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

Mid-term evaluation of the Copernicus programme (2014-2020)

{SWD(2017) 347 final}

INTRODUCTION

This report highlights the key findings of the mid-term evaluation of the European Earth monitoring programme, Copernicus, three years into its implementation. The report is based on an external study¹ carried out on behalf of the Commission to respond to the obligation imposed by Article 32 of the Copernicus Regulation². The evaluation provides valuable insight for the second half of the programme implementation and for defining the approach to future Copernicus initiatives.

The Commission has launched this exercise not only to assess the benefits and achievements of the Copernicus programme, but also to verify how adequate its original objectives still are, and how the programme may better respond to new challenges and ambitions, considering that in the past few years the overall political, societal, scientific and economic environment has dramatically changed. The Space Strategy³ for Europe approved last year, of which Copernicus is one of the pillars, has already outlined the main priorities for the future of EU space activities and will inspire future developments.

The emergence of a new space economy has undoubtedly been a driver of change, but it is mostly the advent of a hyper-connected information society and digital economy that calls for a re-alignment of priorities and perspectives: data are changing our lives in many domains. The combination of big space data with digital technologies and cloud computing are opening up exciting new business opportunities for companies using these data to develop innovative products, services and applications. We look at a system of actionable geo-referenced data and information, feeding and sustaining endless applications. Copernicus geospatial-intelligence⁴ is, in fact already a driver of the 4.0 society. The objectives of the programme will, therefore, need to reflect these societal updates and, while ensuring the existing achievements, provide ground for development in areas like security while promoting economic growth.

That is why this evaluation report adopts a new approach, following the data value chain of Copernicus: from the data gathering and processing to the data and information distribution, to user and market uptake dynamics. This new approach reflects the changing reality of Copernicus which in just a couple of years has become one of the biggest providers of Earth Observation data in the world and engine for Europe's digital economy. From a simple, although unique, Earth observation tool, Copernicus is becoming a dynamic geospatial-intelligence system.

¹ PwC "Interim evaluation of Copernicus", ET-04-17-742-EN-N

² REGULATION (EU) No 377/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 3 April 2014 establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010

³ COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Space Strategy for Europe, COM (2016) 0705 final

⁴ Geospatial Intelligence is meant as intelligence about the human activity on earth derived from the exploitation and analysis of imagery and geospatial information that describes, assesses and visually depicts physical features and geographically referenced activities on the Earth. It consists of imagery, imagery intelligence and geospatial information.

From the success of its data provision infrastructure, to the accuracy of the data distributed according to a free, full and open data policy, to the huge potential for commercial applications, Copernicus has already shown its value and earned recognition for the EU on the international scene. It supports policies and applications in climate change and environment, maritime safety and security, agriculture, disaster management, urban planning and infrastructure. It helps civil authorities to save lives in emergency circumstances, such as earthquakes, forest fires or floods. The programme fosters international cooperation and contributes to global initiatives like the Global Earth Observation System of Systems (GEOSS) and the Committee on Earth Observation Satellites (CEOS).

This report is accompanied by a staff working document providing more details and references to the study on which it is based. The study itself included a series of consultations with stakeholders, the results of which are reflected in the final analysis of the various components of the programme.

The evaluation covers, as expected, only the first 3 years of operation of Copernicus. Even in this short period of time all objectives established in the Regulation have been met, to a various degree of achievement. The infrastructure and the services are set up as planned in a satisfactory way. Some implementation aspects related to the creation of market applications or even user uptake are still too early to be properly assessed as they depend on the provision of raw data that first arrived, as by default operation, months after the launches of the Sentinels. An excellent execution of the allocated budget and a satisfactory progress in user uptake complete the picture of a healthy and dynamic programme. The complexity of the interaction among the programme's clusters (space infrastructures, services supply and users' access) has, however, highlighted the need for a simplification of procedures and governance models, to deliver the best results in terms of industrial policy implementation.

BACKGROUND

Copernicus is the Union programme for Earth observation and monitoring, established in 2014 as a successor to the previous space programme GMES⁵. Its general objectives support the protection of the environment, civil protection and civil security. The programme aims at maximising the socio-economic benefits, ensuring the European independent access to environmental knowledge and fostering the development of a competitive European space and services industry. Copernicus has three key components: a space infrastructure (including satellites and ground equipment for data reception and processing), services for the generation of thematic data and information products and their distribution, and the coordinated access to in-situ data. Most of the operational, project-management, coordination and implementation tasks for the space component have been delegated to the European Space Agency (ESA) and partially to the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), while Services rely on the support of DG JRC⁶ and different Service Operators with whom delegation agreements have been concluded. These include the European Environment Agency (EEA), the European Centre for Medium-Range Weather Forecasting (ECMWF), Mercator Océan, the European Border and Coast Guard Agency (FRONTEX), the European Maritime Safety Agency (EMSA) and the EU Satellite Centre.

⁵ Global Monitoring for Environment and Security -Regulation(EU) No 911/2010 of the European Parliament and of the Council of 22 September 2010 on the European Earth monitoring programme (GMES)

⁶ Joint Research Centre Directorate General that provides precious technical support and solutions for Copernicus activities, including research and international aspects.

Copernicus has inherited from GMES a great synergy with the INSPIRE⁷ programme with which it interacts for the operational context of the core services and data distribution platforms. Copernicus conformity with INSPIRE online services and interoperability is mandatory to ensure effective and efficient integration with all other geospatial data resources.

MAIN FINDINGS OF THE EVALUATION

Following the rules for evaluation, the results of the programme implementation have been assessed against the five criteria of effectiveness, efficiency, relevance, coherence (and associated complementarity and cooperation), and EU added value. The assessment has been based on the key performance indicators defined in the Regulation and the various delegation agreements.

Data acquisition

Copernicus acquires its data from various sources: satellites, in-situ sensors and other missions. The space-borne data transmitted by the Sentinels (Copernicus satellites) to the ground segment are complemented by non-space-borne data with a geographic dimension, including observation data from ground-, sea- or air-borne sensors, as well as reference and ancillary data licensed or provided for use in Copernicus from different sources (mainly Member States data sources, or European and international bodies, such as EUMETNET⁸), the so-called "in-situ". The evaluation has confirmed that the space component, delegated to ESA and EUMETSAT, is the most advanced element of the programme, in terms of deployment of the satellites, the volume and quality of data transmitted and processed for further distribution. All the data acquired by the satellites are controlled, calibrated based on in-situ data, and validated before being published, ensuring a homogeneous quality level. Many users perceive this aspect as being the key asset of the Copernicus programme.

At the end of the first quarter of 2017, the Sentinels constellation counts five satellites in orbit performing very well. Only limited delays for two of them have been registered, due to the availability of the launchers: both satellites (Sentinel -3A and Sentinel -2B) were planned to be launched with a Russian Rockot, identified as the most economical option at the time the launchers were procured. The deterioration of the political context and the impact on the supply chain affected the launch schedule. In order to mitigate the launch delays for at least one of the two satellites (Sentinel 2B), a swap with another launcher (Vega) was decided, allowing its successful launch on 7 March 2017. The delays, however, can be considered negligible for a space programme of this scale and the deployment schedule has generally been respected.

The data volume, accuracy, reliability and quality are one of the most successful elements of Copernicus implementation. By the end of the first quarter of 2017 the Sentinels have reached and exceeded the expected daily volume of data production⁹. The original core ground infrastructure, dedicated to data reception and processing for further dissemination through data distribution hubs, was integrated with additional local stations for receiving data from the satellites, data processing, mirror sites and archives promoted by Member States (called "collaborative segment"). To prevent fragmentation and duplication of structures and

⁷ DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

⁸ European Meteorological Services Network.

⁹ As of summer 2016 the Sentinels were producing about 12 TB of data per day.

investments, an ad-hoc task force to coordinate the initiatives in the data distribution and reinforce synergies was set up by the Commission in 2015.

To complement the Sentinels data with additional data relevant to final users and necessary to generate the Services products Copernicus makes also use of the so-called Contributing Missions, i.e. National or International space missions, vital to the programme. For instance, access to some Very High Resolution data is guaranteed by the contributing missions as Sentinels alone are not able to provide it. From a historic perspective Contributing Missions data have allowed to kick-off Copernicus Services before the launch of the first Sentinel in April 2014. As of today, 10 licences have been signed with Contributing Missions data providers¹⁰. All the contributing missions datasets are included in the Data Warehouse (DWH). Latest statistics from 2017 show that the demand for Contributing Missions data is rapidly growing as the services become increasingly operational.

Copernicus is a "user driven" programme, based on the requirements of the user communities demanding specific data, information and products. This is reflected in the governance structure of the programme, including a "User Forum", where all user communities are represented and can support and steer the implementation of the programme. After one and a half year since the last update, the Commission is currently reviewing the DWH operation for data requirements gathering procedure, user satisfaction and DWH monitoring tools. Several milestones have also been achieved before 2017 on the coordination of activities: Copernicus in-situ data requirements have been revised and updated for all six Copernicus services; critical in-situ data gaps have been listed, including proposals for gap closing activities; data access agreements have been signed with selected European networks; Copernicus Reference Data Access (CORDA) node became operational; a plan for the involvement of selected global level networks has been agreed with the services; a cross-service register of stakeholders, partnerships and data access arrangements was constituted. The agreement with international networks of partners such as EUMETNET has established a single interface providing access to several dozens of partners and is recognised as a best practice of efficiency.

Findings on the budgetary aspects are also positive: according to the feedback from industrial partners Copernicus space operations show no cost overruns and a very efficient procurement process. Spending on the space component (the biggest part of the budget allocated to the programme) is in line with the forecasted budget for the 2014–2016 period. Considering the complexity of the programme and the related costs, difficult to be borne by a single Member State, the EU added value of the programme is very high: with its capabilities, data production and coordination system, Copernicus is more than the sum of each Member State's contribution to the programme; it is a truly European capacity at the service of citizens, industry and society at large.

- The data gathering activity is efficient: high quality satellites have been successfully deployed on time and on budget, supplying high quality imaging. The performance is clear proof of a competitive European Space industry capable to deliver.

¹⁰ These include: Radarsat-2, COSMO-SkyMed, TerraSAR-X, Pléiades 1A & 1B, Deimos-1 & 2, Dubaisat-2, UK-DMC2, WorldView-2 & 3 and GeoEye-1, PROBA-V, GAF AG, and EUSI

Data and information processing

The six Copernicus Services, at the heart of what can be defined as Copernicus geo spatial-intelligence system, provide timely and reliable information to a growing community of users in Europe and world-wide. For this knowledge generation activity, the data acquired are processed and transformed into appropriate products available for the end-users and distributed through the services. Based on both space-borne and in-situ observations and data the Copernicus services generate timely and reliable geo-information products along defined and agreed processes, in some cases involving significant data assimilation and modelling efforts. Each of the six services responds to specific environmental or security-related themes identified as key for the European society. The services are delegated to competent service operators (or Entrusted Entities) that manage the services on behalf of the Commission.

At the onset of the Copernicus Programme, two of the six Core Services, Land monitoring (CLMS)¹¹ and Emergency management (EMS)¹² were operational, thanks to the contributing missions data provided under the GMES GIO¹³ programme. Atmosphere monitoring (CAMS)¹⁴ and Marine environment monitoring (CMEMS)¹⁵ services were in pre-operational phase while Climate Change (C3S)¹⁶ and Security services were still being designed or developed. Three years later, all services are in operation, except specific product groups of the Security service and the Climate Change, still in pre-operational phase. All delegation agreements with the entrusted entities, however, have been signed according to the planned schedule.

Some of the products supplied by the Services are particularly important for the public sector and local authorities: the land monitoring service registers urban planners, city administrators and transport authorities among its user clients. An increasing number of private operators in the field of urban monitoring and development, such as energy and utilities companies, real estate companies, chain stores, and building material suppliers buy Earth observation products. The typology of users varies according to the Service, of course: Emergency

¹¹ The Copernicus Land Monitoring Service (CLMS) provides geographical information on land cover and on variables related, for instance, to the vegetation state or the water cycle. It supports applications in a variety of domains such as spatial planning, forest management, water management, agriculture and food security. These products were downloaded more than 30,000 times in the second half of 2016.

¹² The Copernicus Emergency Management Service (CEMS) provides information for emergency response in relation to different types of disasters. The mapping service, delivering reference, delineation and grading maps, constantly improves its service delivery, notably on the timeliness for Rapid Mapping component.

¹³ GMES Initial Operation Programme

¹⁴ The Copernicus Atmosphere Monitoring Service (CAMS) is providing information on the atmospheric composition, such as real-time analysis and forecasts on daily or even more frequent basis. Furthermore CAMS is providing consistent reanalysis products which are continuously updated, as well as a number of supplementary products.

¹⁵ The Copernicus Marine Environment Monitoring Service (CMEMS) provides information on the state and dynamics of physical ocean and marine ecosystems for the global ocean and the European regional marine areas. These products are applied in four main types of activities: (1) climate, seasonal and weather forecasting, (2) marine and coastal environment, (3) maritime safety and (4) marine resources.

¹⁶ The Copernicus Climate Change Service (C3S), while still being pre-operational, has achieved already tangible achievements: The development of the climate data infrastructure and first content is underway and on a good track. A batch of pilot activities demonstrated the use of C3S products in various application sectors. First pre-operational products are provided regularly, such as surface air temperature, sea ice, seasonal forecasts or reanalysis products.

service's users are, for example, only entities and organisations at regional, National, European and International level, active in the field of crisis management.

The list of EU and Commission political priorities supported by Copernicus services and products is long and includes Climate change, Migration, Environmental policy, Agriculture and food safety, Maritime surveillance, Security, Transports and Energy, Smart urban development, Disaster management and reduction.

The performance of the services is generally considered good by users, based on their good availability, timeliness and the variety of the products portfolio. Even the Climate Change service, although still in a pre-operational phase is already on good track as the number of users doubled between 2015 and 2016, clearly attracted by the highly innovative first results. One example of excellent Service output is the first Ocean State Report, based on Copernicus marine environment monitoring service products, which is a precious tool for environmental directorates, agencies, conventions and international organisations' activity.

The Security Service, in particular, has acquired an increasing relevance for the information it can offer in response to Europe's security challenges, especially for the border surveillance and maritime surveillance. Its data and products are fully integrated and supporting the agencies' mandated tasks in the areas of border protection, maritime safety, and support the EU CFSP/CSDP¹⁷.

A balanced definition of new products within the Copernicus product portfolio has been identified as a challenge, but has been dealt with by the Commission through the establishment of a specific procedure for the definition of new products and the user needs gathering process, in agreement with the stakeholders. This process allows Copernicus to respond dynamically to a rapidly changing environment.

- Copernicus is not only the world's largest single Earth Observation programme, but by incorporating Copernicus Services knowledge generation into its architecture it became a pole of Earth Observation-related scientific and operational expertise which has become a true European success story.
- By responding to evolving user needs with its timely and reliable geo-information products, Copernicus has been able to dynamically adapt to rapidly evolving challenges and to the European political landscape, for example tackling with its Climate Change Service the foremost environmental challenge facing Europe and the world as a whole.

Data access and distribution

Space-borne and in-situ data, as well as Service information and products have to be made available to users in an efficient manner. One of the weaknesses identified during the stakeholders' consultation, as regards the data distribution component of the programme, is the fragmentation of product offer and data dissemination mechanism (via the Entrusted Entities, via EU web portals, via ESA), and this might have created confusion for some users and been perceived as a duplication of effort. Further work is therefore suggested to facilitate access to data with specific attention on collaborative ground segments and data distribution at national level. Data transfers between the Copernicus pick-up points and the users are

¹⁷ Common Foreign and Security Policy/Common Security and Defence Policy

relatively slow, thus affecting the ability to make use of them on large scales. Readability of metadata is also identified as an issue for users, typically if supercomputers are needed to store the data. Users would also expect to have online processing facilities close to the data in order to avoid downloading large volumes of data. The Commission has taken action to respond to these user requests. The traditional distribution routes for accessing Copernicus data and information are being strengthened and innovative Data and Information Access Services (DIAS) are being launched, within the agreements with ESA and EUMETSAT, to bring users closer to the data. The first DIAS are expected to start operations in early 2018. Today, beside the access to Copernicus Services platforms, run by the different delegated bodies the main satellite data access channel consists in the 4 ESA hubs:

1. **Copernicus Open Access Hub (COAHub)**, previously Scientific Hub
2. **Copernicus Services Data Hub (ServHub)**, previously CopHub, only open to Copernicus Services and European institutions.
3. **Collaborative Data Hub (ColHub)**, open to the GMES Space Component (GSC) and Copernicus participating States following a signature of a Collaborative Ground Segment agreement with ESA.
4. **International Access Hub (IntHub)**, open to international partners which have signed an arrangement.

The large volume of data downloaded creates challenges regarding the management of the network traffic on the ICT infrastructure. A dedicated link to the network "GÉANT" ¹⁸ was set up in May 2016 to answer this challenge: it currently routes around 66% of the network traffic. The current infrastructure has been upgraded in March 2017 to double the bandwidth capacity.

As for the security aspects, the full, open and free data policy has been implemented in accordance with the Article 23 of the Regulation, including the limitations therein defined. No particular cyber threats have been identified, considering the current images resolution and each entrusted entity's internal measures to face those threats.

- Copernicus new thresholds of data and information production and processing provoked a paradigm shift in Earth Observation big data domain. The associated challenges have been addressed by engaging with state-of-the-art solutions in building a digital economy.
- The original concept of Copernicus foresaw a provision of data serving primarily the needs of the Copernicus services and this objective has been achieved with great success. New user needs have however emerged, calling also for large-scale access to and exploitation of direct Sentinel data, at various timeliness and processing levels. In response to this user need the Commission is planning a programme evolution to add a robust big data provision system,

¹⁸ GÉANT is the pan-European data [network](#) for the [research](#) and [education](#) community. It interconnects [national research and education networks](#) (NRENs) across Europe, enabling collaboration on projects ranging from biological science to earth observation and arts & culture. The GÉANT project combines a high-bandwidth, high-capacity 50,000 km network with a growing range of services. These allow researchers to collaborate, working together wherever they are located.

Data uptake

To maximise the socio-economic benefits of the programme by supporting the development of smart applications as requested by the Copernicus Regulation has been a challenging task, given that Copernicus data were planned but not yet available (due to the progressive deployment of the constellation).

The free, full and open data policy adopted by Copernicus has led to unforeseen interest: by the end of March 2017, the number of registered users in the main dissemination hub (the Open Access Hub) well exceeded the target set at the beginning of the programme, as well as the number of products downloaded. The availability of Copernicus data and services was met with strong growth in the European Earth Observation downstream sector (over 10% per annum in 2014 and 2015¹⁹, compared with 1.8% on average in the European economy).

The European Commission has supported this trend by launching many user uptake initiatives. To boost the promotion at regional and local levels, two European networks have been set up, the Copernicus Relays and Copernicus Academy, charged with the organisation of awareness activities and acting as local helpdesks. A Copernicus support office was set up to provide support to all users. Furthermore, to stimulate innovative uses of Copernicus data, the Commission joined forces with ESA in the organisation of the Copernicus Masters, an annual competition aimed at stimulating innovation, increasing awareness and providing visibility for start-ups. The Copernicus start-up programme also includes the Copernicus Accelerator, a one-year coaching programme launched in 2016, soon to be complemented by the Copernicus Hackathons and the Copernicus Incubation programme. A large number of information and training sessions and thematic workshops have also been organised targeting public and private users. Communication on the web and on social media has been significantly strengthened. In parallel, the Commission has created a Copernicus skills programme, featuring a partnership on skills for the geo spatial-sector (through the ERASMUS+ programme) and cooperation with two Knowledge Innovation Communities, KIC climate change and KIC raw materials. These activities are complemented by communication and user uptake activities undertaken by the Copernicus Entrusted Entities.

Though the efforts of the Commission to launch user uptake actions have been substantial, there is still a need to expand activities among users who are not earth observation specialists. Some communities should be targeted in particular, such as the IT community or some promising sectors (smart cities, insurance and others). This would widen the user base of Copernicus, thus multiplying its societal impact. To further increase the number of user uptake actions, the Commission could also evaluate delegating some tasks to an operational agency. Finally, a greater involvement of Member States and closer coordination with EU level actions could further accelerate Copernicus user uptake. The Commission has started to address this issue and will soon launch a framework partnership agreement with Member States in order to jointly finance user uptake activities.

- The Copernicus programme has attracted considerable interest from users, with more than 80,000 registered users on the main Sentinel hub (well beyond the original target)

¹⁹ Source: A Survey into the State and Health of the European EO Services Industry, prepared by EARSC for ESA, 2015

- Since 2015, the Commission has launched ambitious user uptake activities, including awareness events, training courses, start-up support programmes, and regional initiatives.
- Expanding activities to non-specialist communities should be considered. Greater involvement of Member States could also considerably accelerate the uptake of Copernicus.

CONCLUSIONS AND WAY FORWARD

Just three years after the launch of the first Sentinel satellite, Copernicus is producing tangible results which clearly demonstrate the added value of the EU action. The programme is well on track and its original objectives have largely been achieved. Today Copernicus is one of the biggest data providers in the world. The huge amount of data it generates, coupled with advances in ICT and cloud computing, creates unprecedented business opportunities in many sectors of the economy and across the EU Member States. Unlocking this economic potential is one of the main challenges Copernicus faces today. Enabling a vibrant ecosystem capable of transforming Copernicus data and information into innovative products and services will remain a clear priority during the next phase of the programme until 2020.

Looking to the future on the basis of the present evaluation, continuity and sustainability of services and observation data will be absolutely critical for the lasting success of Copernicus. The long-term stability of the programme and its free, full and open data policy must be ensured in order to provide predictability and planning certainty for businesses and users. Copernicus is and should remain a user-driven programme. Its future evolution must keep up with the evolving requirements of the users and the paradigm shifts in the Earth Observation sector globally. In line with the Space strategy adopted in 2016, the Commission should plan a long-term vision for the programme, in order to give visibility and predictability to all partners in Copernicus, allowing them to invest, benefit and support, especially considering the shifting priorities of the programme.

The Copernicus services constitute a major part of the added value of the programme. They should continue to develop, improve and evolve, addressing new challenges and new policy priorities. The Space strategy for Europe identifies a number of priority areas for expansion and evolution to address the challenges of climate change and sustainable development, to monitor CO₂ and other greenhouse gas emissions, land use and forestry, or changes in the Arctic. Enhancing the security dimension of Copernicus is also called for to improve the EU's capacity to respond to the evolving challenges of border controls and maritime surveillance and to explore how Copernicus could cover further security needs, including defence. In preparing the post-2020 phase of the programme, all options should be thoroughly analysed and prioritised together with the Member States.

Copernicus has been built as a partnership between the EU, the Member States, ESA and EUMETSAT. The principle of partnerships under the coordination of the European Commission should continue to drive the future development of the programme since its distributed governance has proven to be successful. For the period after 2020, the Commission might, however, explore further opportunities for streamlining and optimisation, and assess the need for involving new actors where this could bring clear value and increased efficiency to the programme.

New business models based on public-public partnerships, public-private partnerships or service-buy schemes, to leverage the capacity of the Member States and the European

industrial competences, could support a robust and sustainable European Earth observation capacity, which in turn is expected to stimulate further investments.

International cooperation is essential in Copernicus. It provides a vital tool underpinning Europe's commitments and leadership role in tackling global challenges such as climate change and global opportunities for marketable products. Future developments must strengthen this aspect even further to enhance the scope and quality of Copernicus data and services, based on mutually beneficial data exchange arrangements, and to engage with key international partners in building positive synergies and pooling capacities for tackling global challenges in a coordinated manner (e.g. CO₂ emissions monitoring). Efforts should therefore be directed towards the consolidation of Copernicus as global standard in the geo-location data domain.

Copernicus is a great opportunity for Europe. It offers a huge potential for innovation, growth and jobs. With Copernicus the European industry has a unique opportunity to become a leader in a global fast growing market. The next years will therefore be crucial to consolidate the achievements and prepare the future adapting to the changing reality of the programme.