialled solutions aiming to show the readiness of U-space services to manage a broad range of drone operations and related applications, and their interaction with manned aviation.

Exploring the Boundaries of Air Traffic Management captures the results of 41 completed exploratory research projects and the SESAR knowledge transfer network project, Engage. Active between 2020 and 2022, the project brought together just under 200 academic and industry partners, such as universities, SMEs, research centres, airlines, manufacturers and air navigation service providers, from across the EU and from the non-EU countries associated with SESAR. The projects explored concepts and technologies not only in aviation and ATM, but also in other sectors, such as automotive, robotics or system engineering, and in other safety-critical industries.

AI offers applications that can learn autonomously and advise on complex problems across various industries. ATM is no exception. In November, the SESAR 3 JU collaborated with the Community Research and Development Information Service to produce AI in Air Traffic Management, a results pack highlighting recent advances made by 15 projects supported by EU funding. The featured projects address all phases of flight, from strategic and pre-tactical planning to tactical operations themselves.

2.1.4 Online communications

2.1.5 Website and e-news

In 2022, the SESAR 3 JU developed new content for its website, including 100 news items about programme-related developments and project results, and a dedicated interface on improving the environmental footprint of ATM.

The website saw an increase in visits, with LinkedIn acting as the main platform driving traffic. Among the most popular content on the website were the U-space and drone developments, general information about the partnership, SESAR Innovation Days and vacancy notices.

Monthly e-news was sent to nearly 8 000 external contacts (in full compliance with the general data protection regulation). In addition, 59 dedicated event mailshots and press releases were distributed, attracting further traffic to the SESAR 3 JU website. An analysis shows a relatively high open rate of 34.4 %; for comparison, the average open rate in the transportation industry is 20 %.

2.1.6 Social media

In 2022, the SESAR 3 JU's social media communication achieved positive results in terms of performance. Starting with its activities, the SESAR 3 JU published 1 189 posts across its social media channels (Figure 1), compared with 995 in 2021, representing a growth rate of nearly 20 %.

In terms of enlarging its online community, the SESAR 3 JU saw an increase in the number of followers across all channels, especially LinkedIn (Figure 2).

FIGURE 1: THE SESAR 3 JU ON SOCIAL MEDIA IN 2022

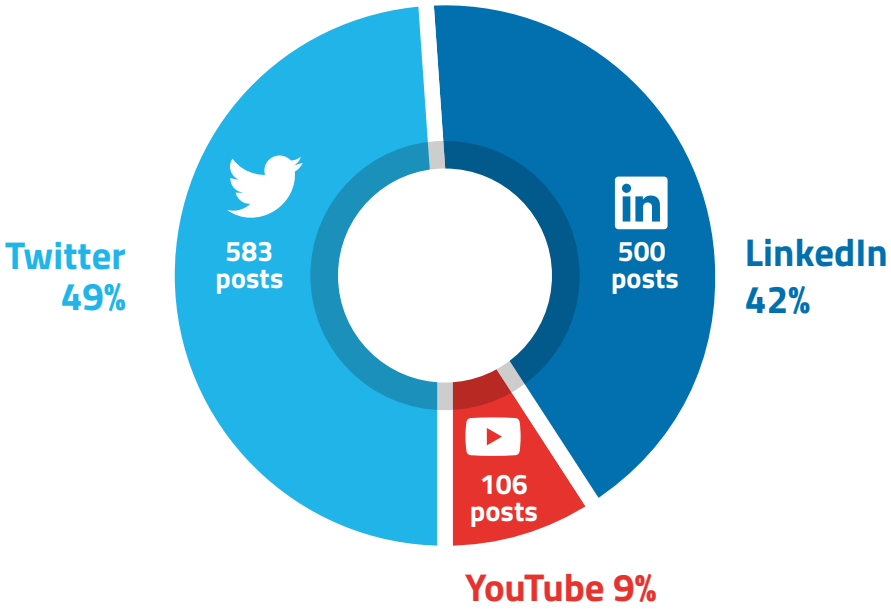
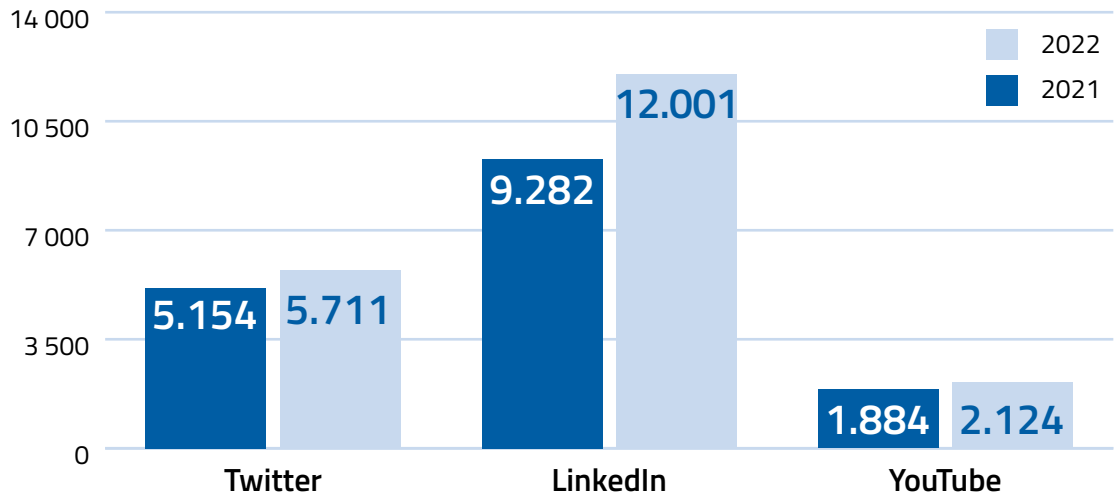


FIGURE 2: **THE SESAR 3 JU'S ONLINE COMMUNITIES IN 2021 AND 2022, BY SOCIAL MEDIA PLATFORM**



The improved performance can be explained by a series of scheduled promotion campaigns, which helped increase the visibility of the SESAR 3 JU across the channels on which it is active. These included campaigns to familiarise audiences with the new members of the SESAR 3 JU, its flagship areas and its work on the environmental footprint of ATM. The campaign with the most positive results was that for the EU Drone Days.

2.2 Legal and financial framework

The SESAR 3 JU was established on the basis of the Treaty on the Functioning of the European Union, Article 187, and of the SBA.

In line with Article 60(2) of the model financial regulation for the public–private partnership bodies falling under Article 71 of the 2018 EU financial regulation ([14]), the SESAR 3 JU adopted its financial rules during the first meeting of the GB on 14 December 2021 (GB(D)01-2021).

2.2.1 Legal support provided to operations

Following the entry into force of the SBA on 30 November 2021, the SESAR 3 JU has experienced a significant increase in legal outputs and advisory support provided to operations. In 2022, all the legally required structural elements of the new Digital European Sky programme were put in place in line with the SBA.

In addition to its usual activities in terms of advice and assessment of the legal compliance of documents and procedures, the legal sector resources were actively involved in the set-up of the JU's advisory bodies envisaged in the SBA (i.e. establishment of the Scientific Committee (SC) ([15]) and States' Representatives Group ([16]) and of the SESAR 3 JU Programme Committee as the advisory body for the Executive Director. The legal sector has also invested heavily in the establishment of unique agreements in the European partnership landscape, which constitute the cornerstone of the programme vis-à-vis the SESAR 3 JU members. These agreements are:

- the membership agreement (Article 28 of the SBA), which was negotiated and drafted, and then adopted in July 2022 by the GB and signed by all members;

([14]) Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018 on the financial rules applicable to the general budget of the Union, amending Regulations (EU) No 1296/2013, (EU) No 1301/2013, (EU) No 1303/2013, (EU) No 1304/2013, (EU) No 1309/2013, (EU) No 1316/2013, (EU) No 223/2014, (EU) No 283/2014, and Decision No 541/2014/EU and repealing Regulation (EU, Euratom) No 966/2012 (OJ L 193, 30.7.2018, p. 1).

([15]) Arts 14, 21 and 154 of the SBA.

([16]) Arts 14, 20 and 153 of the SBA.

- the administrative agreement with EUROCONTROL (Articles 157 and 158 of the SBA), which was negotiated and drafted, and then adopted on 13 October 2022 by the GB and signed on 15 December 2022;
- the Horizon Europe framework financial partnership agreement and the 2022 contribution agreement; the contribution agreement for the DSD programme with the European Commission;
- the negotiation of the termination of the SESAR 3 JU's rent agreement with the landlord.

2.2.1.1 Activities related to data protection

Since the entry into force of Regulation (EU) 2018/1725 ([17]), the SESAR 3 JU's long-term commitment to a privacy practice and culture has been strengthened. During the reporting period, activities related to data protection were carried out in line with the plan outlined in the 2022–2023 BAWP. Table 16 lists the main activities related to data protection carried out in 2022.

TABLE 16: **ACTIVITIES RELATED TO DATA PROTECTION CARRIED OUT BY THE SESAR 3 JU IN 2022**

Month	Activity
April	Records (GB, SC, information and communications technology devices), preparation of Internal Audit Service risk assessment
May	Adoption of policy on data breaches and informative email to staff; publication of decision on restrictions in the *Official Journal of the European Union*
June	Adoption of Data Protection Officer implementing rules; Data Protection Officer / EDPS meeting
July	Meetings with EDPS on the EUROCONTROL DPAA
September	Formal request of DPAA authorisation to EDPS
December	Authorisation by EDPS and signature of DPAA; data protection impact assessment of Microsoft Teams

NB: DPAA, data protection administrative arrangement; EDPS, European Data Protection Supervisor.

2.3 Budgetary and financial management

The GB adopted the 2022 budget through Decision GB(D)13-2021 in December 2021. This decision approved some transitional elements related to the annual work programme, budget, staff establishment plan and procurement plan of the SESAR 3 JU for 2021 and 2022. Regarding the budget, only the administrative parts (Titles 1 and 2) were adopted. The first BAWP, the 2022–2023 BAWP, adopted in March 2022, was approved, and finalised the budget. The 2022 budget was then amended twice, with the second amendment to the 2022–2023 BAWP, in October 2022, and with the third amendment, in December 2022.

The first budget amendment authorised the reinscription of unused appropriations (both commitment appropriations (EUR 17 461 672) and payment appropriations (EUR 188 848)) from previous years and also adjusted the budget (in view of a higher salary index than expected and some additional communication and information technology (IT) needs).

The second budget amendment was necessary to adjust the revenue part of the budget (balanced with an increase of the reserve) with a frontloading payment from EUROCONTROL to the new Digital European Sky programme and with a payment from the European Commission as a 100 % pre-financing payment for the completion of the delegation agreement on the technical assistance provided by the SESAR 3 JU for the preparation and monitoring of the DSD calls.

The 2022 budget, as modified through the third amendment to the 2022–2023 BAWP, established a final amount of EUR 158 786 464 in commitment appropriations and EUR 146 871 885 in payment appropriations.

([17]) Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC (OJ L 295, 21.11.2018, p. 39).

TABLE 17: **SESAR 3 JU STATEMENT OF REVENUE FOR 2022**

Statement of revenue: Category	Initial 2022 budget		Amended 2022 budget	
	Commitment appropriations (EUR)	Payment appropriations (EUR)	Commitment appropriations (EUR)	Payment appropriations (EUR)
EU contribution excluding EFTA	**126 280 927**	**135 166 728**	**128 030 927**	**136 916 728**
of which administrative	0	3 244 911	1 750 000	4 994 911 ([18])
of which operational	126 280 927	131 921 817	126 280 927	131 921 817
Third countries' contribution (including EFTA)	**2 131 139**	**2 652 962**	**2 131 139**	**2 652 962**
of which administrative	0	68 468	0	68 468
of which administrative – third countries excluding EFTA	0	0	0	0
of which operational	2 131 139	2 584 494	2 131 139	2 584 494
Industry financial contribution	**4 158 552**	**4 158 552**	**5 658 552**	**4 838 936**
of which administrative	4 158 552	4 158 552	5 658 552	4 838 936
of which operational	0	0	0	0
Other revenue	**0**	**0**	**0**	**0**
Revenues subtotal	132 570 618	141 978 242	135 820 618	144 408 626
Reactivation of unused appropriations from administrative expenditure	**4 768 174**	**1 454 795**	**19 265 846**	**2 463 259**
of which from 2019	0	1 234 936	818 733	1 905 876
of which from 2020	0	219 859	0	557 383
of which from 2021	4 768 174	0	18 447 113	0

([18]) Included 1.75 million of CEF-assigned revenue for entrusted tasks.

Statement of revenue: Category	Initial 2022 budget		Amended 2022 budget	
	Commitment appropriations (EUR)	Payment appropriations (EUR)	Commitment appropriations (EUR)	Payment appropriations (EUR)
Reactivation of unused appropriations from operational expenditure	**736 000**	**0**	**3 700 000**	**0**
of which from 2019	0	0	2 964 000	0
of which from 2020	0	0	0	0
of which from 2021	736 000	0	736 000	0
Total	**138 074 792**	**143 433 037**	**158 786 464**	**146 871 885**

NB: EFTA, European Free Trade Association.

The EU, EUROCONTROL and the other SESAR 3 JU members have continued to pay their financial contribution to the administrative expenditure due under the SESAR 2020 programme prior to the completion of the 7 years (i.e. 2024).

The SESAR 3 JU made a particular effort in prioritising unused appropriations (administrative expenditure) from the previous year in order to reduce the reserve to close to zero.

TABLE 18: **SESAR 3 JU STATEMENT OF EXPENDITURE FOR 2022 (COMMITMENT APPROPRIATIONS)**

Statement of Expenditure (Commitment appropriations)	Initial 2022 budget (EUR)	Amended 2022 budget (EUR)	Executed 2022 budget including transfers (EUR)	% (executed/ amended)	Carried over to 2023 (EUR)	Available for future use (*N* + 3 rule) (EUR)
Title 1 – Staff expenditure	**5 749 700**	**5 708 760**	**5 313 213**	**93**	**339 486**	**490 237**
Salaries and allowances	5 364 700	5 323 760	5 037 608	95	278 963	371 272
of which establishment plan posts	4 700 000	4 800 000	4 563 288	95	193 689	242 920
of which external personnel	664 700	523 760	474 320	91	85 274	128 352
Expenditure relating to staff recruitment	5 000	5 000	1 000	20	603	4 000
Mission expenses	200 000	200 000	163 000	81	57 740	41 195
Sociomedical infrastructure (including training)	0	0	0	0	0	0
Training	40 000	40 000	15 078	38	0	24 922
External services	90 000	90 000	77 837	86	2 000	21 568
Receptions, events and representation	0	0	0	0	0	0
Social welfare	0	0	0	0	0	0
Other staff-related expenditure	50 000	50 000	18 690	41	180	27 279

Statement of Expenditure (Commitment appropriations)	Initial 2022 budget (EUR)	Amended 2022 budget (EUR)	Executed 2022 budget including transfers (EUR)	% (executed/ amended)	Carried over to 2023 (EUR)	Available for future use (*N* + 3 rule) (EUR)
Title 2 – Infrastructure and operating expenditure	**3 177 026**	**3 468 785**	**3 476 329**	**100**	**1 454 530**	**52 703**
Rental of buildings and associated costs	928 960	898 254	878 631	100	103 848	8 161
Information and communications technology and data processing	1 568 619	1 777 619	1 833 847	100	931 177	33 035
Movable property and associated costs	12 000	11 043	0	0	0	0
Current administrative expenditure	273 043	237 965	198 916	84	19 907	847
Postage/ telecommunications	0	0	0	0	0	0
Expenditure on formal meetings	10 404	10 404	10 404	100	4 623	0
External communication information and publishing	384 000	533 500	554 531	104	394 974	10 660
Title 3 – Operational expenditure SESAR2020	**736 000**	**736 000**	**6 339 219**	**98**	**65 734 890**	**147 424**
Previous years' calls / other funded actions – SESAR 2020 programme	736 000	736 000	6 339 219	98	65 734 890	147 424
Title 4 –Operational expenditure DES and SESAR 3 operations	**128 412 066**	**128 412 066**	**128 412 066**	**100**	**128 411 616**	**0**
Current year's calls / other funded actions – Digital European Sky programme	128 412 066	128 412 066	128 412 066	100	128 411 616	N/A
Title 5 – Unused appropriations not required in current year	**0**	**20 460 853**	**0**	**0**	**0**	**20 460 853**
Total	**138 074 792**	**158 786 464**	**143 540 827**	**87**	**195 940 522**	**21 151 217**

The execution rate of commitment appropriations was very high at the end of 2022. The commitment appropriations for the Digital European Sky (Title 4) were committed in full, as the ER1 and IR1 calls for proposals were under evaluation.

TABLE 19: **SESAR 3 JU STATEMENT OF EXPENDITURE FOR 2022 (PAYMENT APPROPRIATIONS)**

Statement of Expenditure (Payment appropriations)	Initial 2022 budget (EUR)	Amended 2022 budget (EUR)	Executed 2022 budget including transfers (EUR)	% (amended/ executed)	Carried over to 2023 (EUR)	Available for future use (*N* + 3 rule) (EUR)
Title 1 – Staff expenditure	**5 749 700**	**5 513 860**	**5 029 646**	**93**	**0**	**373 592**
Salaries and allowances	5 364 700	5 128 860	4 789 938	93	0	228 131
of which establishment plan posts	4 700 000	4 700 000	4 369 599	95	0	218 758
of which external personnel	664 700	428 860	420 339	98	0	9 373
Expenditure relating to staff recruitment	5 000	5 000	397	8	0	4 603
Mission expenses	200 000	200 000	109 291	55	0	90 878
Sociomedical infrastructure (including training)	0	0	0	0	0	0
Training	40 000	40 000	15 078	38	0	24 922
External services	90 000	90 000	76 732	85	0	13 568
Receptions, events and representation	0	0	0	0	0	0
Social welfare	0	0	0	0	0	0
Other staff-related expenditure	50 000	50 000	38 510	77	0	11 490
Title 2 – Infrastructure and operating expenditure	**3 177 026**	**3 601 714**	**3 009 270**	**84**	**0**	**712 957**
Rental of buildings and associated costs	928 960	842 342	902 842	107	0	27 819
Information and communications technology and data processing	1 568 619	1 974 999	1 314 562	67	0	650 437
Movable property and associated costs	12 000	11 043	0	0	0	1 161
Current administrative expenditure	273 043	304 926	267 556	88	0	28 896
Postage/ telecommunications	0	0	0	0	0	0
Expenditure on formal meetings	10 404	10 404	5 782	56	0	4 623
External communication information and publishing	384 000	458 000	518 528	113	0	22

Statement of Expenditure (Payment appropriations)	Initial 2022 budget (EUR)	Amended 2022 budget (EUR)	Executed 2022 budget including transfers (EUR)	% (amended/ executed)	Carried over to 2023 (EUR)	Available for future use (*N* + 3 rule) (EUR)
Title 3 – Operational expenditure SESAR2020	**51 047 975**	**51 047 975**	**28 241 600**	**55**	**0**	**23 724 565**
Previous years' calls / other funded actions – SESAR 2020 programme	51 047 975	51 047 975	28 241 600	55	0	23 724 565
Title 4 – Operational expenditure DES and SESAR 3 operations	**83 458 336**	**83 458 336**	**450**	**0**	**0**	**83 457 886**
Current year's calls / other funded actions – Digital European Sky programme	83 458 336	83 458 336	450	0	0	83 457 886
Title 5 – Unused appropriations not required in current year	**0**	**3 250 000**	**0**	**0**	**0**	**3 250 000**
Total	**143 433 037**	**146 871 885**	**36 280 966**	**25**		**111 519 000**

The execution rates of the payment appropriations for the administrative expenditure were also high.

For Title 1 (staff expenditure), the execution rate was 93 %. With a salary index reflecting the increasing inflation, the usual margin for salaries was very useful.

For Title 2 (infrastructure and operating expenditure), it was 84 %. The execution rate would have been even higher had an invoice from EUROCONTROL for the delivery of IT services not been delayed by a few weeks.

In contrast, the execution rate for the operational expenditure is low, for the following reasons.

For Title 3 (operational expenditure), many SESAR 2020 projects obtained an extension of 3 or 6 months due to COVID-19. This means that payments initially planned for 2022 will take place in 2023. By the end of 2023, all SESAR 2020 co-financing payments should have been made.

For Title 4 (operational), no payment has yet been made for the Digital European Sky programme. Due to the late adoption of the SBA, the 2022–2023 BAWP could be adopted only in March 2022 and the calls could be published only in April 2022. At the end of 2022, the proposals were still under evaluation. The pre-financing payments for the ER1 and IR1 projects will take place in 2023.

2.4 Financial and in-kind contributions from members other than the European Union

TABLE 20: **CONTRIBUTIONS FROM MEMBERS OTHER THAN THE EU**

Nature	Amount (EUR): SESAR 2020 programme	Amount (EUR)
IKAA reported and certified	N/A	14 706 000
Total contributions reported	**88 098 663**	**42 928 000**
Total contributions reported, including certified IKAA	**N/A**	**57 634 000**

NB: IKAA, in-kind contributions to additional activities; IKOP, in-kind contributions to operational activities.

TABLE 21: **VALUES OF IKOP – EVOLUTION IN 2022 FOR THE SESAR 2020 PROGRAMME (EUR)**

Member	Total amount of IKOP committed for SESAR 2020 programme ([19])	Amount of IKOP validated before 2022	Amount of IKOP validated in 2022	Total amount of IKOP certified until 2022	Total amount of IKOP related to 2022 to be validated in 2023
Airbus	25 093 735	21 899 810	3 275 248	25 175 059	3 443 205
AT-One	11 867 806	8 127 236	2 784 218	10 911 454	3 440 640
B4	1 985 379	1 421 466	198 738	1 620 203	296 887
COOPANS	8 676 061	4 593 929	815 436	5 409 365	522 280
Dassault	1 806 681	953 658	610 643	1 564 301	518 859
DFS	7 810 987	9 077 693	1 134 413	10 212 106	969 497
DSNA	9 190 202	6 550 366	1 191 733	7 742 099	1 200 256
ENAIRE	15 617 352	9 598 506	2 018 609	11 617 116	1 930 404
ENAV	7 499 310	4 931 176	1 127 675	6 192 362	1 155 177
EUROCONTROL	475 000 000	230 777 228	43 281 455	274 058 684	39 391 689
Frequentis	6 410 132	3 675 815	841 239	4 517 054	951 871
Honeywell	14 546 257	9 535 705	1 829 712	11 365 417	2 379 747
Indra	19 878 000	14 804 760	3 242 397	18 047 157	2 682 797
Leonardo	45 835 829	26 822 720	4 783 631	31 606 351	4 654 912
NATMIG	9 960 423	7 301 958	1 790 162	9 092 119	2 644 003
NATS	8 708 327	6 254 468	1 907 444	8 161 912	2 360 782
SEAC2020	2 351 979	1 210 927	301 694	1 512 621	236 615
Skyguide	1 373 305	1 024 657	185 684	1 210 341	538 959
Thales AVS	32 713 185	28 445 480	3 669 712	32 115 192	5 207 198
Thales LAS	48 700 000	26 001 729	9 838 137	35 839 866	9 103 941
Total	**755 024 950**	**423 009 288**	**84 827 978**	**507 837 266**	**629 717**

NB: IKOP, in-kind contributions to operational activities.

([19]) Following membership agreement.

TABLE 22: **VALUES OF CERTIFIED IKAA FOR THE DIGITAL EUROPEAN SKY PROGRAMME – EVOLUTION SINCE 2022 (EUR)**

Year	Amount of certified IKAA
2020	N/A
2021	N/A
2022	14 706 000
Total since 2021	**14 706 000**

NB: IKAA, in-kind contributions to additional activities.

2.5 Corporate programming and reporting

2.5.1 Corporate programming

On 17 March 2022, the GB adopted the 2021–2031 MAWP, which establishes the framework under which the operations of the SESAR 3 JU will be defined, planned and executed ([20]).

At the same meeting, the GB also adopted the 2022–2023 BAWP ([21]).

The 2022–2023 BAWP was amended three times in 2022. These amendments related to the following factors.

- The exclusion of legal entities established in Belarus, Russia or non-government-controlled territories of Ukraine from participating in Horizon Europe (first amendment) ([22])
- The reinscription of unused appropriations from previous years into the 2022 budget (see Section 2.3) (second amendment) ([23]).
- The adoption of the 2023 budget and an additional amendment to the 2022 budget. This also allowed for the adoption of the in-kind additional activities plan for 2022 and 2023 (see Section 2.3) ([24]).

([20]) GB(D)02-2022 on the adoption of the 2022–2031 SESAR 3 JU MAWP.

([21]) GB(D)03-2022 on the adoption of the 2022–2023 SESAR 3 JU BAWP.

([22]) GB(D)08-2022 on the adoption of the first amended version of the 2022–2023 SESAR 3 JU BAWP.

([23]) GB(D)17-2022 on the adoption of the second amended version of the 2022–2023 SESAR 3 JU BAWP.

([24]) GB(D)21-2022 on the adoption of the third amended version of the 2022–2023 SESAR 3 JU BAWP.

2.5.2 Corporate reporting

In 2022, the SESAR 3 JU released its 2021 CAAR, which the GB approved at its meeting on 27 June 2022 ([25]). Throughout the reporting period, the SESAR 3 JU regularly monitored and assessed on a quarterly basis progress in the implementation of the 2022 work programme as defined in the 2022–2023 BAWP.

During the reporting period, the SESAR 3 JU also prepared and submitted implementation reports for 2021 in response to two delegation agreements signed with the European Commission, namely on CEF U-space demonstrations and on geofencing demonstrations ([26]). The JU made no payments relating to those projects in 2022; therefore, the reports cover only the audit activities performed during the reporting period.

Moreover, the SESAR 3 JU provided inputs to the European Commission in the framework of the 2022 biennial monitoring report on partnerships in Horizon Europe ([27]), released on 16 May 2022. The 2022 biennial monitoring report focuses on Horizon Europe's new partnership landscape and establishes benchmarks for assessing progress in future reports.

2.6 Administrative procurement and contracts

TABLE 23: **ADMINISTRATIVE PROCUREMENT AND CONTRACTS IN 2022**

Subject of the contract	Type of contract	Contractor	Tender procedure (if applicable)	Signature date	Amount (EUR)
Back office arrangement for accounting service (Article 13 SBA)	SLA8	Other JUs	Interinstitutional procedure	16.12.2022	N/A
Use of Speedwell and Bluebell	SLA	European Research Council Executive Agency	N/A	5.4.2022	17 300.00
Communication support for graphical design	SLA	Publications Office of the European Union	Interinstitutional procedure	3.6.2022	N/A
Publication support services	SLA	Publications Office of the European Union	Interinstitutional procedure	3.6.2022	15 000.00
Termination of the mandate of the Commission's Accounting Officer as the SESAR 3 JU's Accounting Officer	Amendment to SLA	European Commission (Directorate-General for Budget)	Interinstitutional procedure	14.12.2022	4 000.00
Move of a set of network devices allowing the SESAR 3 JU to connect to a local network alongside the European Commission to access the EUROCONTROL data centre	Specific contract implementing the framework contract	Deutsche Telekom Business Solutions GmbH	Interinstitutional procedure	22.12.2022	13 207.00

([25]) GB(D)11-2022 on the adoption of the *SESAR 3 JU Consolidated Annual Activity Report 2021*.

([26]) EC / SESAR JU delegation agreement (reference: MOVE/E3/DA/2016-669/SI2.743803) signed on 6 December 2016, with a delegated budget of EUR 500 000 in assigned revenue to organise a call for proposals for geofencing demonstrations; and EC / SESAR JU delegation agreement (reference: MOVE/E3/DA/2017-564/si2.771010) signed on 13 December 2016, with a delegated budget of EUR 10 million in assigned revenue from CEF funds to organise a call for proposals on U-space demonstrations.

([27]) Performance of European partnerships.

Subject of the contract	Type of contract	Contractor	Tender procedure (if applicable)	Signature date	Amount (EUR)
Provision of web services from Q2 2022 to Q1 2023	Specific contract implementing the framework contract	European Service Network (ESN)	Interinstitutional procedure	21.3.2022	94 380.00
Provision of digital communication services	Specific contract implementing the framework contract	ESN	Interinstitutional procedure	15.6.2022	7 425.00
Provision of digital communication services for upcoming SESAR 3 JU events	Specific contract implementing the framework contract	ESN	Interinstitutional procedure	13.9.2022	76 560.00
Hot cut move	Specific contract implementing the framework contract	Deutsche Telekom Business Solutions GmbH	Interinstitutional procedure	2.6.2022	22 949.00
Legal support services	Service contract	PwC Legal SARL	Negotiated procedure	21.2.2022	8 250.00
Provision of support for upcoming SESAR events	Specific contract implementing the framework contract	TMAB	Interinstitutional procedure	29.3.2022	149 991.00
Cleaning and waste collection management services	Service contract amendment	Activa SA	Negotiated procedure	25.5.2022	25 364.00
Venue rental	Specific contract implementing the framework contract	TMAB	Interinstitutional procedure	28.10.2022	13 908.00
IT services in the first half of 2023	Specific contract implementing the framework contract	TESTA GmbH	Interinstitutional procedure	28.10.2022	13 206.90
Provision of support to the EU Drone Days event	Specific contract implementing the framework contract	EU-turn	Interinstitutional procedure	20.12.2022	20 350.00
External auditors for the audit of the annual accounts 2022 and 2023	Specific contract implementing the framework contract	Baker Tilly BV	Interinstitutional procedure (reopening of competition)	21.12.2022	42 798.00
Rental contract – SESAR 3 JU launch event	Service contract	World Center of the Automobile (also referred to as "Autoworld")	Negotiated procedure	10.1.2022	6 993.00
SESAR 3 JU internal meeting on 7 March 2023	Specific contract implementing the framework contract	TMAB	Interinstitutional procedure	12.12.2022	36 234.00
Total for 2022					**567 915.90**

2.7 Information technology and logistics

2.7.1 Information and communications technology management

During 2022, the operational information and communications technology (ICT) services were delivered primarily by EUROCONTROL in accordance with a signed services agreement. The scope and cost of the services were agreed using the normal service request, service offer and confirmation workflow. Changes to support the evolving needs of the JU were similarly described and agreed then closely monitored by the JU for cost control, scope and acceptable deployment.

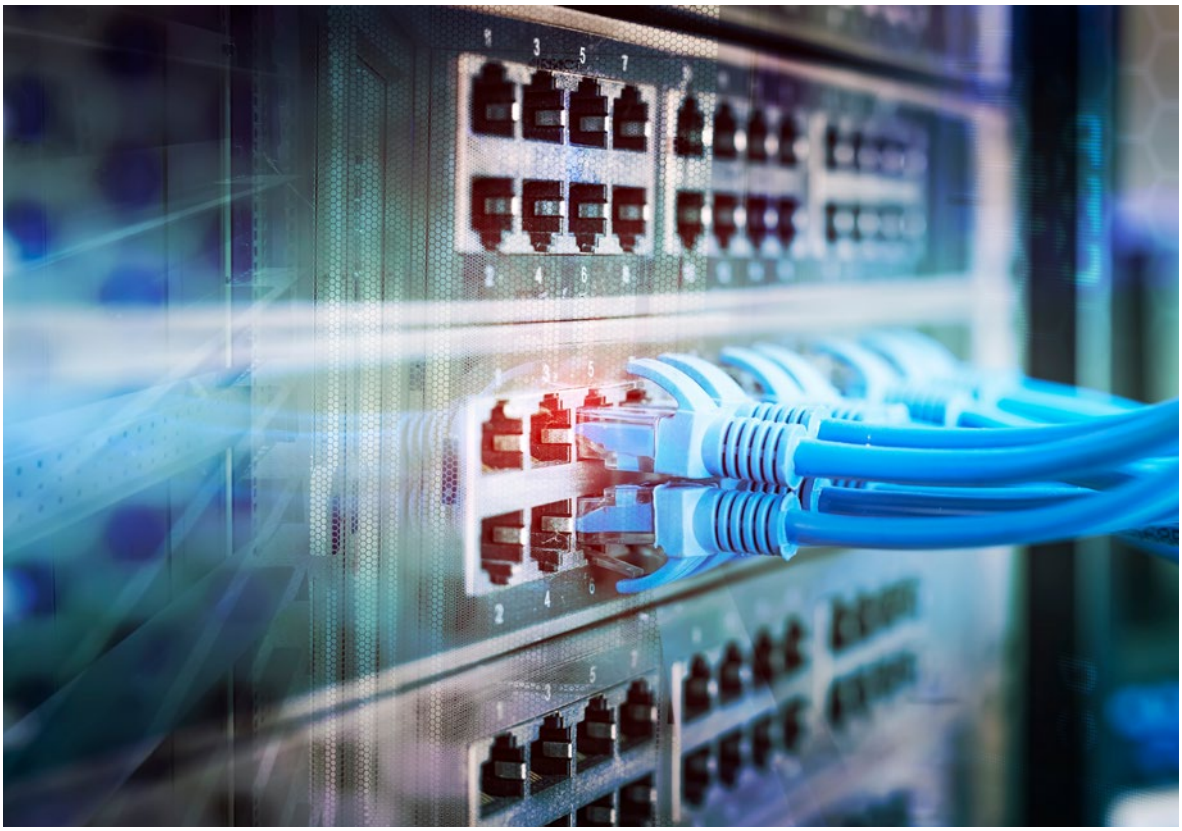
During the year, EUROCONTROL experienced significant issues with its new ICT suppliers, and this negatively impacted the delivered service performance, triggering five significant losses of service to users during the reporting year. A formal letter was sent to EUROCONTROL and a recovery plan and actions were agreed.

Some ICT services that could not be provided by EUROCONTROL, or could not be provided cost-effectively, were delivered under framework contracts established by the Directorate-General for Informatics and managed by the JU directly. Such services included establishing an access point to allow the JU to securely connect to various European Commission systems, including for finance, accounting and grant management.

The JU contracts an external service provider of ICT coordination services to be the focal point for users and to integrate all services into one coherent whole. This service provider manages on behalf of the SESAR 3 JU the costs claims provided by EUROCONTROL in relation to its services to meet the requirements regarding budget planning and the obligations in the applicable founding regulation, and to preserve the principles of sound financial management in accordance with the financial rules.

ICT is governed by an internal governance committee (Quality and ICT Committee), which is responsible for configuration control, and budget and expenditure monitoring; providing a forum for feedback from users; and the review of the service performance data.

In late 2022, the SESAR 3 JU established a new agreement with EUROCONTROL, covering its associated data protection arrangements, that again includes the provision of ICT services to the SESAR 3 JU, but this time as part of the back office arrangements to support the SESAR 3 JU.



2.7.2 Facilities management

In 2022, work in the area of facilities management mostly involved the legal aspects related to the change of premises (see Section 2.7.2.1).

During the reporting period, however, work continued on a number of initiatives in the SESAR 3 JU's premises in Brussels to maintain the productivity, safety and efficiency of the working environment and facilities provided to SESAR 3 JU staff.

In particular, as a result of the ongoing COVID-19 pandemic, the facilities team was still tasked with ensuring that the premises were safe for staff in accordance with pandemic-related requirements. The team successfully implemented the necessary measures and tools to ensure the safety of staff and others physically present on the premises. The facilities team also supported the implementation of new working practices by the European Commission.

2.7.2.1 Legal aspects of change of premises

During the reporting period, the SESAR 3 JU was located in Avenue de Cortenbergh 100, Brussels. According to the lease, rent is to be paid until February 2025.

In view of the unsuccessful search for alternative tenants, the recent European Commission policy on offices and the current property market situation, the SESAR 3 JU negotiated the early termination of the aforementioned rent agreement in order to allow for a change of premises in early 2023.

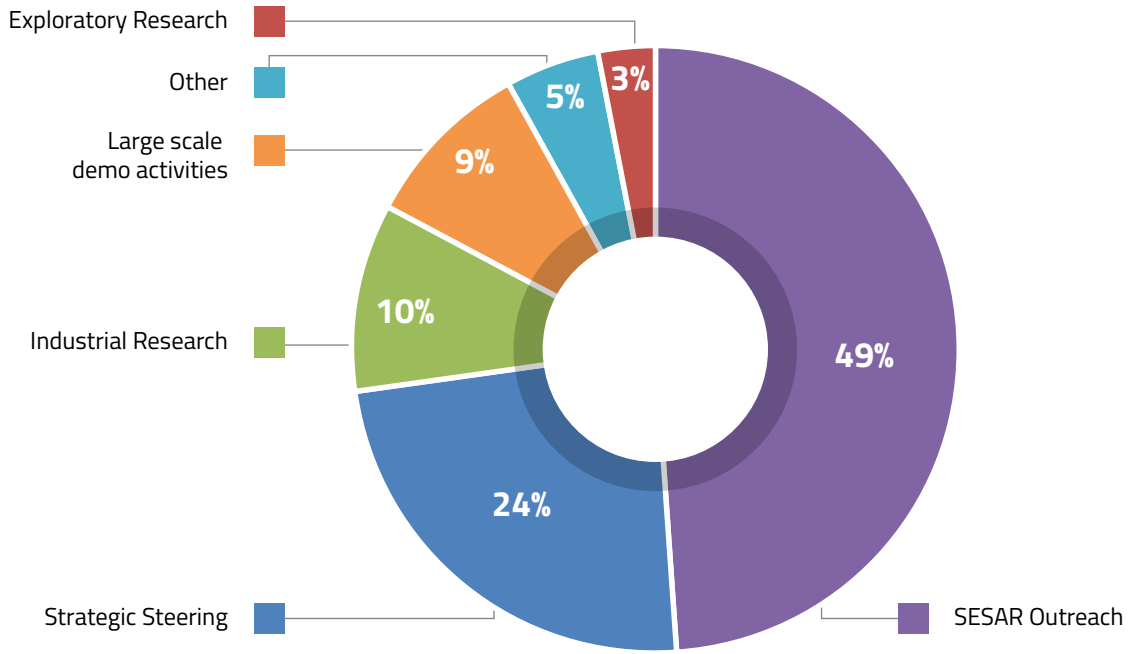
The conditions of the early termination of the rent agreement were presented to and adopted by the GB in December 2022 ([28]). The amendment to the rent agreement, which implemented these conditions, was signed on 30 January 2023.

2.7.3 Travel coordination

In 2022, due to the removal of COVID-19 restrictions on travel, the number of missions performed by the SESAR 3 JU staff increased: 113 missions took place in 2022, compared with 27 missions in 2021 (not including missions related to the activities managed by the Programme Management Unit under the SESAR 3 JU–EUROCONTROL agreement).

Of the 113 missions carried out in 2022, 55 were related to SESAR 3 JU outreach (49 %) and 27 to strategic steering (24 %). See Figure 3, which shows all areas of operation.

FIGURE 3: **MISSIONS CARRIED OUT BY THE SESAR 3 JU STAFF IN 2022, BY STRATEGIC AREA OF OPERATION**



([28]) GB Decision GB(D)21-2022.

2.8 Human resources

2.8.1 Human resources management

The SESAR 3 JU's approved 2022 staff establishment plan allows for 37 temporary agents, one contract agent and two seconded national experts, as set out in the annual general budget of the European Union for the European Commission. The authorised staff establishment plan and its implementation are presented in Annex 2.

The effective allocation of staff remained a priority for the SESAR 3 JU during 2022. Efforts were focused on the professional and career development of its staff, in addition to ensuring that allocated staff were used in the most economic, efficient and effective way.

In 2022, the SESAR 3 JU conducted its appraisal exercise in accordance with the implementing rules, and was able to conduct the reclassification exercise, as a result of which six temporary agents were reclassified.

The vacancy rate at the end of 2022 was 8.1 % ([29]). It should be noted that, as the SESAR 3 JU staff establishment plan has only 37 temporary agent positions, each temporary staff departure increases the relevant vacancy rate by 2.7 %.

During the final quarter of 2022, the external selection processes for the vacant positions of 'human resources and support services coordinator' and 'senior corporate services officer' were launched in order to create reserve lists. Therefore, all posts were in the process of being filled at the end of 2022.

During 2022, implementation of the Sysper job information system module began. It will be completed in 2023.

Regarding gender and geographical balance, the SESAR 3 JU remained committed to ensuring that its overall balance remains stable. At the end of 2022, 59 % of the 37 staff were female and 41 % were male, with 15 nationalities represented.

Table 24 sets out the human resources decisions adopted by the GB in 2022.

TABLE 24: STAFF IMPLEMENTING RULES ADOPTED BY THE GB IN 2022

Title of the staff implementing rules	Date of the GB decision
Decision GB(D)06-2022 concerning the application of Commission Decision C(2022)1788 final on working time and hybrid working	27 April 2022
Decision GB(D)18-2022 laying down general implementing provisions on the conduct of administrative inquiries and disciplinary proceedings	13 October 2022

2.9 Efficiency gains and synergies

Article 13 of the SBA does not apply to the SESAR 3 JU, but the SESAR 3 JU is committed to working with the other JUs to identify opportunities for savings and synergies.

The SESAR 3 JU committed to a common approach to accounting services, signing a dedicated service-level agreement with the other JUs on 16 December 2022. In addition, the SESAR 3 JU is considering other back office arrangement possibilities, including for common procurement, human resources or data protection activities.

In the area of ICT and as outlined in Section 2.7.1, the SESAR 3 JU primarily obtains efficiency gains from its back office arrangement with EUROCONTROL, where practicable and legally possible. Where this is not possible, the SESAR 3 JU makes use of European Commission framework contracts (e.g. through the Directorate-General for Informatics) or other shared initiatives of other agencies or institutions before launching its own procurements.

In the area of communications, in 2021, the SESAR 3 JU, in collaboration with the Clean Aviation JU and Europe's Rail JU, implemented a 4-year multiple framework contract for external support related to strategic communications; editorial support and graphic design; digital communications; the organisation of events; and web services. This facilitated the launch in 2022 of several specific contracts addressing all aspects of communications.

([29]) One of the open positions was filled at the beginning of 2023 through the use of an existing reserve list.

3 Governance

In 2022, the SESAR 3 JU met all of its objectives related to the governance of implemented programmes, as set out in Section 4.1 of the 2022–2023 BAWP. This includes the following achievements and results.

- Effective and efficient governance of the programmes implemented by the SESAR 3 JU was ensured. The SESAR 3 JU GB held six meetings. Furthermore, the SESAR 3 JU held two meetings with each of the new SC (appointed in October 2022), the SESAR 3 JU Programme Committee and the newly established SRG, and three meetings with the SESAR 2020 Programme Committee. These bodies provided support to the GB and the Executive Director in steering the operational activities of the SESAR 3 JU by, among other things, contributing strategic document reviews and participating in evaluation activities.

3.1 Major developments

In December, the GB approved a strengthened and simplified Master Planning approach and agreed to plan for an update of the European ATM Master Plan in 2024.

Other significant achievements were the finalisation and approval of the membership agreement between members on their collective engagement in the programme, and the administrative agreement signed with E, setting out the organisation's renewed role in and commitment to the partnership. More details on this are provided in the sections below.

3.1.1 Signature of agreements

3.1.1.1 Membership agreements

Pursuant to Article 28 of the SBA, the private members of the SESAR 3 JU agreed on a common set of rules defining their collective engagement to work and cooperate together with a view to:

- implementing the Digital European Sky programme in a correct, efficient, open and timely manner;
- attaining the objectives and deliverables defined in the European ATM Master Plan and strategic R & I agenda.

The members other than the EU and EUROCONTROL shall collectively make a total contribution of at least EUR 500 000 000 (as per Articles 11, 28 and 146(1) of the SBA). This total contribution shall include financial contributions to the administrative costs, in-kind contributions to operational activities and in-kind contributions to additional activities (IKAA), as outlined in Sections 2.3 and 2.4.

This was formalised in a unique SESAR 3 JU membership agreement approved by the GB under Decision GB(D)10-2022. This agreement provides for a mechanism allowing members to join through the signing of a specific adhesion form. This mechanism ensures stability in the conditions of members' contributions over the duration of the programme. All the members party to the membership agreement (i.e. all members except the EU) adhered to it.

3.1.1.2 Agreements with EUROCONTROL

3.1.1.2.1 Administrative agreement (Articles 157 and 158 of the single basic act)

Articles 157 and 158 of the SBA required that the SESAR 3 JU and EUROCONTROL set out an administrative agreement describing the tasks, responsibilities and contribution of EUROCONTROL in relation to the activities of the SESAR 3 JU.

Based on Decision GB(D)15-2022, the SESAR 3 JU and EUROCONTROL signed their administrative agreement on 15 December 2022.

This tailor-made agreement is complementary to the membership agreement signed that EUROCONTROL by the other, private, members of the JU.

The agreement detailed the functioning of the renewed cooperation between the SESAR 3 JU and EUROCONTROL. It clarified in particular the correspondence between the activities to be performed by EUROCONTROL, the related type of contribution and the mechanisms for certifying and reporting the related costs.

The agreement also defined in its schedules the activities to be provided by EUROCONTROL on a regular basis, as IKAA and other specific back office arrangements, in particular ICT, and infrastructure and logistics support.

3.1.1.2.2 Data protection administrative arrangement (Article 48(3) of Regulation (EU) 2018/1725 and Article 35 of the single basic act)

The SESAR 3 JU and EUROCONTROL signed a data protection administrative arrangement on 15 December 2022 – upon receipt of the European Data Protection Supervisor (EDPS) decision ([30]) – valid until 30 June 2024. This agreement maps the procedures, safeguarding measures and other relevant measures to ensure that transfers of personal data can proceed between the SESAR 3 JU and EUROCONTROL, as an international organisation not bound by Regulation (EU) 2018/1725 ([31]).

3.2 SESAR 3 Joint Undertaking Governing Board

The SESAR 3 JU GB met on six occasions in 2022 and adopted 20 decisions either in meetings (17) or by written procedures (3). Of particular note were the decisions to appoint the new Executive Director and to recognise the authority of the Executive Director to sign a new agreement and data protection administrative arrangements with EUROCONTROL that enabled the change of premises of the SESAR 3 JU, planned in the first quarter of 2023, as outlined in Section 2.7.2.

3.3 Executive Director

Richard Frizon remained the Executive Director *ad interim for the first half of 2022. He managed the operations of the JU in accordance with its work programme, and ensured the successful transition to and launch of the SESAR 3 JU at the end of 2021.*

On 5 May 2022, the GB appointed Andreas Boschen as the new Executive Director. Mr Boschen took up the Executive Director's duties on 1 July 2022.

During the reporting period, the Executive Director decided to delegate certain powers for the purposes of budget implementation to the two heads of unit.

([30]) EDPS decision temporarily authorising the use of administrative arrangement between the SESAR 3 JU and the European Organisation for the Safety of Air Navigation ('EUROCONTROL') in the context of EUROCONTROL's in-kind contributions to SESAR (Case 2022-0933).

([31]) When assessing the data protection administrative arrangement, the EDPS noted that one of the major issues was related to oversight and judicial redress mechanisms, in other words measures concerning supervising and checking that these types of international transfers would sufficiently protect individuals' personal data, and the contingency measures should such transfers go wrong. As a way of resolving some of these issues, EUROCONTROL aims to modernise its data protection framework by the end of 2023. In the meantime, EUROCONTROL and the SESAR 3 JU will rely on the International Court of Arbitration of the International Chamber of Commerce to fulfil the role of oversight and judicial redress for the data protection administrative arrangement, which the EDPS assessed as satisfactory for the time being. Taking this assessment into account, the EDPS specifically highlights that, for the present administrative arrangement to be renewed after 30 June 2024, the SESAR 3 JU should file this request in due course, including specific information on how, and in what ways, EUROCONTROL's data protection framework has been modernised to safely support transfers of individuals' personal data outside the EU or the European Economic Area.

3.4 States' Representatives Group

The SRG met twice in 2022. During the first meeting, the SRG finalised the terms of reference and discussed the obligations stemming from the SBA. In the second meeting, it discussed how to capture information from across the states on activities at national level that could have synergies with the activities of the SESAR 3 JU. On the basis of a commonly agreed template, the states' representatives provided feedback, which will serve as the basis for further discussions and examples to be analysed in 2023.

On 24 February 2022, the SRG gave a positive opinion on the 2022–2031 MAWP. The SRG also gave a positive opinion on the 2022–2023 BAWP, with the following recommendations:

Stress a risk on the availability of budget, including capping, for WA6 to complete critical Phase C activities pending the final outcomes of SESAR 2020.

Invite the JU to revert to the SRG with a risk assessment in relation to the roll-out of Phase C of the Master Plan when the outcome of the calls planned to be launched in April is known. On that basis the SRG may formulate additional recommendations to address this risk.

3.5 Scientific Committee

The members of the SESAR 3 JU SC were appointed by the GB in October 2022.

The first meeting was held remotely on 10 November 2022, with the goal of finalising the set-up of the SC. During the meeting, the SC members introduced themselves, and the SESAR 3 JU MAWP was explained, together with the governance bodies' structure. The members elected Tatjana Bolic as chairperson and Juan Besada as vice chairperson. The relevant rules of procedure were discussed and adopted.

The second meeting was held in person, during the SESAR Innovation Days in Budapest. During this first working meeting, the SC received the briefing on the innovation days from its programme chair and discussed possible strategic changes to the publication of the best-rated papers; the discussion will continue based on the authors' responses regarding their publication preferences. The SC was also briefed about the consultation process for the upcoming ER2 call for proposals and the role of the SC in this process. The SC members discussed some initial ideas for tasks to be pursued in 2023, the aim being to further improve the programme and its scientific outreach.

3.6 Programme committees

3.6.1 SESAR 2020 Programme Committee

Since its establishment in November 2016, the SESAR 2020 Programme Committee has assisted the Executive Director in defining and implementing effective programme management through strategic guidance and tactical steering of the JU's work programme. Three meetings were held in 2022, all addressing the following main areas.

- In close coordination with its members, the JU closely monitored the effects of the COVID-19 crisis on its projects and members. Throughout 2022, the Delivery Management Subcommittee continued to carry out in-depth analysis of the impact of the crisis on the development of the SESAR Solutions, with the aim of identifying potential issues and applying mitigating actions (e.g. reallocation of tasks among the contributors). Reports of the overall situation were regularly sent to the programme committee. In addition, the Russian war of aggression against Ukraine affected some traffic flows, necessitating the adaptation of ATC operations, which led to an increased need for ATCOs. In this context, the SESAR 3 JU members drew the programme committee's attention to greater than anticipated difficulties in implementing mitigation actions in the post-COVID-19 recovery phase. Indeed, the increased need for ATCOs to manage real operations and the refocus on core business at airport level had a knock-on impact on the preparation and execution of the R & I validation activities. Extending the duration of most of the wave 2 and wave 3 grants was a key mitigation action to secure the delivery of the SESAR solutions. It allowed the projects to reschedule their activities and will provide more time for carrying out the validation activities, finalising the technical deliverables and running the maturity gates before June 2023.
- The SESAR 2020 programme delivery approach is based on the release process, which identifies, on a yearly basis, the solutions that will be delivered at a specific maturity level, and the planned VLDs. The programme committee supported the SESAR 3 JU in the context of the three releases, 11, 12 and 13, outlined in Section 1.2.3.3. More specifically, the programme committee (1) acknowledged the release 11 final report, which confirmed the delivery of results in accordance with the plan, (2) approved the release 12 plan in December 2021, and, during the reporting period, regularly monitored the progress of the solutions to

ensure that execution remained in line with the plan, and (3) endorsed the release 13 plan, in December 2022, addressing all validation and demonstration activities to be performed in 2023. More information on the releases and their individual outcomes can be found in Section 1.2.3.3.

- The programme committee members were also regularly updated about the progress of the R & I programme towards meeting the ATM Master Plan ambition. A Master Plan coverage report was made available, presenting a snapshot of the R & I status. The report provided an overview of the current status of the key R & I solutions delivery and the forecast at the end of SESAR 2020.
- Following a strengths, weaknesses, opportunities and threats analysis and extensive consultations with all stakeholders involved in the execution of the European ATM Master Plan, the SESAR 3 JU regularly presented to the programme committee the progress made on the proposal to further simplify and strengthen the MP approach and supporting process. This process consists mainly of lifting up the content of the ATM Master Plan to strategic level and ensuring regular development and deployment strategic monitoring. The programme committee members supported the proposed Master Plan simplified process, after which it was therefore adopted at the December GB meeting.

3.6.2 SESAR 3 JU Programme Committee

The SESAR 3 JU Programme Committee was established in June 2022 with the appointment of the representatives by the GB. Two meetings were held in 2022, addressing the following main areas.

- The SESAR 3 JU Programme Committee was presented with the progress made in the elaboration of the membership agreement. The members had the opportunity to receive clarification on the content of the membership agreement and to provide comments. As a result, the membership agreement document was submitted to the GB for adoption.
- The SESAR 3 JU briefed the members about the IKAA as defined in Article 11 of the SBA. These additional activities are all the expenses of the members other than those co-financed by the Union in contributing to the achievement of the objectives of the European ATM Master Plan. Therefore, the IKAA have to be declared in a plan to be annexed to the BAWP and adopted by the GB. Following an IKAA workshop that helped to better scope the activities members will have to consider in the IKAA plan, consolidated additional activity plans for 2022 and 2023 were presented to the SESAR 3 JU Programme Committee.
- The SESAR 3 JU Programme Committee was briefed about the ramp up of the Digtal European Sky programme. In particular, the members were informed about the launch into operation of the five DSDs dealing with the implementation of U-space and Green Deal solutions. The SESAR 3 JU also provided an update on the statuses of the ER1 and IR1 calls, which were closed in October 2022. Finally, the ER2 call consultation process was presented to the members. The members of the SESAR 3 JU will have the opportunity to comment and co-design the call's technical specifications with the aim of opening the call by the end of June 2023.

4 Financial management and internal control

In 2022, progress towards the objectives in the area 'Strategy and plans for the organisational management and internal control systems', as set out in Section 5.1 of the 2022–2023 BAWP, was satisfactory overall, with some specific exceptions.

- In terms of monitoring the efficiency and effectiveness of the SESAR 3 JU's project audit activities, the activities were carried out in accordance with the plan.
- In terms of monitoring the efficiency and effectiveness of the SESAR 3 JU's corporate and management activities, the absence of the internal control coordinator, the quality manager and the risk manager negatively impacted the implementation of actions in relation to compliance requirements. Despite these challenges, the SESAR 3 JU ensured the performance of tasks remained compliant with the minimum requirements, utlising the robust set-up established in previous years.
- In terms of monitoring the efficiency and effectiveness of the budget and finance activities, (1) the budget request for 2022 was submitted to the European Commission on 31 January 2022 (the date of the deadline); (2) the 2020 annual accounts were completed and published within the regulatory deadlines before the deadline of 1 July 2022 (transmitted to the budgetary authority on 30 June 2022); and (3) the European Court of Auditors (ECA) gave an unqualified opinion on the 2021 accounts. However, in 2022, of the 656 payments (+ 50 % compared with 2021), 126 were late (19.2 %, compared with 7.7 % in 2021). See Section 1.7 for more details.
- In terms of monitoring the exceptions and non-compliance events registered in 2022, the SESAR 3 JU recorded one non-compliance event and two exceptions.

4.1 Control results

The SESAR 3 JU applies, *mutatis mutandis, the components, principles and characteristics set forth in the European Commission's internal control framework. Internal control systems and procedures are applicable at all levels of management and are designed to provide reasonable assurance of achieving the following objectives:*

- effectiveness, efficiency and economy of operations,
- reliability of reporting,
- safeguarding of assets and information,
- prevention, detection, correction and follow-up of fraud and irregularities.

4.1.1 Effectiveness of controls

4.1.1.1 *Ex ante* controls on operational expenditure

In order to ensure the sound financial management, legality and regularity of the underlying transactions, all transactions are in line with the four-eyes principle in the preparation phase and in the payment phase.

The *ex ante* control function is exercised at operational level, to verify the work performed during the initiation of the transaction and to ensure that the required results are achieved, and at financial level, to verify the application of the rules. The extensive *ex ante* controls helped prevent material errors and formal errors at all stages of the authorisation process (initiation, verification, authorisation and payment).

A key element of the *ex ante* controls applicable to Horizon 2020 and Horizon Europe grants is the related guidance issued by the Commission and applicable to all Horizon 2020 and Horizon Europe stakeholders.

4.1.1.2 *Ex post* control of operational expenditure and error rates identified

Since 2007, the R & I family has adopted a common audit strategy intended to contribute to the legality and regularity of expenditure on a multiannual basis, including detection and correction of non-systemic and systemic errors.

For Horizon 2020, the Common Audit Service of the Common Implementation Centre carries out all audits, including those concerning the grants concluded by the executive agencies and the JUs. This is a major step towards ensuring a harmonised approach, legal certainty and equality of treatment of beneficiaries, and minimising the audit burden on beneficiaries.

The main indicators of legality and regularity of EU framework programmes for R & I are:

- **the cumulative representative detected error rate,** based on errors detected by the *ex post* audits on a common representative sample of cost claims across the R & I family;
- **the cumulative residual error rate,** which is the extrapolated level of error after corrective measures have been implemented by the Commission services following the audits, accumulated on a multiannual basis.

The targets set for this control system for Horizon 2020 is to ensure that the cumulative residual error rate remains within a range of 2-5 %, aiming to be as close as possible to 2%.Progress against Horizon 2020 targets is assessed annually based on the results of the implementation of the *ex post* audit strategy and taking into account the frequency and importance of the detected errors along with cost–benefit considerations regarding the effort and resources needed to detect and correct the errors.

However, it should be noted that, due to its multiannual nature, the effectiveness of the control strategy of the R & I family can be measured and assessed fully only in the final stages of the EU framework programme, once the *ex post* audit strategy has been fully implemented, and once errors, including those of a systemic nature, have been detected and corrected.

Despite objective challenges due to the impact of the COVID-19 pandemic, the audit target was achieved. The Common Audit Service of the Common Implementation Centre managed to finalise audits on 633 participations, corresponding to 103.6 % of the planned most probable scenario for the 2022 target ([32]).

4.1.1.2.1 Results of the Horizon 2020 *ex post* audits

In 2020, the Commission refined its methodology for calculating the Horizon 2020 error rates in line with the observations of the ECA in its 2018 and 2019 annual reports ([33]). The methodology applied is described in Annex 5, 'Materiality criteria', of the Directorate-General for Research and Innovation's CAAR. Since January 2020, the Directorate-General for Research and Innovation has applied the revised methodology for a sample of 1 937 audit conclusions. This resulted in the following error rates for Horizon 2020 ([34]) on 31 December 2022:

- cumulative representative detected error rate: **2.71 %** ([35]),
- cumulative residual error rate for the R & I family directorates-general: **1.67 %**.

In line with the financial statement ([36]) accompanying the Commission's proposal for the Horizon 2020 regulation, a reservation is not necessary for the related expenditure if the cumulative residual error rate for the programme falls within the target range of

([32]) Given the uncertainties related to the evolution of the COVID-19 pandemic and related carryover, the Common Audit Service of the Common Implementation Centre developed two scenarios for the closure of audit targets.

([33]) When calculating the multiannual error rate, the Commission took into account the results of the audit reperformed by the ECA as part of module 2 of the 2018–2019 Declaration of Assurance (DAS).

([34]) The Horizon 2020 audit campaign started in 2016. At the time of writing, four common representative samples with a total of 628 expected results have been selected. By the end of 2022, cost claims amounting to EUR 40.8 billion had been submitted by the beneficiaries to the services. The audit coverage for Horizon 2020 is presented in Annex 7 in the AAR of DG-RTD. In addition to the common representative samples, common risk samples and additional samples have also been selected. The audits of 4 060 participations were finalised by 31 December 2022 (of which 633 took place in 2022).

([35]) Based on the 479 representative results out of the 628 expected in the four common representative samples.

([36]) The legislative financial statement accompanying the Commission's proposal for the Horizon 2020 regulation states 'The Commission considers therefore that, for research spending under Horizon 2020, a risk of error, on an annual basis, within a range between 2-5 % is a realistic objective taking into account the costs of controls, the simplification measures proposed to reduce the complexity of rules and the related inherent risk associated to the reimbursement of costs of the research projects. The ultimate aim for the residual level of error at the closure of the programmes after the financial impact of all audits, corrections and recovery measures will have been taken into account is to achieve a level as close as possible to 2 %.'

2–5 %. In 2022, despite the abovementioned caveats, the cumulative residual error rate for Horizon 2020, calculated at 1.67 %, more than fulfils this condition and is below the materiality threshold. Despite the absence of reservation, the root causes of errors have been identified and targeted actions taken to address any identified weaknesses.

Since Horizon 2020 is a multiannual programme, the error rates, and the residual error rate in particular, should be considered within a time perspective. Specifically, the cleaning effect of audits will tend to increase the difference between the representative detected error rate and the cumulative residual error rate, with the latter finishing at a lower value.

These error rates are calculated on the basis of the audit results available at the time of drafting the CAAR. They should be treated with caution as they may change subject to the availability of additional data from audit results.

Given the results of the audit campaign, and the observations made by the ECA in its annual reports, the Common Implementation Centre, in close cooperation with central Commission services, defined actions aiming to significantly simplify the rules and paving the way for a significant reduction of the error rate in Horizon Europe. In addition to the use of a corporate model grant agreement and a common annotated grant agreement for all programmes directly managed by the Commission, other actions include further simplification, such as the increased use of simplified forms of funding (including lump sums and unit costs); communication campaigns focused on more 'error-prone' types of beneficiaries with higher than average error rates, such as SMEs and newcomers; and enhanced training for external audit firms performing audits on behalf of the Commission (these measures also target Horizon 2020 grants and beneficiaries). Focusing on the most common errors, these actions will be straightforward, reaching more participants and achieving a greater impact.

In addition, the ECA recommended certain improvements related to the quality of the audit process. Following this recommendation, the Commission reinforced or introduced a number of actions to remedy the risks identified by the ECA. The ECA has acknowledged these efforts to improve the quality of audits and considers its recommendation to be fully implemented.

4.1.1.2.2 Horizon Europe framework programme

In 2022, the SESAR 3 JU launched its first call for proposals for the Horizon Europe framework programme. Therefore, no payments have been made and no audits have been performed.

4.1.1.2.3 Results of the *ex post* SESAR-specific audits

Even though the common representative sample is a basic indicator of the legality and regularity of transactions for the entire R & I family, SESAR calculates its specific results based on audits of its own population and its own expenditure.

In 2021, one snapshot of the population of SESAR activities (IR VLD) was taken. The amounts that

had been paid by this cut-off date (a total of EUR 52 million) resulted in a sample of eight participations in five beneficiaries and an audit coverage of 10 %.

By 31 December 2022, the Common Audit Service of the Common Implementation Centre had finalised three reports covering five participations ([37]). For the purpose of calculating the error rate, the SESAR 3 JU took into account the results of the remaining three participations that were being finalised, and the figures were not expected to change. This resulted in a detected error rate of 2.39 %, with a systematic error of 1.69 % and a residual error rate of 1.75 %. The SESAR multiannual cumulative residual error rate (2016–2022) is calculated as 1.03 %.

The error rates reported for 2022, annual and cumulative, stayed within the materiality threshold of 2–5 %.

In 2022, one snapshot of the population was taken, on 10 June. The audit of the cost claims received and paid by this cut-off date resulted in a sample of eight participations in eight beneficiaries. The results of this audit will be available in 2023.

The SESAR 3 JU has in place an effective mechanism to correct errors through recoveries and financial corrections. In terms of audit result implementation (AURI), the SESAR 3 JU processed 92 % of the received audit results in a timely manner (i.e. within 6 months).

TABLE 25: **NUMBER OF IMPLEMENTED AURIS (CUMULATIVE FOR 2017–2022)**

SESAR 3 JU	Audit results processed	% of audit results processed	Audit results pending	% of audit results pending	Total
Audits	106	99	1	1	107
Extensions	124	87	18	13	142
Total	230	92	19	8	249

TABLE 26: **TIME TO IMPLEMENT CLOSED AURIS IN THE 2022 FINANCIAL YEAR**

SESAR 3 JU	0–6 months	% of total number (0–6 months)	> 6 months	% of total number (> 6 months)	Total
Closed projects	20	100	0	0	20
Negative adjustments with recovery	10	100	0	0	10
Negative adjustments without recovery	1	100	0	0	1
Positive or zero adjustment	9	100	0	0	9
Ongoing projects	11	100	0	0	11
Negative adjustments	1	100	0	0	1
Positive or zero adjustment	10	100	0	0	10
Total	31	100	0	0	31

([37]) In accordance with the revised targets (due to the consequences of the COVID-19 pandemic) as agreed in the 2022 annual activity report of the Common Audit Service of the Common Implementation Centre.

During the reporting year, recoveries and financial corrections following the results of *ex post* controls amounted to EUR 259 283, whereas the executed corrective capacity amounted to EUR 95 656 in total, representing 0.13 % of the relevant expenditure.

The relevant expenditure of the SESAR 3 JU, its estimated overall risk at payment, the estimated future corrections and the risk at closure are provided in Table 27.

TABLE 27: ESTIMATED RISK AT PAYMENT AND RISK AT CLOSURE (EUR)

Programme	Relevant expenditure	Estimated risk (error rate %) at payment	Estimated future corrections	Estimated risk (error rate %) at closure
Horizon 2020	75 064 347.98	1 794 037.9 (2.39 %)	163 627.29 (0.22 %)	1 630 410.63 (2.17 %)

The estimated overall risk at payment for 2022 expenditure amounts to EUR 1.8 million, representing 2.39 % of the JU's total relevant expenditure for 2022. This is the authorising officer's best, conservative estimate of the amount of relevant expenditure not in conformity with the contractual and regulatory provisions applicable at the time the payment was made. This expenditure will subsequently be subject to *ex post* controls, and a proportion of the underlying errors will be detected and corrected in subsequent years. The conservatively estimated future corrections for 2022 expenditure represent EUR 163 627. The difference between those two amounts results in an estimated overall risk at closure of EUR 1.6 million, representing 2.17 % of the JU's total relevant expenditure for 2022. The exposure is below the European Commission's *de minimis* threshold for financial annual activity report reservations of EUR 5 million; therefore, no reservation is considered necessary.

4.1.1.2.4 Follow-up of the *ex post* audits in assigned revenues

Geofencing

The audit in geofencing was performed in January 2022 and resulted in a negative adjustment of EUR 12 574 (2.86 % of total costs claimed). This error was not systematic. The recovery order was issued in July 2022 and was cashed in.

U-space

In 2021, the declaration of assurance of the authorising officer was qualified by a reservation for the U-space-assigned revenue. During 2022, corrective and preventive actions were put in place, and the relevant recovery orders were mostly issued ([38]). The recovery orders for one audited beneficiary took longer than 6 months due to the beneficiary submitting observations contesting the audit findings.

TABLE 28: RECOVERY ORDERS ISSUED IN 2022 (EUR)

Total recovery order amount with extension of audit findings	Total amount of recovery orders issued	Total amount of recovery orders cashed in
– 806 211.19	– 204 851.69	– 71 151.88

TABLE 29: NUMBER OF IMPLEMENTED AURIS IN ASSIGNED REVENUES

SESAR 3 JU	Audit results processed	% of audit results processed	Audit results pending	% of audit results pending	Total
Audits	8	80	2	20	10
Extensions	2	66	1	33	3
Total	10	77	3	33	13

([38]) Status on 15 February 2023.

TABLE 30: **TIME TO IMPLEMENT CLOSED AURIS FOR ASSIGNED REVENUES IN THE 2022 FINANCIAL YEAR**

SESAR 3 JU	0–6 months	% of total number (0–6 months)	> 6 months	% of total number (> 6 months)	Total number
Closed projects	7	54	6	46	13
Negative adjustments with recovery	4	40	6	60	10
Negative adjustments without recovery	1	100	0	0	1
Positive or zero adjustment	2	100	0	0	2

4.1.1.3 Legality and regularity of financial transactions

The SESAR 3 JU financial rules, adopted by GB(D)01-2021, are aligned with the Commission Delegated Regulation (EU) 2019/887 on the model financial regulation for public–private partnership bodies referred to in the 2018 financial regulation.

The SESAR 3 JU also adopted a manual of financial circuits relating to the JU budget implementation. The manual establishes the financial circuits within the JU, which allow the correct legal and regular implementation of the budget for the revenue through recovery orders and forecasts of revenue, and for the expenditure from the budgetary commitment until the payment of the expenditure to the decommitment and possible recovery orders.

4.1.1.4 Fraud prevention, detection and correction

The SESAR 3 JU uses an updated anti-fraud strategy, which was adopted in March 2020 ([39]). It provides a detailed action plan indicating the specific actions that the SESAR 3 JU plans to undertake in the fight against fraud for the next 3 years.

By the end of 2022, the action plan related to the updated anti-fraud strategy had been fully implemented. Among the notable actions, personal data records in the field of anti-fraud were established, anti-fraud-related newsletters were sent to all staff, a code of conduct for GB members was set up and 98 % of staff members attended awareness training sessions.

A new anti-fraud strategy will be set up in 2023. The basis for this new strategy is an anti-fraud risk assessment that was performed in December 2022.

4.1.1.4.1 Follow-up of recommendations issued by the European Anti-Fraud Office

In 2022, the SESAR 3 JU was not subject to an investigation led by OLAF. The following indicators are used in relation to fraud cases:

- number of files sent to OLAF for investigation – in 2022, there were no cases of suspected fraud;
- time elapsed between the receipt by staff or management of the first information on alleged internal fraud and the transmission of this information to OLAF – not applicable in 2022;
- time elapsed between OLAF requests for information and the date when information is provided to OLAF – not applicable in 2022;
- time elapsed between the receipt of an OLAF report and the decision on recovery or disciplinary sanctions by the SESAR 3 JU – not applicable in 2022.

No follow-up actions to implement OLAF recommendations from previous years were required in 2022.

4.1.1.5 Assets and information, and reliability of reporting

Physical assets are recorded in ABAC Assets while information assets are stored primarily in a local information and data management system on SharePoint (for local storage) and otherwise on a contractor-provided platform (for information assets shared with external parties).

([39]) SESAR JU Administrative Board Decision ADB(D)04-2020, signed on 12 March 2020, on the updated 2020–2022 anti-fraud strategy. This decision was later transferred to the SESAR 3 JU by GB Decision GB(D)05-2021.

4.1.2 Efficiency of controls ('time to')

Annex 3 provides the measurement of the three efficiency indicators required by the EU financial regulation: time to inform (KPI 8, Article 194(2)), time to grant (KPI 10, Article 194(2)), time to sign (KPI 11, Article 194(2)) and time to pay (KPI 12, Article 116(1)).

Considering that no grants were signed in 2022, it is not possible to assess the evolution of time to inform, time to sign and time to grant.

However, in terms of time to pay, there was a reduction in the time spent for final payments and a slight increase in time spent for interim payments, due to the different payment amounts managed during the reporting year. In any case, the legal obligation of 90 days to pay was respected again in 2022.

4.1.3 Economy of controls

Not applicable.

4.1.4 Register of exceptions and non-compliance events

The SESAR 3 JU has an exceptions and non-compliance events management process. This process ([40]) is based on internal control standard No 8 ([41]) and consists in maintaining an exceptions and non-compliance events register to manage and monitor possible deviations that are not initially set out by the procedures submitted to the authorising officer with a justification for endorsement.

In accordance with the abovementioned policy and process, in 2022 the SESAR 3 JU recorded:

- one non-compliance event resulting from the absence of a signature of an amendment between the SESAR 3 JU and a beneficiary to formalise the project extension by 1 month and to entitle the project beneficiaries to declare the costs incurred during this extension period as eligible;
- two exceptions, relating to:
  - the extension of the duration of the contract governing the provision of cleaning services,
  - the financial framework partnership agreement with the European Commission, which includes several deviations from the SBA provisions, the SESAR 3 JU financial rules and the EU financial regulation, as discussed with the European Commission.

The exceptions and non-compliance events register is available on request and is consulted by the ECA during audits.

4.1.5 Conclusion on the cost-effectiveness of controls

The controls in place are being used, and this is measured and reported at least annually. The report for 2022 is available in Annex 7.

4.2 Audit observations and recommendations

4.2.1 Internal Audit Service

In June 2022, the Internal Audit Service (IAS) of the European Commission did not perform an audit of the SESAR 3 JU and therefore did not issue any audit recommendations. Instead, the IAS performed a strategic risk assessment of all administrative, financial, operational and IT processes of the SESAR 3 JU to determine the scope of its next audits. Following this assessment, the IAS decided to audit, in 2023, the SESAR 3 JU's processes related to the planning, budgeting, monitoring and reporting of activities, and, in 2024, the processes related to the validation of in-kind contributions.

4.2.2 Internal Audit Capability

On 17 March 2022 ([42]), the GB invited the Executive Director to establish an Internal Audit Capability (IAC) for the SESAR 3 JU. Consequently, on 25 April 2022, the Executive Director appointed ([43]) the IAC of the SESAR 3 JU.

([40]) Executive Director Decision SJU/ED/762 of 15 November 2021, transferred to the SESAR 3 JU under Executive Director Decision S3JU/ED/0001 dated 30 November 2021.

([41]) Internal control standard No 8 requires the SESAR JU to establish 'a method … to ensure that all instances of overriding of controls or deviations from established processes and procedures are documented in exception reports, duly approved before action is taken and logged centrally'.

([42]) GB(D)05-2022 on the establishment of an Internal Audit Capability.

([43]) Executive Director Decision S3JU/ED/014 on the appointment of Internal Audit Capability of the SESAR 3 JU.

In 2022, the IAC performed its duties in compliance with the internal audit charter and the code of ethics adopted by the GB ([44]) and implemented by the IAC annual audit plan 2022, which was approved by the GB ([45]). The activities of the IAC in 2022 did not lead to any recommendations. The work of the IAC focused on consulting engagements, anti-fraud-related activities and the coordination of the work of the IAS, the ECA and other relevant audit bodies. In this context, the IAC provided advice on efficient and effective management, ethics, delegations of authority and ABAC user authorisations. The IAC also performed a fraud risk assessment, which led to the establishment of a stand-alone fraud risk register that will be the basis for the next anti-fraud strategy of the SESAR 3 JU. Furthermore, the IAC monitored the implementation of past recommendations, followed up on the discharge procedure and vice-chaired the IAS network of internal auditors (Auditnet) meetings.

4.2.3 Audit by the European Court of Auditors

During 2022, the ECA audited the 2021 SESAR 3 JU accounts. In the final audit report ([46]), the ECA provides an unqualified opinion for the SESAR 3 JU and concludes that the JU's accounts present fairly the financial position of the SESAR 3 JU, the results of its operations, its cash flows and the changes in net assets for 2021, and that the revenue and payments underlying the accounts for 2021 are legal and regular in all material respects.

4.2.4 Follow-up of observations from the discharge authorities

4.2.4.1 Discharge for the 2020 and 2021 financial years

In May 2022, the European Parliament granted discharge to the SESAR 3 JU with respect to the implementation of the budget for the 2020 financial year, and approved the closure of the accounts of the SESAR 3 JU for the 2020 financial year.

In its resolution, the European Parliament made observations regarding the budget and financial management; performance; procurement; staff well-being in relation to the COVID-19 pandemic; internal control; and internal auditing. These observations were formally acknowledged by the SESAR 3 JU in a written reply, which outlined how the SESAR 3 JU will address these observations. The full discharge text and the reply of the SESAR 3 JU are available on the European Parliament website ([47]).

The discharge decision in respect of the implementation of the budget for the 2021 financial year is expected in Q2 2023.

([44]) GB(D)05-2022 on the establishment of an Internal Audit Capability.

([45]) GB(D)12-2022 on the approval of the annual audit plan of the SESAR 3 JU's Internal Audit Capability for 2022.

([46]) Annual report on EU joint undertakings for the financial year 2021.

([47]) Text adopted by the European Parliament; reply of the SESAR 3 JU.

4.3 Assessment of the effectiveness of internal control systems

4.3.1 Continuous monitoring

Following an observation of the ECA during the preliminary phase (fieldwork) of the audit on the 2020 accounts for the annual self-assessment and monitoring of the effectiveness of the control activities required by the internal control framework, the JU developed relevant indicators for all internal control principles and related characteristics. The SESAR 3 JU continuously monitors the indicators and performs an assessment on a yearly basis to identify lessons learnt and possibilities for improvement.

The SESAR 3 JU used these indicators for the first time in February 2022 to run the assessment for 2021. The result of the assessment for 2022 is available in Annex 7.

4.3.2 Risk assessment and management

Risk management aims to enable an organisation to fulfil its mission and objectives in the most efficient and effective way by ensuring the timely and adequate identification, assessment (analysis and evaluation), management (treatment and escalation, as required), monitoring and controlling of the risks and opportunities.

In 2022, one formal risk management workshop took place in November. As a result of this risk workshop, it was agreed that the categories of risks identified in the SESAR 3 JU's risk management policy ([48]) would be streamlined and simplified. This simplification involved two of the original four categories, namely the strategic risks and the internal risks, being merged into a new category (corporate) and assessed as such. The result of the risk assessment exercise is outlined in Table 31.

([48]) Strategic risks, internal risks, Master Plan risks and programme risks.

TABLE 31: **SESAR 3 JU RISK REGISTER FOR 2022**

Category	No	Description	Thread	Likelihood	Severity	Criticality ([49])
Corporate	13	The SESAR 3 JU members' ability to commit to the established programme delivery is reduced due to the financial/resource situation of the aviation sector, with a knock-on effect resulting from the departure of members of the JU and a reduction in research budget available in the multiannual financial framework and the financial regulation.	Strategic	3	3	9
Corporate	14	There is an insufficient number of skilled resources to maintain and further develop the quality and document management systems, subsequently making organisation-wide internal control ineffective.	Strategic	2	3	6
Corporate	15	Business continuity management planning and its associated staff contact list is not maintained, which might lead to the risk that either staff cannot be contacted in case of a need to trigger the plan or the plan contains insufficient information on how to react.	Strategic	2	2	4
Corporate	17	Limited specialist resources combined with increasing demands for IT security and significant effort to comply with data protection obligations significantly exceed the capacity of the JU to maintain and evolve its IT system, possibly leading to failure to establish and implement disaster recovery measures for critical systems, non-functioning of business continuity or non-compliance with cybersecurity and data protection obligations.	Strategic	1	4	4
Corporate	18	Expected benefits from the implementation of the new IKAA approach prove not to be aligned across the JUs because of a lack of clear guidance from the European Commission on reporting and validation and a lack of a proper tool to systematically capture the information, possibly leading to an inconsistent approach to accepting IKAA and unrealistic comparisons being made across the JUs by auditors.	Strategic	3	2	6

([49]) Using a 5x5 likelihood/severity matrix, classification of possible criticality values are - Red = high (value between 12 and 25), orange = moderate (value between 5 and 10), green = low (value between 1 and 4).

Category	No	Description	Thread	Likelihood	Severity	Criticality ([49])
Corporate	19	Financial framework partnership agreement: the EU's financial contribution to the JU is now considered pre-financing, meaning that there is no certainty in it until final approval of the CAAR, creating uncertainty regarding the financial contribution to be received until the end of the programme, despite the legislative financial statement.	Strategic	3	3	9
Corporate	20	Difficulty in recovering grant money from private members might lead to an unexpected reduction in their financial contribution or inability to recover grant money post-audit as the mutual insurance mechanism would not apply once grants are closed.	Strategic	3	2	6
Corporate	21	Long-lasting high inflation might lead to the digital European sky programme not being delivered, as value is deflated due to increased costs. Procurement and staff costs increase as indexed by inflation, leading to a reduction in the financial commitment for the programme, resulting in it delivering significantly less due to the reduced value to the beneficiaries.	Strategic	4	4	16
Master Plan	29	A lack of buy-in to the Airspace Architecture Study transition leads to the virtual de-fragmentation of European skies not being achieved, resulting in the inability to deal with future traffic growth.	Master Plan	3	3	9
Master Plan	29	Lack of incentives for early movers might impact the market uptake of SESAR solutions.	Master Plan	29	4	12
Programme	10	COVID-19 and the Russian war of aggression against Ukraine might lead to incomplete delivery of the ATM Master Plan phase C solutions at the end of the SESAR 2020 programme.	Programme	2	3	6
Programme	12	Lack of adequate guidance for engagement of UK participants in grants will likely result in an awarded project having different conditions applied to the same company by other JUs if guidance material from the European Commission arrives late.	Programme	3	2	6
Programme	13	Lack of global interoperability of certain solutions hampers the deployment of SESAR solutions.	Programme	2	4	8

During the reporting period, the SESAR 3 JU performed a fraud risk assessment. This will be the basis for the next anti-fraud strategy (see Sections 4.1.1.4 and 4.2). This fraud risk assessment involved three steps: identification of the risks of fraud, assessment of the identified risks and prioritisation of the risks. The results were discussed during the risk workshop with SESAR 3 JU management. The most significant risks were consequently documented in a stand-alone fraud risk register.

4.3.3 Prevention of conflicts of interest

In December 2021, the SESAR 3 JU Governing Board adopted new rules on confidentiality and the prevention, avoidance and management of conflicts of interest ([50]). In addition, in December 2021, a code of conduct for GB members was adopted ([51]).

In this context, the SESAR 3 JU performs a yearly exercise requesting that its staff report any interests in the form of a written declaration. The 2022 exercise was launched in November 2022 and concluded by means of a note to the Executive Director in January 2023.

4.4 Conclusion on the assurance

On the basis of the above elements, management provides reasonable assurance that all necessary internal control procedures are in place to guarantee the legality and regularity of the SESAR 3 JU's activities, in line with the principles of economy, efficiency and effectiveness.

In conclusion, management provides reasonable assurance that, overall, suitable controls are in place and are working as intended, risks are being appropriately monitored and mitigated, and necessary improvements and reinforcements are being implemented. Therefore, the Executive Director, in his capacity as authorising officer, has signed the declaration of assurance presented in Section 4.5.3.

([50]) SESAR 3 JU Governing Board Decision GB(D)03-2021 on confidentiality, prevention, avoidance and the management of conflicts of interest.

([51]) SESAR 3 JU Governing Board Decision GB(D)04-2021 on the code of conduct for the Governing Board.

4.5 Statement of assurance

4.5.1 Assessment of the consolidated annual activity report by the SESAR 3 Joint Undertaking Governing Board

The GB has assessed the 2022 CAAR, and notes the following.

- The SESAR 3 JU met all of its key policy and operational objectives in 2022 as outlined in the 2022–2023 BAWP.
- For the SESAR 2020 programme, the SESAR 3 JU's key achievements in 2022 were the following:
  - completion of release 11, in line with the release plan published in 2020,
  - initiation of release 12 based on the plan published at the end of 2021,
  - supervision of active projects under the IR VLD wave 2, IR VLD wave 3, ER4 and VLD calls for proposals, management of related grant agreements and closure of some of these grants.
- For the Digital European Sky ProgrammeSky programme, the SESAR 3 JU's key achievements in 2022 were the following:
  - follow-up of activities as outlined in the European ATM Master Plan (2020 edition), in particular in levels 2 and 3 (the 'implementation view'),
  - preparation and launch of two calls, one under Exploratory Researchexploratory research (S3 ER1) and one under Industrial Researchindustrial research (S3 IR1),
  - provision of technical expertise to CINEA for the preparation, evaluation and supervision of two calls relating to SESAR DSDs (DSD01a and DSD01b).
- Over 2022, the SESAR 3 JU carried out a range of corporate and back-end services to support the aforementioned operational activities. These services were carried out efficiently and effectively in line with best practices, standards and applicable regulatory frameworks. The following are the SESAR 3 JU's key achievements in 2022 in this domain:
  - promotion of the SESAR 3 JU partnership and showcasing its results through events, publications and digital media,
  - familiarisation of audiences with the flagship areas of work, enlarged membership and strengthened partnerships,
  - organisation of and/or participation in major European and global events related to ATM and aviation, including the SESAR Innovation Days, the SESAR 3 JU Annual Conference and several ICAO events,
  - communication of programme results and the promotion of scientific excellence through the SESAR Digital Academy and the SESAR Young Scientist Award,
  - provision of guidance to members and projects (beneficiaries) and monitoring of their compliance with obligations and commitments to communicate, disseminate and exploit project outcomes within the framework of the partnership, Horizon 2020 and Horizon Europe,
  - effective and efficient financial, administrative, legal and corporate management of the SESAR 3 JU through the implementation of internal control principles and systematic quality assurance activities, and through synergies, where applicable,
  - adoption of a simplified and strengthened MP approach that preserves the strategic value of the Master Plan.
- With these achievements, the SESAR 3 JU fully completed its work programme for 2022; the performance indicators show that all targets were met.
- The main risks to the delivery of the SESAR 3 JU's key objectives were identified and the relevant mitigating measures were taken, keeping overall risks under control and at an acceptable level of criticality.

4.5.2 Reservations

No reservations were reported in 2022.

4.5.3 Declaration of assurance

I, the undersigned, Executive Director of the SESAR 3 JU,

In my capacity as authorising officer by delegation,

Declare that the information contained in this report gives a true and fair view.

State that I have reasonable assurance that the resources assigned to the activities described in this report have been used for their intended purpose and in accordance with the principles of sound financial management, and that the control procedures put in place give the necessary guarantees concerning the legality and regularity of the underlying transactions.

This reasonable assurance is based on my own judgement and on the information at my disposal, such as the results of the self-assessment, *ex post* controls, the work of the Internal Audit Capability, the observations of the IAS and the lessons learnt from the reports of the Court of Auditors for years prior to the year of this declaration.

Confirm that I am not aware of anything not reported here that could harm the interests of the joint undertaking.

Brussels, 26 June 2023

(Signed)

Andreas Boschen

Executive Director

SESAR 3 JU

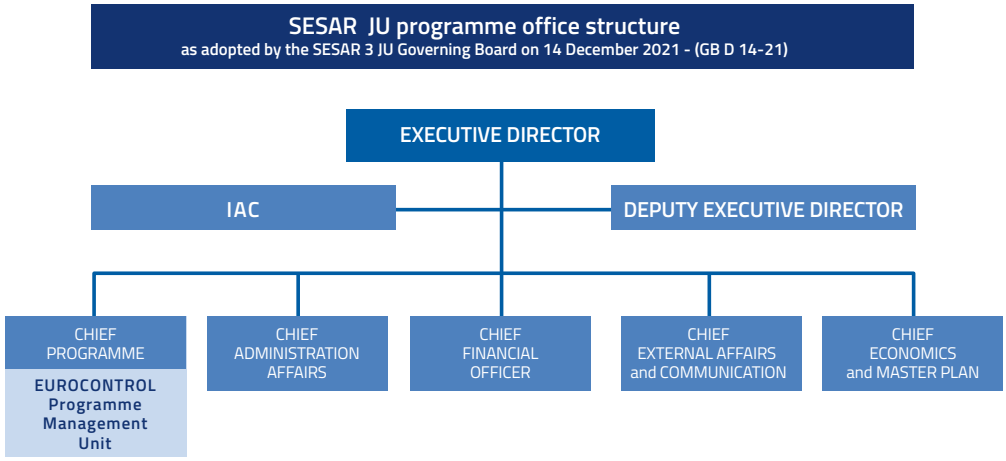

VOLOTEA
VOLOTEA
VOLOTEA
IBERIA REGIONAL

Annexes

1. Organisational chart

Figure 4 shows the organisational structure of the programme office as approved by the GB through decision GB(D)14-2021, signed on 14 December 2021.

FIGURE 4: **ORGANISATION STRUCTURE OF THE SESAR 3 JU PROGRAMME OFFICE**



2. Establishment plan and additional information on human resources management

TABLE 32: **2022 STAFF ESTABLISHMENT PLAN**

Function group and grade	2021				2022			
	Authorised		Actually filled as of 31.12.2021		Authorised		Actually filled as of 31.12.2022	
	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts
AD 16								
AD 15		1				1		
AD 14								1
AD 13		1				2		
AD 12		4		4		3		4
AD 11		3		1		4		1
AD 10		2		2		2		3
AD 9		6		6		7		5
AD 8		7		6		7		6
AD 7		4		6		4		4
AD 6		3		3		1		4
AD 5								
Total AD		**31**		**28**		**31**		**28**

Function group and grade	2021				2022			
	Authorised		Actually filled as of 31.12.2021		Authorised		Actually filled as of 31.12.2022	
	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts
AST 11								
AST 10								
AST 9		1		1		1		1
AST 8								
AST 7		1				1		
AST 6								
AST 5		2		1		3		2
AST 4		1		2				2
AST 3		1		1		1		
AST 2				1				1
AST 1								
Total AST		**6**		**6**		**6**		**6**
AST/SC 6								
AST/SC 5								
AST/SC 4								
AST/SC 3								
AST/SC 2								
AST/SC 1								
Total AST/SC								
Total AD + AST + AST/SC		**37**		**34**		**37**		**34**
Grand total		**37**		**34**		**37**		**34**

NB: AD, administrator; AST, assistant; SC, secretary.

Contract agents	Authorised	Actually filled as of 31.12.2022
Function group IV	1	1
Function group III		
Function group II		
Function group I		
Total	**1**	**1**

	Seconded national experts	Authorised	Actually filled as of 31.12.2022
	2	2	2
Total	**2**	**2**	**2**

3. Scoreboard of Horizon 2020 key performance indicators

In line with the previous editions of the CAAR, the yearly value for the reporting period has been provided here and in the following annexes in accordance with the methodology received by the European Commission ([52]). Tables 33 and 35 follow the instructions on annual activity reports for JUs operating under Horizon 2020.

By definition, as the SESAR 2020 programme is approaching closure, for a number of KPIs such methodology led to an empty sample, which did not allow for a yearly measurement (i.e. for indicators that sample projects by start date). Therefore, although not requested by the template, the SESAR 3 JU provided a cumulative overview of relevant categories of Horizon 2020 common KPIs (Table 34) and of the indicators for monitoring cross-cutting issues (Table 36) ([53]).

TABLE 33: **SCOREBOARD OF HORIZON 2020 COMMON KPIS**

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU ([54])	Value in 2021 ([55])	Value in 2022 ([57])
1	SMEs – proportion of participating SMEs introducing innovations new to the company or the market (covering the period of the project end date within reporting year + 3 years) (number of SMEs that have introduced innovations)	Number and percentage of participating SMEs that have introduced innovations to the company or to the market	No	31 (25 %) ([56])	78 (20 %) ([57])
2	SMEs – growth and job creation in participating SMEs (turnover of company, number of employees)	Turnover of company Number of employees	No	EUR 326 069 344 2 964 ([58])	EUR 486 284 845.75 5 071 ([59])
3	Number of publications in peer-reviewed, high-impact journals	Percentage of papers published in the top 10 % of journals, ranked by impact factor, by subject category	No	21 (81 %) ([58])	90 (75 %) ([59])

([52]) Council Decision 2013/743/EU, Annexes II and III; Horizon 2020 Indicators – Assessing the results and impact of Horizon 2020; Guidelines on key performance indicators (KPI) for directors of EU decentralised agencies (SWD(2015)62); Communication from the Commission on the strengthening of the governance of Union bodies under Article 70 of the Financial Regulation 2018/1046 and on the guidelines for the single programming document and the consolidated annual activity report, COM(2020) 2297 (see the template for the consolidated annual activity report).

([53]) Industrial leadership; societal challenges; widening participation; SME participation; gender; international cooperation; moving from discovery to market; private sector participation; funding for public–private partnerships; communication and dissemination; and participation of research organisations and universities.

([54]) Data not provided by the SESAR 3 JU are provided by beneficiaries through project reporting.

([55]) Data refer to the projects within SESAR 2020.

([56]) Data refer to projects with an end date between 2021 and 2023.

([57]) Data refer to projects with an end date between 2022 and 2023.

([58]) Data refer to publication year 2021.

([59]) Data refer to publication year 2022.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU [54]	Value in 2021 [55]	Value in 2022 [57]
4	Patent applications and patents awarded in the area of the joint technology initiative (number of patents awarded)	Number of patent applications by theme Number of awarded patents by theme	No	Patent applications: 0 Awarded patents: 0 [60]	Patent applications: 0 Awarded patents: 0 [61]
5	Number of prototypes, testing activities and clinical trials	Number of prototypes, testing (feasibility/ demonstration) activities and clinical trials	No	Prototypes: 368 Feasibility activities: 518 Clinical trials: N/A [62]	Prototypes: 509 Feasibility activities: 767 Clinical trials: N/A [63]
6	Number of joint public–private publications in projects	Number of joint public–private publications and percentage of all relevant publications	No	79 (32 %) [64]	102 (22 %) [65]
7	New products, processes and methods launched into the market	Number of projects with new innovative products, processes and methods	No	Innovative products: 33 Innovative processes: 27 Innovative methods: 27 [66]	Innovative products: 58 Innovative processes: 49 Innovative methods: 56 [67]
8	Time to inform all applicants of outcome of evaluation	Number and percentage of information letters sent to applicants within target (153 days) Average time to inform (calendar days) Maximum time to inform (calendar days)	Yes	N/A [68]	N/A [69]
9	Redress after evaluation / evaluation review	Number of redress requests	Yes	0 %	N/A [71]
10	Time to grant from call deadline to grant signature	Number and percentage of grants signed within target (8 months) Average time to grant (calendar days) Maximum time to grant (calendar days)	Yes	Grants signed: 2 (100 %) Average time: 233 Maximum time: 244 [70]	N/A [71]

[60] Data refer to patent application year 2021.

[61] Data refer to patent application year 2022.

[62] Cumulative amounts referring to projects with a start date in 2016–2021. For clinical trials, the values reported by the beneficiaries were corrected, as clinical trials apply only to health programmes/projects.

[63] Cumulative amounts referring to projects with a start date in 2016–2022. There were no projects with a start date in 2022. For clinical trials, the values reported by the beneficiaries were corrected, as clinical trials apply only to health programmes/ projects.

[64] Cumulative amounts referring to a publication date in 2016–2021.

[65] Cumulative amounts referring to a publication date in 2016–2022. There were no projects with a start date in 2022.

[66] Cumulative amounts referring to projects with a start date in 2016–2021.

[67] Cumulative amounts referring to projects with a start date in 2016–2022. There were no projects with a start date in 2022.

[68] Not applicable, as all information letters were sent in 2020.

[69] Not applicable, as there were no calls in 2022.

[70] Data refer to call H2020-SESAR-2020-1.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU ([54])	Value in 2021 ([55])	Value in 2022 ([57])
11	Time to sign from successful applicant letter	Number and percentage of grants signed within target (92 days) Average time to sign (calendar days) Maximum time to sign (calendar days)	Yes	Grants signed: 2 (100 %) Average time: 74 days Maximum time: 85 ([72])	N/A ([71])
12	Time to pay (percentage of payments that were on time) for pre-financing, interim payment and final payment	Average number of days for pre-financing (target: 30 days), interim payment (target: 90 days) and final payment (target: 90 days) Average number of days for administrative payments Number of experts appointed	Yes	100 % on time for pre-financing Average number of days for pre-financing: 16 Average number of days for interim payment: 60 Average number of days for final payment: 78 Average number of days for administrative payments: 18 Experts contracted: 24 ([72])	0 % on time for pre-financing Average number of days for pre-financing: 36 Average number of days for interim payment: 77 Average number of days for final payment: 63 Average number of days for administrative payments: 22 Experts contracted: 22 ([73])
13	Vacancy rate (%)	Vacancy rate during the reporting period (%)	Yes	7.5 %	8.1 %
14	Budget implementation/ execution: 1. % commitment to total budget 2. % of payments to total budget	Realistic yearly budget proposal and possibility to monitor and report on its execution, both in commitment and in payments, in line with the sound financial management principle	Yes	1. 69.47 % 2. 90.37 % ([74])	1. 87.35 % 2. 24.70 % ([75])
15	Administrative budget: number of late payments and percentage of total	Number and percentage of late payments	Yes	13 (7 %)	100 (19.2 %)

([71]) Not applicable, as there were no calls in 2022 and all grants were signed in 2021.

([72]) Data refer to experts members of the SC and monitors for projects of call H2020-SESAR-2019-1 and call H2020-SESAR-2020-2.

([73]) Data refer to monitors for projects of calls H2020-SESAR-2019-1, H2020-SESAR-2020-1 and H2020-SESAR-2020-2.

([74]) The percentages presented refer exclusively to Titles 1–3.

([75]) The percentages presented refer exclusively to Titles 1–4. Further details are available in Section 2.3.

TABLE 34: CUMULATIVE VALUES OF THE SCOREBOARD OF A SELECTION OF HORIZON 2020 COMMON KPIS FOR SESAR 2020

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([76])	Cumulative value for the SESAR 2020 programme
1	SMEs – proportion of participating SMEs introducing innovations new to the company or the market (covering the period of the project end date within reporting year + 3 years) (number of SMEs that have introduced innovations)	Number and percentage of participating SMEs that have introduced innovations to the company or to the market	No	253 (23 %) ([77])
2	SMEs – growth and job creation in participating SMEs (turnover of company, number of employees)	Turnover of company Number of employees	No	EUR 2 082 900 473 22 134 ([79])
3	Number of publications in peer-reviewed, high-impact journals	Percentage of papers published in the top 10 % of journals, ranked by impact factor, by subject category	No	343 ([78])
4	Patent applications and patents awarded in the area of the joint technology initiative (number of patents awarded)	Number of patent applications by theme Number of awarded patents by theme	No	Patent applications: 0 Awarded patents: 0 ([79])
9	Redress after evaluation / evaluation review	Number of redress requests	Yes	0 % ([80])

NB: Industrial leadership; societal challenges; widening participation; SME participation; gender; international cooperation; moving from discovery to market; private sector participation; funding for public–private partnerships; communication and dissemination; and participation of research organisations and universities.

([76]) Data not provided by the SESAR 3 JU are provided by beneficiaries through project reporting.

([77]) Data refer to projects with an end date between 2017 and 2023.

([78]) Data refer to publication years between 2016 and 2022.

([79]) Data refer to patent application years between 2016 and 2022.

([80]) Data refer to redress requests between 2015 and 2021.

TABLE 35: **INDICATORS FOR MONITORING CROSS-CUTTING ISSUES**

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([81])	Value in 2021 ([82])	Value in 2022 ([84])
16	Number of nationalities in Horizon 2020, applicants and beneficiaries	Number of nationalities of Horizon 2020 applicants and beneficiaries	No	28 ([83])	N/A ([84])
17	Total amount of EU financial contributions, by Member State	Nationalities of Horizon 2020 beneficiaries and corresponding EU financial contribution	No	Austria: EUR 2 983 952 Belgium: EUR 686 728 Croatia: EUR 87 500 Cyprus: EUR 0 Czechia: EUR 1 648 909 Denmark: EUR 1 003 931 Estonia: EUR 766 658 Finland: EUR 840 554 France: EUR 7 613 007 Germany: EUR 5 488 318 Greece: EUR 125 500 Hungary: EUR 176 250 Ireland: EUR 46 799 Italy: EUR 3 957 926 Lithuania: EUR 101 938 Luxembourg: EUR 351 488 Netherlands: EUR 3 029 501 Poland: EUR 1 265 317 Portugal: EUR 0 Slovenia: EUR 127 995 Spain: EUR 12 280 846 Sweden: EUR 1 186 138 United Kingdom: EUR 5 448 339 ([85])	N/A ([86])

([81]) Data not provided by the SESAR 3 JU are provided by beneficiaries through project reporting.

([82]) Data refer to the projects within SESAR 2020.

([83]) Data refer to calls H2020-SESAR-2019-1, H2020-SESAR-2019-2, H2020-SESAR-2020-1 and H2020-SESAR-2020-2 referring to proposal submission date or project start year of 2021.

([84]) Not applicable as there were no calls in 2022 and no projects with a start year of 2022.

([85]) Data refer to calls H2020-SESAR-2019-1, H2020-SESAR-2019-2, H2020-SESAR-2020-1 and H2020-SESAR-2020-2 referring to projects with a start year of 2021.

([86]) Not applicable as there were no projects with a start year of 2022.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([81])	Value in 2021 ([82])	Value in 2022 ([84])
18	Number of nationalities in Horizon 2020, applicants and beneficiaries (associated countries)	Number of nationalities of Horizon 2020 applicants and beneficiaries (associated countries)	No	3 (Norway, Switzerland, Türkiye) ([87])	N/A ([88])
19	Total amount of EU financial contributions, by associated country	Nationalities of Horizon 2020 beneficiaries and corresponding EU financial contribution	No	Norway: EUR 1 080 309 Switzerland: EUR 956 350 Türkiye: EUR 76 250 ([6])	N/A ([88])
20	Proportion of EU financial contribution going to SMEs	Number of Horizon 2020 beneficiaries flagged as SMEs Percentage of EU contribution going to beneficiaries flagged as SMEs	No	39 SMEs 14.2 % ([87])	N/A ([88])
21	Percentage of women in Horizon 2020 projects	Percentage of female participants in Horizon 2020 projects	No	29 % ([87])	N/A ([88])
22	Percentage of women project coordinators in Horizon 2020	Percentage of female MSc fellows, European Research Council principal investigators and scientific coordinators in other Horizon 2020 activities	No	24 % ([87])	N/A ([88])
23	Percentage of women in European Commission advisory groups, expert groups, evaluation panels, individual experts, etc.	Percentage of female members in advisory groups, panels, etc.	Yes	Administrative Board: 1 out 28 (3.6 %) Evaluation panel: N/A ([88]) SC: 3 out of 10 (30 %) External observers: 1 out of 3 (33 %)	GB: 15 out 127 (11.8 %) Evaluation panel: N/A ([89]) SC: 4 out of 9 (44 %) External observers: N/A ([91])
24	Proportion of non-EU country participants in Horizon 2020	Nationalities of Horizon 2020 beneficiaries	No	2 out of 138 (1 %) 2 nationalities: Cape Verde, United States ([90])	N/A ([88])

([87]) Data refer to calls H2020-SESAR-2019-1, H2020-SESAR-2019-2, H2020-SESAR-2020-1 and H2020-SESAR-2020-2 referring to submission year of 2021.

([88]) No call evaluation took place in 2021.

([89]) No call evaluation took place in 2022.

([90]) The value for 2021 was corrected to address a misinterpretation in the methodology used to measure the KPI. Data refer to call H2020-SESAR-2020-1 referring to projects with a start year of 2021.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([81])	Value in 2021 ([82])	Value in 2022 ([84])
25	Percentage of EU financial contribution assigned to non-EU country participants	Percentage of non-EU Horizon 2020 beneficiaries with EU financial contribution	No	0 ([87])	N/A ([88])
26	Proportion of projects and EU financial contribution allocated to IAs([91])	Number of IA proposals and projects properly flagged in the work programme; follow-up at grant level	Yes	Number of IA projects: 7 ([87]) Percentage of IA projects out of all projects: 50 % IAs out of overall EU contribution: 53 %	N/A ([88])
27	Within the IAs, proportion of EU financial contribution focused on demonstration and first-of-a-kind activities	Topics properly flagged in the work programme; follow-up at grant level	Yes	100 % (all IA projects are VLD activities) (6)	N/A ([88])
28	Scale of impact of projects (high TRL)	Number of projects between TRL4 and TRL6 and between TRL5 and TRL7	Yes	Projects up to TRL2 or equivalent operational concept maturity level (exploratory research): 41 Projects at TRL2 to TRL6 or equivalent operational concept maturity level: 13 Projects at TRL6 or TRL7 or equivalent operational concept maturity level: 14 Projects addressing transversal activities (i.e. non-directly TRL or operational-concept-related activities): 3	Projects up to TRL2 or equivalent operational concept maturity level (exploratory research): 41 Projects at TRL2 to TRL6 or equivalent operational concept maturity level: 13 Projects at TRL6 or TRL7 or equivalent operational concept maturity level: 14 Projects addressing transversal activities (i.e. non-directly TRL or operational-concept-related activities): 3
29	Percentage of Horizon 2020 beneficiaries from the private for-profit sector	Number and percentage of total Horizon 2020 beneficiaries classified by type of activity and legal status	Yes	PRC([92]): 167 out of 242 (69 %) ([87]) IR: 81 out of 107 (76 %) VLD: 77 out of 113 (68 %)	N/A ([88])
30	Proportion of EU financial contribution going to private for-profit entities (enabling and industrial technology and Part III of Horizon 2020)	Horizon 2020 beneficiaries classified by type of activity and corresponding EU contribution	Yes	EUR 32 661 167 out of EUR 51 330 501 for PCR (64 %) ([87])	N/A ([88])

([91]) IAs: Innovation Actions

([92]) PRC: Private for-profit entities (excluding Higher or Secondary Education Establishments

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([81])	Value in 2021 ([82])	Value in 2022 ([84])
31	EU financial contribution for public–private partnerships (Article 187 of the Treaty on the Functioning of the European Union)	EU contribution to public–private partnerships (Article 187 of the Treaty on the Functioning of the European Union)	Yes	EUR 549 209 833 ([93])	EUR 549 209 833 ([94])
32	Public–private partnerships leverage: total amount of funds leveraged through Article 187 Treaty on the Functioning of the European Union initiatives, including additional activities, divided by the EU contribution	Total funding from private actors involved in public–private partnerships: in-kind contributions already committed by private members to projects selected for funding additional activities (i.e. research expenditure / investment of industry in the sector, compared with previous year)	Yes	See indicator 40 (Table 37)	See indicator 40 (Table 37)
33	Dissemination and outreach activities other than publications in peer-reviewed journals	Type of dissemination activity can be chosen from a drop-down list. Number of events, funding amount and number of people reached thanks to the dissemination activities	No	Events: 543 Meetings: 207 Open days: 149 Other media: 176 Publications: 232 Social media: 133	Events: 686 Open days: 160 Other media: 155 Publications: 236 Social media: 158
34	Proposal evaluators by country	Nationalities of proposal evaluators	Yes	N/A ([95])	N/A ([96])
35	Proposal evaluators by organisation's type of activity	Type of activity of evaluators' organisations	Yes	N/A ([97])	N/A ([98])

([93]) Cumulative amounts referring to projects with a start date in 2016–2021.

([94]) Cumulative amounts referring to projects with a start date in 2016–2022. There were no projects with a start date in 2022.

([95]) No call evaluation took place in 2021.

([96]) No call evaluation took place in 2022.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([81])	Value in 2021 ([82])	Value in 2022 ([84])
36	Participation of research and technology organisations and universities in public–private partnerships	Number of participations of research and technology organisations in funded projects, and percentage of the total Number of participations of universities in funded projects and percentage of the total Percentage of budget allocated to research and technology organisations and to universities	Yes	41 research organisations out of 242 (all entity types) (17 %) 13 higher education institutions out of 242 (all entity types) (5 %) Budget allocated to research and technology organisations and to universities: 19.1 % ([97])	N/A ([88])
37	The objective is to ensure that research projects funded are compliant with provisions on ethics efficiency	Proposals not granted because of non-compliance with ethics rules as a percentage of proposals invited to grant (target: 0 %); time to ethics clearance (target: 45 days) ([98])	Yes	0 %	N/A ([98])
38	Error rate (for Horizon 2020 grants)	Representative error rate (%) Residual error rate (%)	Yes	Representative error rate: 0.67 % Residual error rate: 0.57 %	Representative error rate: 2.39 % Residual error rate: 1.75 %
39	Implementation of *ex post* audit results for Horizon 2020 projects	Percentage of cases implemented out of total cases (total EUR million)	Yes	59 % (EUR 1 011 199 / EUR 1 721 290)	89 % (EUR 2 534 870 / EUR 2 842 264)

([97]) Amounts refer to calls H2020-SESAR-2019-2, H2020-SESAR-2020-1 and H2020-SESAR-2020-2 referring to projects with a start year of 2021.

([98]) The SESAR 3 JU provides ethics clearance together with the rest of the grant agreement preparation feedback (within 90 days).

TABLE 36: **SESAR 2020 CUMULATIVE VALUES OF THE INDICATORS FOR MONITORING CROSS-CUTTING ISSUES**

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([99])	Cumulative value for SESAR 2020 ([100])
16	Number of nationalities in Horizon 2020, applicants and beneficiaries	Number of nationalities of Horizon 2020 applicants and beneficiaries	No	42 ([101])
17	Total amount of EU financial contributions, by Member State	Nationalities of Horizon 2020 beneficiaries and corresponding EU financial contribution	No	Austria: EUR 17 072 264 Belgium: EUR EUR 11 799 477 Bulgaria: EUR 56 300 Croatia: EUR 1 701 674 Cyprus: EUR 100 188 Czechia: EUR 7 130 234 Denmark: EUR 4 877 903 Estonia: EUR 766 658 Finland: EUR 2 123 570 France: EUR 180 815 444 Germany: EUR 50 137 430 Greece: EUR 898 000 Hungary: EUR 2 916 848 Ireland: EUR 2 834 073 Italy: EUR 646 905 123 Lithuania: EUR 2 914 468 Luxembourg: EUR 423 488 Malta: EUR 185 859 Netherlands: EUR 13 403 692 Poland: EUR 7 570 688 Portugal: EUR 1 091 800 Romania: EUR 0 Slovakia: EUR 1 520 961 Slovenia: EUR 269 538 Spain: EUR 93 538 178 Sweden: EUR 17 476 637 United Kingdom: EUR 35 621 193 ([103])
18	Number of nationalities in Horizon 2020, applicants and beneficiaries (associated countries)	Number of nationalities of Horizon 2020 applicants and beneficiaries (associated countries)	No	6 (Iceland, Israel, Norway, Serbia, Switzerland, Türkiye) ([102])
19	Total amount of EU financial contributions, by associated country	Nationalities of Horizon 2020 beneficiaries and corresponding EU financial contribution	No	Iceland: EUR 362 950 Israel: EUR 591 409 Norway: EUR 9 022 222 Serbia: EUR 1 227 986 Switzerland: EUR 13 580 732 Türkiye: EUR 1 603 625 ([103])

([99]) Data not provided by the SESAR 3 JU are provided by beneficiaries through project reporting.

([100]) Data refer to calls H2020-SESAR-2015-01, H2020-SESAR-2015-02, H2020-SESAR-2016-01, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2019-02, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016, 2017, 2018, 2019, 2020 or 2022, as of 2015–2022.

([101]) Cumulative amounts refer to calls H2020-SESAR-2015-01, H2020-SESAR-2015-02, H2020-SESAR-2016-01, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2019-02, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016, 2017, 2018, 2019, 2020 or 2022. There were no projects with a start date in 2022.

([102]) Cumulative data refer to calls H2020-SESAR-2020-01 and H2020-SESAR-2020-02.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([99])	Cumulative value for SESAR 2020 ([100])
20	Proportion of EU financial contribution going to SMEs	Number of Horizon 2020 beneficiaries flagged as SMEs. Percentage of EU contribution going to beneficiaries flagged as SMEs	No	227 SMEs 8 % ([103])
21	Percentage of women in Horizon 2020 projects	Percentage of female participants in Horizon 2020 projects	No	19 % ([103])
22	Percentage of women project coordinators in Horizon 2020	Percentage of female MSc fellows, European Research Council principal investigators and scientific coordinators in other Horizon 2020 activities	No	17 % ([103])
24	Proportion of non-EU country participants in Horizon 2020	Nationalities of Horizon 2020 beneficiaries	No	5 nationalities: Australia, Canada, Cape Verde, Russian Federation, United States Non-EU participants: 35 out of 2 319 (2 %) ([103])
25	Percentage of EU financial contribution assigned to non-EU country participants	Percentage of non-EU Horizon 2020 beneficiaries with EU financial contribution	No	EUR 5.94 million (1 %) ([104])
26	Proportion of projects and EU financial contribution allocated to IAs	Number of IA proposals and projects properly flagged in the work programme; follow-up at grant level	Yes	Number of IA projects: 30 ([105]) Percentage of IA projects out of all projects: 20 % IAs out of overall EU contribution: 19 %
27	Within the IAs, proportion of EU financial contribution focused on demonstration and first-of-a-kind activities	Topics properly flagged in the work programme; follow-up at grant level	Yes	100 % (all IA projects are VLD activities) ([106])

([103]) Amounts refer to calls H2020-SESAR-2015-02, H2020-SESAR-2016-01, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016, 2017, 2018, 2019, 2020 or 2021. There were no projects with a start date in 2022. Data refer to the participation of non-associated, non-EU countries in the programme (an entity can participate more than once).

([104]) Amounts refer to calls H2020-SESAR-2015-01, H2020-SESAR-2015-02, H2020-SESAR-2016-01, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2019-02, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016–2021. There were no projects with a start date in 2022. Data refer to the percentage of the net EU contribution going to non-associated, non-EU countries, out of the total net EU contribution going to projects in the programme.

([105]) Data refer to calls H2020-SESAR-2015-02, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016–2021. There were no projects with a start date in 2022.

([106]) Amount refers to calls H2020-SESAR-2015-02, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016–2021. There were no projects with a start date in 2022.

No	Horizon 2020 KPI	Definition	Data provided by the SESAR 3 JU? ([99])	Cumulative value for SESAR 2020 ([100])
28	Scale of impact of projects (high TRL)	Number of projects between TRL4 and TRL6 or between TRL5 and TRL7	Yes	Projects up to TRL2 or equivalent operational concept maturity level (exploratory research): 85 Projects at TRL2 to TRL6 or equivalent operational concept maturity level: 30 Projects at TRL6 or TRL7 or equivalent operational concept maturity level: 35 Projects address transversal activities (i.e. non-directly TRL or operational-concept-related activities): 6
29	Percentage of Horizon 2020 beneficiaries from the private for-profit sector	Number and percentage of total Horizon 2020 beneficiaries classified by type of activity and legal status	Yes	PRC: 1 587 out of 2 317 (68 %) ([107]) IR: 1 044 out of 1 366 (76 %) VLD: 340 out of 449 (76 %)
30	Proportion of EU financial contribution going to private for-profit entities (enabling and industrial technology and Part III of Horizon 2020)	Horizon 2020 beneficiaries classified by type of activity and corresponding EU contribution	Yes	EUR 398 465 063 for PCR out of EUR 548 857 950 (all entity types) (73 %) ([108])
33	Dissemination and outreach activities other than publications in peer-reviewed journals	Type of dissemination activity can be chosen from a drop-down list. Number of events, funding amount and number of people reached thanks to the dissemination activities	No	Events: 848 Open days: 177 Other media: 217 Publications: 286 Social media: 177
36	Participation of research and technology organisations and universities in public–private partnerships	Number of participations of research and technology organisations in funded projects, and percentage of the total Number of participations of universities in funded projects and percentage of the total Percentage of budget allocated to research and technology organisations and to universities	Yes	379 research institutions out of 2 317 (all entity types) (16 %) 196 higher education institutions out of 2 317 (all entity types) (8 %) Budget allocated to research and technology organisations and to universities: 17 % ([10])

([107]) Amounts refer to calls H2020-SESAR-2019-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016–2021. There were no projects with a start date in 2022.

([108]) Amounts refer to calls H2020-SESAR-2015-01, H2020-SESAR-2015-02, H2020-SESAR-2016-01, H2020-SESAR-2016-02, H2020-SESAR-2019-01, H2020-SESAR-2019-02, H2020-SESAR-2020-01 and H2020-SESAR-2020-02 referring to projects with a start year of 2016–2021. There were no projects with a start date in 2022.

4. Scoreboard of general Horizon Europe key impact pathway indicators (based on Annex V of Regulation 2021/695/EU)

Not applicable, as no Digital European Sky projects were financed in 2022.

5. Horizon Europe common Joint Undertakings key performance indicators (based on the Commission experts' interim report published on 21 June 2021, Section 5 and Appendix 1)

Not applicable, as no Digital European Sky projects were financed in 2022.

6. Scoreboard of key performance indicators specific to the SESAR 3 Joint Undertaking

SESAR 2020 programme

TABLE 37: **KPIS SPECIFIC TO THE SESAR 3 JU – 2021 AND 2022**

No	Horizon 2020 KPI	Definition	Value in 2021	Value in 2022	Target by 2024
40	Public–private partnerships leverage: in-kind contributions committed by private members to SESAR 2020 projects selected for funding	Ratio of private to public funding in all project types (see Section 2.4 for an explanation)	**Programme leverage results:** Method 1 (interim evaluation): 0.87 Method 2 (EU body leverage): 0.92 Method 3 (Horizon 2020): 1.92 **Partnership leverage result: 1.65** ([109])	**Programme leverage estimates:** Method 1 (interim evaluation): 1.03 Method 2 (EU body leverage): 1.08 Method 3 (Horizon 2020): 2.08 **Partnership leverage estimate: 1.62** ([110])	Programme targets Method 1 (interim evaluation): 1.40 Method 2 (EU body leverage): 1.44 Method 3 (Horizon 2020): 2.44 **Partnership leverage: 1.95**
41	Completion of SESAR 2020 programme	Actual versus planned percentage of each project that had been completed as of the end of the reporting period	10 calls for proposals completed of the 10 planned at the end of 2021 84 grants completed and 2 terminated 70 grants active	No calls for proposals in 2022 50 grants completed 20 grants active	100 %
42	Delivery of SESAR 2020 solutions	Solutions ready for pre-industrialisation (V3/TRL6) ([111]) as a percentage of those in the plan ([112])	67 %	88 %	100 %

Digital European Sky programme

Not applicable, as no Digital European Sky projects were financed in 2022.

([109]) The 2021 CAAR reported an estimated value for 2021. Following receipt of validated financial figures from the members of the SESAR 3 JU, the 2021 value has been updated to its final approved version.

([110]) 2022 estimated values are subject to receipt of validated financial figures from the members of the SESAR 3 JU, in line with the reporting cycle, and will be reported in the 2023 CAAR. Collectively, members from the industry have exceeded their target contribution, established at the outset of the programme and documented in the membership agreement. More details are provided in Section 1.7.3.

([111]) As per the close-out reports for releases 7–12.

([112]) Plans for releases 7–13.

7. Assessment of the internal control system

TABLE 38: **ASSESSMENT OF THE SESAR 3 JU INTERNAL CONTROL SYSTEM IN 2022**

ID	Control description	Type	Target **	Measured value[113]	Measurement frequency	Date of latest measurement
CONTROL ENVIRONMENT						
1. The SESAR 3 JU demonstrates a commitment to integrity and ethical values						
C1P01-01	% of managers/staff who participated in the SESAR 3 JU corporate training in ethics	Minimum %	1	94	Yearly	31.12.2022
C1P01-02	An annual reminder about declaring conflicts of interest was sent to all managers and staff	Score (0–3)	3	3	Yearly	31.12.2022
C1P01-03	A code of conduct / ethical guidance exists and all staff members have access to it in the information and document management system	Score (0–3)	3	3	Yearly	31.12.2022
2. The board demonstrates independence from management and exercises oversight of the development and performance of internal control						
C1P02-01	The SESAR 3 JU provides information and regularly participates in coordination mechanisms so that the Commission, and in particular the Directorate-General for Mobility and Transport, exercises effective oversight of the SESAR 3 JU activities	Score (0–3)	3	3	Quarterly	31.12.2022
C1P02-02	GB meetings regularly deal with the topics of risk management, risk allocation and internal control	Score (0–3)	3	3	Yearly	31.12.2022
C1P02-03	Management staff have a clear view of the specific activities they are responsible for, in compliance with their job description, and keep track of main issues identified	Score (0–3)	3	3	Weekly	31.12.2022
C1P02-04	The Director in charge of risk management and internal control signs Appendix 3 — Statement of the Director in charge of risk management and internal control. A declaration of Assurance (Appendix 2 of ICF) is signed annually by the AO.	Score (0–3)	3	3	Yearly	31.12.2022
3. Management establishes, with political oversight, structures, reporting lines and appropriate authorities and responsibilities in the pursuit of objectives						
C1P03-01	Clear management structures are established and implemented at every level of the organisation, notably roles and tasks are clearly defined in the financial circuits The supervisory activities focus particularly on high-risk areas	Score (0–3)	3	3	Quarterly	31.12.2022

([113]) Colour shading of cells based on measured value figures: green – measured value equals the target, yellow – measured value is slightly less than target but not 0, red – measured value is well below target or is 0

ID	Control description	Type	Target **	Measured value[113]	Measurement frequency	Date of latest measurement
C1P03-02	Each job in the SESAR 3 JU is linked with SESAR 3 JU's objectives and priorities	Score (0–3)	3	3	Yearly	31.12.2022
C1P03-03	Managers have a clear view of the activities within their teams and keep track of main issues identified through regular team meetings	Score (0–3)	3	3	Half-yearly	31.12.2022
4. The SESAR 3 JU demonstrates a commitment to attracting, developing and retaining competent individuals in alignment with objectives						
C1P04-02	The catalogue of training course sessions takes into account the skills needed at SESAR 3 JU level in accordance with the learning and development policy	Score (0–3)	3	3	Yearly	31.12.2022
C1P04-03	The SESAR 3 JU complies with the rules on promotion within the organisation, and vacancies are open to internal candidates	Score (0–3)	3	3	Yearly	31.12.2022
5. The SESAR 3 JU holds individuals accountable for their internal control responsibilities in the pursuit of objectives						
C1P05-01	The SESAR 3 JU implements a career development review for SESAR 3 JU staff where: mutual expectations are set and responsibilities are clearly allocated performance is reviewed and assessed on a yearly basis reclassification is decided	Score (0–3)	3	3	Yearly	31.12.2022
RISK ASSESSMENT						
6. The SESAR 3 JU specifies objectives with sufficient clarity to enable the identification and assessment of risks relating to objectives						
C2P06-01	Number of critical and very important recommendations from internal auditors	Maximum number	1	0	Yearly	31.12.2022
C2P06-02	Number of financial/non-financial exceptions and non-compliance events	Maximum number	4	3	Yearly	31.12.2022
C2P06-03	The SESAR 3 JU has a mission statement, clearly stated in a formalised document and easily accessible to all	Score (0–3)	3	3	Yearly	31.12.2021
C2P06-04	The BAWP clearly states the order of priorities among the main tasks in case of significant changes	Score (0–3)	3	3	Yearly	31.12.2022
C2P06-05	The SESAR 3 JU monitors the achievement of objectives through the indicators; management ensures that all abnormalities in the progress of the objectives' achievement are reported when appropriate	Score (0–3)	3	2	Quarterly	31.12.2022
7. The SESAR 3 JU identifies risks to the achievement of its objectives across the organisation and analyses risks as a basis for determining how the risks should be managed						
C2P07-01	Management regularly reviews progress towards the specific objectives, and strategic and operational risks in the SESAR 3 JU are identified/assessed at the appropriate level	Score (0–3)	3	2	Half-yearly	31.12.2022

ID	Control description	Type	Target **	Measured value[113]	Measurement frequency	Date of latest measurement
C2P07-02	Management puts mitigation plans in place for the risks identified in the risk register, and regularly monitors their implementation	Score (0–3)	3	2	Half-yearly	31.12.2022
8. The SESAR 3 JU considers the potential for fraud in assessing risks to the achievement of objectives						
C2P08-01	The SESAR 3 JU has an up-to-date anti-fraud strategy (not older than 3 years), which is based on a stand-alone risk assessment	Score (0–3)	3	3	Yearly	31.12.2022
C2P08-02	Number of opened and ongoing OLAF cases during the reporting year	Maximum number	0	0	Yearly	31.12.2022
C2P08-03	The SESAR 3 JU informs its staff about the rules relating to conflicts of interest, fraud prevention and reporting of irregularities	Score (0–3)	3	3	Yearly	31.12.2022
9. The SESAR 3 JU identifies and assesses changes that could significantly impact the internal control system						
C2P09-01	A procedure exists for updating the objectives to take into account significant changes in activities and priorities	Score (0–3)	3	3	Quarterly	31.12.2022
CONTROL ACTIVITIES						
10. The SESAR 3 JU selects and develops control activities that contribute to the mitigation of risks to the achievement of objectives to acceptable levels						
C3P10-01	A control strategy exists and has been reviewed/updated, and staff have been made aware of it	Score (0–3)	3	3	Yearly	31.12.2022
C3P10-02	Number of business continuity exercises performed during the year for which lessons learnt are documented and implemented	Minimum number	0	0	Yearly	31.12.2022
C3P10-03	Number of security exercises performed during the year for which lessons learnt are documented and implemented	Minimum number	1	0	Yearly	31.12.2022
C3P10-04	ABAC access rights are reviewed once a year	Score (0–3)	3	3	Yearly	31.12.2022
C3P10-05	A list of critical functions exists	Score (0–3)	3	3	Yearly	31.12.2022
C3P10-06	The SESAR 3 JU has a business continuity plan	Score (0–3)	3	3	Yearly	31.12.2022
11. The SESAR 3 JU selects and develops general control activities relating to technology to support the achievement of objectives						
C3P11-01	Number of IT security incidents reported during the year with an impact on the confidentiality, integrity or availability of information systems	Maximum number	0	0	Monthly	31.12.2022
C3P11-02	Statistics on system downtime, server capacity and other performance indicators are regularly analysed System performance issues are reported to the appropriate management level	Score (0–3)	3	3	Monthly	31.12.2022

ID	Control description	Type	Target **	Measured value[113]	Measurement frequency	Date of latest measurement
C3P11-03	Feedback from IT users regarding system performance is collected and analysed	Score (0–3)	3	3	Yearly	31.12.2022
C3P11-04	The SESAR 3 JU has defined and operates an appropriate procedure for the management of the information systems it uses (generally in the form of an IT steering committee) Each information system owned by the SESAR 3 JU possesses a clearly identified business owner (and is overseen by a steering committee) The IT steering committee takes appropriate action if necessary	Score (0–3)	3	3	Quarterly	31.12.2022
12. The SESAR 3 JU deploys control activities through corporate policies that establish what is expected and through procedures that put policies into action						
C3P12-01	Exceptions and non-compliance events are systematically reported in the exception register in accordance with defined and documented procedures	Score (0–3)	3	3	Yearly	31.12.2022
C3P12-02	A policy, processes and procedures for information security exist and staff have been made aware of them	Score (0–3)	3	3	Yearly	31.12.2022
C3P12-03	A policy, processes and procedures for Document Managementdocument management exist and staff have been made aware of them	Score (0–3)	3	3	Yearly	31.12.2022
C3P12-04	A policy, processes and procedures for Data Protectiondata protection exist and staff have been made aware of them	Score (0–3)	3	3	Yearly	31.12.2022
C3P12-05	A policy, processes and procedures for public access to documents exist and staff have been made aware of them	Score (0–3)	3	3	Yearly	31.12.2022
C3P12-06	Appropriate control procedures are in place for the SESAR 3 JU's main operational and financial processes and for the main ICT systems and services	Score (0–3)	3	3	Yearly	31.12.2022
C3P12-07	The main SESAR 3 JU processes are defined, described/documented and applied in practice	Score (0–3)	3	1	Half-yearly	31.12.2022
INFORMATION AND COMMUNICATION						
13. The SESAR 3 JU obtains or generates and uses relevant quality information to support the functioning of internal control						
C4P13-01	The SESAR 3 JU implements a quality policy and quality manual that includes reference to internal control and its monitoring	Score (0–3)	3	2	Yearly	31.12.2022
14. The SESAR 3 JU internally communicates information, including objectives and responsibilities for internal control, necessary to support the functioning of internal control						
C4P14-01	The SESAR 3 JU has an internal communication strategy in place	Score (0–3)	3	3	Yearly	31.12.2022

ID	Control description	Type	Target **	Measured value[113]	Measurement frequency	Date of latest measurement
C4P14-02	Team meetings and Staff Briefingsstaff briefings regularly take place to share information within the teams at various levels	Score (0–3)	3	3	Quarterly	31.12.2022
C4P14-03	Arrangements are in place to ensure that management and staff are informed of other units', departments' or the SESAR 3 JU's decisions/ projects/initiatives that may affect their responsibilities and tasks	Score (0–3)	3	2	Half-yearly	31.12.2022
15. The SESAR 3 JU communicates with external parties about matters affecting the functioning of internal control						
C4P15-01	Communication activities are aligned with the European Commission's political priorities	Score (0–3)	3	3	Half-yearly	31.12.2022
C4P15-02	The Chief External Affairs and Communication submits communication planning proposals to the corporate management team for approval	Score (0–3)	3	3	Yearly	31.1.2022
C4P15-03	An external communication strategy and implementation plan exist	Score (0–3)	3	3	Yearly	31.10.2022
MONITORING ACTIVITIES						
16. The SESAR 3 JU selects, develops and performs ongoing and/or separate assessments to ascertain whether the components of internal control are present and functioning						
C5P16-01	Specific and continuous assessment exercises have been coordinated horizontally in the context of the internal control framework	Score (0–3)	3	3	Yearly	31.12.2022
C5P16-02	The SESAR 3 JU performs regular staff surveys (every 2–3 years) to monitor the commitment and satisfaction of staff	Score (0–3)	3	3	Yearly	31.12.2022
17. The SESAR 3 JU assesses and communicates internal control deficiencies in a timely manner to those parties responsible for taking corrective action, including senior management, as appropriate						
C5P17-01	The results of the continuous and specific assessment have been discussed with senior management and the GB	Score (0–3)	3	3	Yearly	28.2.2022
C5P17-02	The results of the continuous and specific assessment of internal control have been properly disclosed in the CAAR	Score (0–3)	3	3	Yearly	31.12.2022

** 0 – not implemented,1 – limited implementation,2 – implementation in progress,3 – fully implemented

8. Statement of the manager in charge of risk management and internal control

I, the undersigned,

Manager in charge of risk management and internal control within the SESAR 3 JU,

In my capacity as manager in charge of risk management and internal control, declare that in accordance with the SESAR 3 JU's internal control framework, I have reported my advice and recommendations on the overall state of internal control in the joint undertaking to the Executive Director.

I hereby certify that the information provided in the present CAAR and in its annexes is, to the best of my knowledge, accurate, reliable and complete.

Brussels, 26 June 2023

(Signed)

Peter Hotham

Deputy Executive Director

Manager in charge of risk management and internal control

SESAR 3 JU

9. In-kind contributions to additional activities report

Overview amount of IKAA for 2022 EUROCONTROL (amounts to be reported by 31 May 2023)						
AA category ([1])	**Brief description of the AA ([2])**	**Link to JU objectives/ KPIs ([3]) (IKAA at programme level)**	**Link to JU project/ topic (IKAA at project level; reference / name of project)**	**Estimated total in-kind contributions linked to this AA (if on several years)**	**Certified IKAA (EUR)**	**Reported IKAA with pending certification (EUR)**
	1. Support to additional R & I					
				3 100 000	3 090 000	0
	2. Scale up of technologies					
				2 500 000	2 309 000	2 309 0000
	3. Demonstrators					
				20 000	0	0
	4. Creating new business opportunities					
				0	0	0
	5. Training and skills development					
				0	0	0
	6. Contribution to the development of new standards, regulations and policies					
				900 000	779 000	0
	7. Supporting ecosystem development					
				820 000	764 000	0
	8. Communication, dissemination, awareness raising and citizen engagement					
				60 000	22 000	0
	9. Others					
				0	0	0
Total					**6 964 000**	**0**
Total IKAA						**6 964 000**

Overview amount of IKAA for 2022 All other Members (amounts to be reported by 31 May 2023)						
AA category (1)	**Brief description of the AA (2)**	**Link to JU objectives/ KPIs (3) (IKAA at programme level)**	**Link to JU project/ topic (IKAA at project level; reference /name of project)**	**Estimated total in-kind contributions linked to this AA (if on several years)**	**Certified IKAA (EUR)**	**Reported IKAA with pending certification (EUR)**
	1. Support to additional R & I					
				109 800	0	177 000
	2. Scale up of technologies					
				45 631 000	7 138 000	23 312 000
	3. Demonstrators					
				581 000	0	499 000
	4. Creating new business opportunities					
				0	0	0
	5. Training and skills development					
				0	0	0
	6. Contribution to the development of new standards, regulations and policies					
				131 000	17 000	1 766 000
	7. Supporting ecosystem development					
				13 116 000	174 000	10 703 000
	8. Communication, dissemination, awareness raising and citizen engagement					
				168 000	413 000	71 000
	9. Others					
				8 942 000	0	6 399 000
Total					**7 742 000**	**42 928 000**
Total IKAA						**50 670 000**

NB: AA, additional activities.

Total IKAA 2022: breakdown per country	
Country (code)	Value (EUR)

Total IKAA 2021 – 2022 (evolution (EUR))			
Member	**Planned IKAA**	**Reported IKAA with pending certification**	**Certified IKAA**
EUROCONTROL	7 400 000	0	6 964 000
Other Members	68 678 000	42 928 000	7 742 000
Total	**76 078 000**	**42 928 000**	**14 706 000**

10. Final annual accounts

The tables below represent an extract of the final accounts of the SESAR 3 JU for 2022, which were handed over, as a separate document, to the budgetary authorities, the ECA and the external auditors. The final accounts of the SESAR 3 JU for 2022 shall be transmitted to the budgetary authorities by 1 July 2023.

Balance sheet

			EUR '000
	Note	31.12.2022	31.12.2021
NON-CURRENT ASSETS			
Intangible assets	2.1	-	1
Property, plant and equipment	2.2	102	142
Pre-financing	2.3	-	7 233
		102	**7 376**
CURRENT ASSETS			
Pre-financing	2.3	10 492	84 240
Exchange receivables and non-exchange recoverables	2.4	109 045	54 058
Cash and cash equivalents	2.5	9	4
		119 546	138 303
TOTAL ASSETS		**119 648**	**145 679**
CURRENT LIABILITIES			
Short Term provisions	2.6	1 534	-
Payables and other liabilities	2.7	175 731	97 182
Accrued charges	2.8	28 099	35 651
		205 364	132 834
TOTAL LIABILITIES		**205 364**	**132 834**
Contribution from Members	2.9	2 776 716	2 686 079
Accumulated deficit		(2 673 234)	(2 497 254)
Economic result of the year		(189 198)	(175 979)
NET ASSETS		**(85 716)**	**12 845**
TOTAL NET ASSETS AND LIABILITIES		**119 648**	**145 679**

Statement of financial performance

			EUR '000
	Note	2022	2021
REVENUE			
Revenue from non-exchange transactions			
Recovery of operating expenses	3.1	1 359	–
		1 359	-
Revenue from exchange transactions			
Financial revenue		0	5
		0	5
Total revenue		**1 359**	**5**
EXPENSES			
Operational costs	3.2	(180 510)	(168 684)
Staff costs	3.3	(4 532)	(4 340)
Finance costs	3.4	(15)	(32)
Other expenses	3.5	(5 500)	(2 929)
Total expenses		**(190 577)**	**(175 985)**
ECONOMIC RESULT OF THE YEAR		**(189 198)**	**(175 979)**

Cash flow statement

		EUR '000
	2022	2021
Economic result of the year	(189 198)	(175 979)
Operating activities		
Depreciation and amortization	54	64
(Increase)/decrease in pre-financing	80 982	41 481
(Increase)/decrease in exchange receivables and non-exchange recoverables	(54 986)	(35 467)
Increase/(decrease) in payables	78 549	(2 982)
Increase/(decrease) in accrued charges	(7 552)	(10 936)
Increase/(decrease) in cash contributions	5 809	97 193
Increase/(decrease) in in-kind contributions	84 828	86 630
Other non-cash movements	1 534	–
Investing activities		
(Increase)/decrease in intangible assets and property, plant and equipment	(14)	(9)
NET CASHFLOW	**5**	**(6)**
Net increase/(decrease) in cash and cash equivalents	5	(6)
Cash and cash equivalents at the beginning of the year	4	10
Cash and cash equivalents at year-end	9	4

NB: The SESAR 3 JU treasury was integrated into the Commission's treasury system. Because of this, the SESAR 3 JU has only one bank account of its own, which covers the bank guarantee issued for the rental of the SESAR 3 JU premises. All payments and receipts are processed via the Commission's treasury system and registered on intercompany accounts, which are presented under the heading exchange receivables.

Statement of changes in net assets

				EUR '000
	Contribution from Members	Accumulated Surplus/ (Deficit)	Economic result of the year	Net Assets
BALANCE AS AT 31.12.2020	**2 502 255**	**(2 360 667)**	**(136 588)**	**5 001**
Allocation 2020 economic result	–	(136 588)	136 588	-
Cash contribution	43 814		-	43 814
Contribution in-kind	86 630	-	-	86 630
Economic result of the year	53 379	-	-	53 379
Unpaid cash contributions	–		(175 979)	(175 979)
BALANCE AS AT 31.12.2021	**2 686 079**	**(2 497 254)**	**(175 979)**	**12 845**
Allocation 2021 economic result	-	(175 979)	175 979	-
Cash contribution	57 335		-	57 335
Contribution in-kind	84 828	-	-	84 828
Unpaid cash contributions	(51 895)		-	(51 895)
Economic result of the year	-	-	(189 198)	(189 198)
BALANCE AS AT 31.12.2022	**2 776 716**	**(2 673 234)**	**(189 198)**	**(85 716)**

11. Materiality criteria

The assessment of the effectiveness of the SESAR 3 JU control system for Horizon 2020 grants is based mainly, but not exclusively, on the results of *ex post* audits. Effectiveness is expressed in terms of detected and residual error rates, calculated using a representative sample on an annual basis and on a multiannual basis.

The starting point for determining the effectiveness of the controls in place is the cumulative level of error, expressed as the percentage of errors in favour of the SESAR 3 JU, detected by *ex post* audits, measured with respect to the amounts accepted after *ex ante* controls.

To take into account the impact of the *ex post* controls, this error level is adjusted by subtracting:

- errors detected and corrected as a result of the implementation of audit conclusions;
- errors corrected as a result of the extension of audit results to non-audited contracts with the same beneficiary.

This results in a residual error rate, which is calculated as follows:

$$\mathrm{Re}\,sER\% = \frac{(\mathrm{Re}\,pER\% * (P - A)) - (\mathrm{Re}\,pERsys\% * E)}{P}$$

where:

- **Re*sER%*** represents the residual error rate, expressed as a percentage;
- **Re*pER%*** represents the representative error rate, or error rate detected in the representative sample, in the form of a weighted average error rate, expressed as a percentage and calculated as described below;
- **Re*pERsys%*** represents the portion of the RepER% representing negative systematic errors, expressed as a percentage;
- ***P*** represents the total requested SESAR contribution (EUR) in the auditable population (i.e. all paid financial statements);
- ***A*** represents the total requested SESAR contribution (EUR), as approved by financial officers, of all audited financial statements (this is collected from audit results);
- ***E*** represents the total non-audited requested SESAR contribution (EUR) of all audited beneficiaries.

The representative error rate is established as a weighted average error rate identified for an audited representative sample.

The weighted average error rate is calculated according to the following formula:

$$\mathrm{Rep}ER\% = \frac{\Sigma(er)}{A}$$

where:

- **∑(*er*)** represents the sum of all individual errors of the sample – only the errors in favour of the JU will be taken into consideration;
- ***A*** represents the total amount (EUR) of the audited sample.

Multiannual approach

As a result of the multiannual nature of the SESAR 3 JU, the effectiveness of its controls can be fully measured and assessed only in the final stages of the programme's lifetime, once the *ex post* audit strategy has been fully implemented and systematic errors have been detected and corrected.

The control objective is to ensure, for the SESAR Horizon 2020 programme, that the residual error rate, which represents the level of errors that remain undetected and uncorrected, does not exceed 2 % of the total expense recognised until the end of the programme..

If the residual error rate is higher than 5 %, a reservation should be made and an additional action plan should be drawn up.

These thresholds are consistent with those established by the Commission and by the ECA for its annual assessment of the effectiveness of the control systems operated by the Commission.

Notwithstanding the multiannual span of the control strategy, the Executive Director is required to sign a statement of assurance for each financial year. In order to determine whether this statement of assurance should be qualified with a reservation, the effectiveness of the control systems in place needs to be assessed not only for the year of reference, but also from a multiannual perspective, to determine whether it is possible to reasonably conclude that the control objective will be met in the future as planned.

In view of the crucial role of *ex post* audits, this assessment needs to check, in particular, whether the scope and results of the *ex post* audits carried out until the end of the reporting period are sufficient and adequate, respectively, to meet the multiannual control strategy goals.

Adequacy of the scope

The adequacy of the scope of the (cumulative) audit effort carried out until the end of each year is to be measured by comparing the planned with the actual volume of audits completed.

The data are to be shown per year and cumulated, in line with the current annual activity report presentation of error rates.

The Executive Director should form a qualitative opinion to determine whether deviations from the plan are of such significance that they seriously endanger the achievement of the control objective for the programmes. If this were the case, the Executive Director would be expected to qualify their annual statement of assurance with a reservation.

Audit coverage: SESAR-specific Horizon 2020 audits

By the end of 2022, the SESAR 3 JU had audited 115 participations, covering 15.2 % of its Horizon 2020 expenditure to date. This percentage refers to the value of the participations of the audited beneficiaries, also referred to as the 'direct' coverage. The non-audited participations of the audited beneficiaries, also referred to as the 'indirect' coverage, which after the full treatment of audit results are considered clean from systemic errors, are calculated as 86.6 %.

12. Abbreviations

Acronym or abbreviation	Definition
ABAC	attribute-based access control
ACI	Airports Council International
ADS-B	automatic dependent surveillance – broadcast
AI	artificial intelligence
A-PNT	alternative position, navigation and timing
ATC	air traffic control
ATCO	air traffic controller
ATM	air traffic management
ATSU	air traffic service unit
AURI	audit result implementation
BAWP	biannual work programme
CAAR	consolidated annual activity report
CANSO	Civil Air Navigation Services Organisation
CEF	Connecting Europe Facility
CINEA	European Climate, Infrastructure and Environment Executive Agency
CNS	communications, navigation and surveillance
DAS	Declaration of Assurance
DFMC	dual-frequency multiconstellation
DSD	Digital Sky Demonstrator
EASA	European Union Aviation Safety Agency
ECA	European Court of Auditors
ECHO	European concept of operations for higher airspace operations
EDA	European Defence Agency
EDPS	European Data Protection Supervisor
EUROCAE	European Organisation for Civil Aviation Equipment
EUROCONTROL	European Organisation for the Safety of Air Navigation
eVTOL	electric vertical take-off and landing
FAA	Federal Aviation Administration (United States)
GANP	global air navigation plan
GB	Governing Board of the SESAR 3 Joint Undertaking
GBAS	ground-based augmentation system
GNSS	global navigation satellite system
IAC	Internal Audit Capability
IAS	Internal Audit Service
ICAO	International Civil Aviation Organization
ICT	information and communications technology

IFR	instrument flight rules
IKAA	in-kind contributions to additional activities
INS	inertial navigation system
IR	industrial research and validation
IT	information technology
JU	joint undertaking
KPI	key performance indicator
MAWP	multiannual work programme
MoC	memorandum of cooperation
MP	master planning
OLAF	European Anti-Fraud Office
PhD	Doctor of Philosophy
R & I	research and innovation
RPAS	remotely piloted aircraft system
SBA	Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and repealing Regulations (EC) No 219/2007, (EU) No 557/2014, (EU) No 558/2014, (EU) No 559/2014, (EU) No 560/2014, (EU) No 561/2014 and (EU) No 642/2014 (OJ L 427, 30.11.2021, p. 17) (single basic act)
SC	Scientific Committee, established in accordance with Article 154 of Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and repealing Regulations (EC) No 219/2007, (EU) No 557/2014, (EU) No 558/2014, (EU) No 559/2014, (EU) No 560/2014, (EU) No 561/2014 and (EU) No 642/2014 (OJ L 427, 30.11.2021, p. 17)
SESAR	Single European Sky ATM Research
SESAR 2020	Single European Sky ATM Research 2020 (this R & I programme is the coordinated set of activities described in this document, undertaken by the SESAR JU members and managed by the SESAR JU)
SESAR 3 JU	Single European Sky ATM Research 3 Joint Undertaking
SESAR JU	Single European Sky ATM Research Joint Undertaking, established as a joint undertaking within the meaning of Article 187 of the Treaty on the Functioning of the European Union, established under Council Regulation (EC) No 219/2007 of 27 February 2007 on the establishment of a joint undertaking to develop the new generation European air traffic management system (SESAR) (OJ L 64, 2.3.2007, p. 1), as amended by Council Regulation (EC) No 1361/2008 of 16 December 2008 amending Regulation (EC) No 219/2007 on the establishment of a joint undertaking to develop the new generation European air traffic management system (SESAR) (OJ L 352, 31.12.2008, p. 12) and by Council Regulation (EU) No 721/2014 of 16 June 2014 amending Regulation (EC) No 219/2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR) as regards the extension of the Joint Undertaking until 2024 (OJ L 192, 1.7.2014, p. 1)
SLA	service-level agreement
SMEs	small and medium-sized enterprises
SRAP	second runway aiming point
SRG	States' Representatives Group
SWIM	system-wide information management
TBO	trajectory-based operation
TMA	terminal manoeuvring area
TRL	technology readiness level

UAM	urban air mobility
UAS	unmanned aerial system
U-space	A set of new services relying on a high level of digitalisation and automation of functions, and on specific procedures, designed to support safe, efficient and secure access to airspace for a large number of drones, with an initial focus on very low-level operations
V	validation phase
VHF	very high frequency
VLD	very large-scale demonstration

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Publications Office
of the European Union

PDF ISBN 978-92-9216-193-4 ISSN 2467-4133 doi:10.2829/737820 MG-AF-23-001-EN-N