



Copernicus4Regions

“How did the stories evolve?”

Report of the Update activity

OCTOBER 2022

How did the stories evolve?

REPORT OF THE COPERNICUS4REGIONS UPDATE ACTIVITY

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The Update activity has been conducted by Politecnico di Milano in the role of Publication Manager in continuous close coordination with members of the Publication board namely, the European Space Agency and NEREUS Network.



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EXECUTIVE SUMMARY

Since they first set their digital eyes on Earth, Copernicus Sentinel satellites have generated data that has proven crucial to evidence-based decision-making systems. Sentinels now directly impact how we live, positively influencing socio-economic, political, and scientific strategies demonstrated through enhanced monitoring capabilities. In 2018, a report entitled *The Ever-Growing Use of Copernicus Across Europe's Regions* was published under the Copernicus4Regions initiative, collecting ninety-nine user stories on how public administrations (PA) across Europe were using Copernicus data and services to address their challenges. This current *Copernicus4Regions Update Activity* report presents further insights into the advancements of Copernicus-based applications while expanding the opportunities introduced in the original publication.

Taking a seemingly simple question as a point of departure, "*How did the user stories evolve?*" the report investigates the challenges, opportunities, and possible achievements of utilizing Copernicus data and services to help sustain various evidence-based policies. Areas of application include the following capacities of local and regional authorities: i) Transports, Civil Infrastructure and Safety, ii) Cultural Heritage, Tourism, and Leisure, iii) Biodiversity and Environmental Protection, iv) Territorial, Management, and Urban Planning, v) Public Health, vi) Civil Protection, vii) Agriculture, Food, Forestry and Fisheries and viii) Climate, Water and Energy. This report aims to establish a referential archive that aids optimal functionality for current and future projects. The scope of inquiry spans technological and socio-economic benefits while focalizing advancements in public administration workflows that could also prove beneficial to other local and regional administrations (LRA) within Europe and beyond.

Data can create value when used effectively and in a timely manner. In the case of Earth Observation (EO) data systems specifically, significant prerequisites of this value are systematic technological updates and maintenance. This report finds that technical advancement was essential for optimal functionality in more than 80% of cases where Copernicus-based solutions were utilized. Although Usage Maturity Level (UML) did not deteriorate for any of the user stories over the past few years, many authors acknowledged difficulties arising during uptake activities. Those user stories registering a higher UML attributed this upward transition to the availability of additional funding and the recognition of Copernicus's added value at the decision-making level (equating to 30% and 29% of respondents, respectively).

In Europe, LRAs play a significant role in how Open Geospatial Data is created, used, and directed toward project-based initiatives, while taking on the responsibility for data accuracy and reliability. Findings of this report highlight that LRAs are on the cusp of transitioning from the passive role of "client" to a more proactive role of partner when it comes to EO-based solution development. Since 2018, for example, more than 75% of cases identify an increase in technical or scientific expertise related to Copernicus/EO within the PA itself. User stories show that public administrations often had a vested interest in appointing in-house specialists who could determine how EO-based solutions can be developed, deployed, and implemented to best suit their particular needs. In this sense, rather than operating merely within the parameters of existing technologies, several LRAs are directing internal resources toward expanding possible uses and benefits of a specific space-based solution. It can be argued that European public authorities are capable of proactively shaping the panorama of the use of Copernicus data and service in the future.

Key Findings and Outcomes

Here below is a summary of the key findings and outcomes of Copernicus4Regions Update Activity report:

- There are 14 possible relationship combinations between service providers and end users. The most frequent value-chain scenario is a "scientific entity producing a solution for a PA."
- Public Administrations are investing in internal resources for EO-based solution development. More than 75% of user stories recognize an "increase in technical and or scientific expertise related to Copernicus or EO within the Public Administration." This indicator is confirmed across all eight thematic areas and for solutions with different UML.
- The most popular categories of the User Maturity Level in which applications tend to advance are "UML 2 - Ad hoc user" and "UML 5 - Operational user".
- Some user stories remained at the same UML over the last few years. One of the reasons concerns no need to tackle those emergencies for which the original Copernicus-based solution was designed.
- The benefits of space-based applications have been recognized in the everyday work practice of the LRAs. A positive impact of these changes can contribute to a more collaborative environment across sectors in the future.
- Copernicus' benefits are recognized at the decision-making level, as declared by more than 25% of respondents.
- Allocation of "New space funds" is the most significant contributing factor facilitating the solution's transition to a higher UML.
- Six applications provide concrete operational solutions within institutional workflows. Four of the six solutions belong to the more traditional EO thematic track of Agriculture, Food, Forestry, and Fisheries.

CHAPTER I: BACKGROUND 2018 - 2022

The Copernicus4Regions is an ongoing initiative managed by the Network of European Regions Using Space Technologies (NEREUS)¹. It provides a platform for the European Regions to address common challenges, to show the benefits of the Copernicus programme, and hence stimulate more local and regional administrations to be involved in the Copernicus community.

In 2018 a Publication entitled "*The Ever Growing Use of Copernicus across Europe's Regions*" was published under the Copernicus4Regions initiative. The collection of 99 user stories focused on how public administrations across Europe were using Copernicus data and services to address their challenges and how this was positively impacting the lives of citizens.

A few years ahead, Update Activity aims to provide a better insight into the advancements of Copernicus-based applications of the original Publication. Taking a seemingly simple question as a point of departure, "How did the user stories evolve?" this report investigates the challenges, opportunities, and possible achievements of utilizing Copernicus for various solutions within a multidisciplinary context. It aims to establish a referential archive that aids optimal functionality. The scope of inquiry spans technological and socio-economic benefits, while focalising advancements in public administration workflows across Europe.

To navigate the accelerated rate of Copernicus-based solution adoption, this Report defines a context of action across several main factors such as technology background, EU policy background, and Copernicus User Uptake.

Technology background

A period of a few years can be quite significant in a dynamic space-technology domain. Technological advancement of Copernicus satellites and services has continued over the past years. Sentinel-3B has joined its twin in orbit in April 2018 to complete the tandem. These two satellites "systematically measure Earth's oceans, land, ice, and atmosphere, to monitor and understand large-scale global dynamics" (source©ESA). Another satellite, Sentinel-6, was then launched in November 2020. Its mission was to extend the legacy of sea-surface height measurements (source©ESA). Copernicus services are currently at different levels of maturity. Some more traditional services, like Land Monitoring (CLMS) and Emergency Management (CEMS) are operational since 2012. Others became operational over the last years. An important advancement regards Copernicus Climate Change Service (C3S), which is operational since mid-2018.

EU policy background

In this domain, Report identifies several instruments as a reference to the domain of space-based applications in the years to come:

- European Green Deal (EGD). This package of policy initiatives was established in 2019. It paves the path toward Europe's green transition. It argues how "*accessible and interoperable data are at the heart of data-driven innovation*". EGD requires "*to predict and manage environmental disasters*" as an immediate priority for the EU. In such context, an initiative called Destination Earth (DestinE) is a cornerstone to building resilience to climate change. It aims to develop an accurate digital model of the

¹ The initiative is under a contract from the European Space Agency and funding from the European Union, in collaboration with NEREUS.

Earth and to trace and predict the interaction between natural phenomena and human activities. European Green Deal relies on benefits of the digital transformation to support the ecological transition. As part of the Green Deal and Digital Strategy, “DestinE” aims to contribute to achieving the objectives of a transition that is foreseen as both green and digital.

- European Open Data Directive. As a compulsory legal instrument for all EU member states, Open Data Directive acknowledges Earth Observation (EO) to be Public Sector information of high-added value (EC, 2019). It defines geospatial (information) and EO and environmental information as “high-value” datasets.
- The new Common Agricultural Policy (CAP). This important update came into force in 2021. This financial mechanism relates to Agriculture monitoring, a specific traditional field of Satellite Remote Sensing applications. The new CAP will ensure a legal context in the period 2023-2027 to provide for a “fairer, greener and more performance-based CAP”.

Copernicus User Uptake

In 2021, a Report entitled “*EU space programmes Galileo and Copernicus: services launched, but the uptake needs a further boost*” (ECA, 2021), acknowledges that a framework for Copernicus user uptake activities was created by the EC. More specifically, the Report states, “*it aimed at (I) awareness raising, (II) facilitating access to Copernicus data and services, (III) support of downstream actors and (IV) leverage of Commission actions with Member States and the Copernicus entrusted entities, and defined a set of key actions to support uptake.*”. An important Framework Partnership Agreement on Copernicus User Uptake (FPCUP) started in July 2018. This project, led by the German Aerospace Center (DLR), currently accounts for circa 175 User uptake activities, ranging from national and international user uptake to business solutions and innovative products and applications implemented across Europe. Other networks such as Copernicus Academy Network and Copernicus Relay Networks actively promote Copernicus User Uptake in activities and events organised for their members.

Main objectives of the Copernicus4Regions Update activity

Considering a span of a few years, the main objectives of the user stories Update activity were:

- **OBJECTIVE 1 |** To access if the Sentinel-based services/products were incorporated into the flow of daily administrative processes;
- **OBJECTIVE 2 |** To access if the space solution became institutionalized if the Public Administration grew increasingly engaged;
- **OBJECTIVE 3 |** To identify any new applications that emerged from the originally portrayed user stories;
- **OBJECTIVE 4 |** To learn if any of the portrayed space solutions make it to the market²

This Report aims to tackle all main objectives across 4 Chapters. Firstly, Chapter 2 describes the Data collection methodology and exchange with Authors. The main findings are structured across different sections and illustrated in detail in Chapter 3. Finally, Chapter 4 discusses the main outcomes of the Update activity across the four main objectives.

² Objective 4 was an optional outcome of the Update activity

CHAPTER II: METHODOLOGY

Agile Methodology

Copernicus4Regions Update Activity consisted of the Authors' consultation and analysis of their feedback. This exercise was useful to understand how Local and Regional Authorities (LRA) proceeded to integrate the original Copernicus-based solutions into their organisational workflow or work routine.

The methodology of the work applied can be related to "Agile methodology"³. Such an approach is characterised by adaptive planning and continuous improvement. It is flexible in response to changes in requirements and the problems to be addressed.

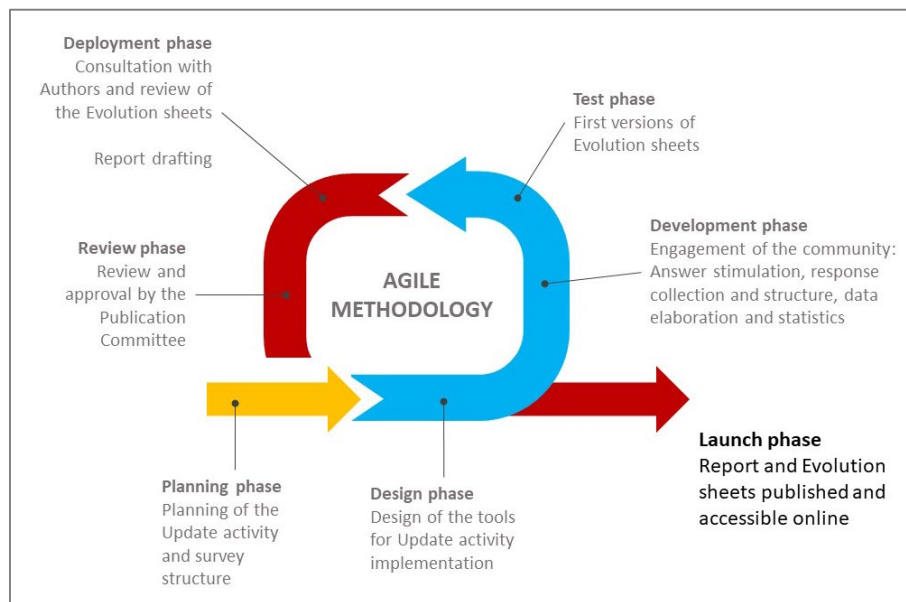


Figure 1 Illustration of the Agile methodology applied to the Update activity

The method described allowed to structure of the process of data collection into seven phases (Figure 1). The phases' duration and sequence were updated according to dynamic exchanges with the Authors and with Editorial Board. Significant efforts have been made to stimulate as many answers as possible. The activities of different phases are described below.

Planning phase. The whole consultation process was planned to define actions, timing, and outputs.

Design phase. Two main tools of the Update process were designed in this phase:

- **The Survey questionnaire.** This tool was developed by structuring the questions that could provide feedback to the four main objectives of the Update Activity. Specific aspects considered technological advancements, benefits across different domains, possible challenges, and achievements;

³ Agile methodology, as described by the "Agile Manifesto", is an adaptive approach, usually referred to software development. More information can be found at: <https://www.agilealliance.org/>

- **Evolution sheet mock-up.** This tool helped to envisage the results of the survey and their possible graphical structure into a document that will be significant to both experts and non-experts.

Survey phase. This phase regarded an active engagement of the community using different tools/activities: personalised e-mails to Authors by the PM, participation as speakers in disseminations events, stimulation through partial results a few months after the survey launch, presented by the PM during a Copernicus4regions webinars⁴.

Data elaboration phase. Here data was analysed to prepare and set up several draft versions of Evolution sheets. Initial Mock-ups (Development phase) were redesigned together with ESA graphic Bureau to provide the best possible visibility of the answers. It was decided to introduce a novel item i.e. a Value-chain analysis developed by the PM. This new version of Mock-ups was developed in consultation with and approved by Editorial Board.

The deployment phase consisted of an active last loop of exchange with Authors that provided feedback - they were invited to once again check and update the information on the evolution of their case in the past few years. All comments were implemented, sometimes requesting a few loops reiterations, to fully meet all requests.

Review phase. The final review of the Report and all Evolution sheets was performed by the Editorial Board.

Launch phase. All the results were published online and disseminated among the wider community.

Communication process

During the Planning phase, the methodology was implemented in the communication and exchange process among the three main actors i.e. Authors of the original user stories, the Publication Manager, and the Publication Committee. Figure 2 illustrates the Workflow of the Update activity.

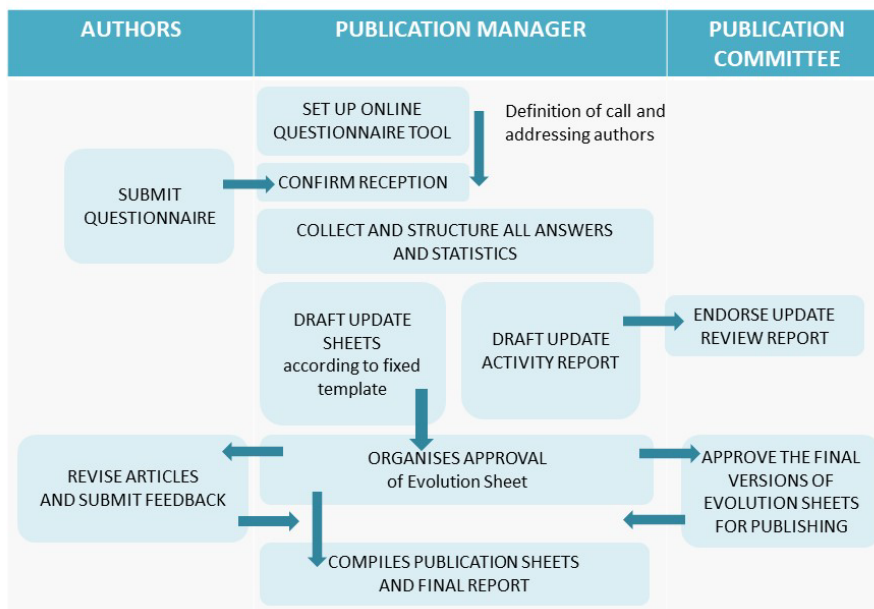


Figure 2 Copernicus4Regions: Update activity Workflow

⁴ Material for further reading and consultation is available here: Follow-up of the Copernicus4Regions webinar on innovating public policies: NEREUS | NEREUS (nereus-regions.eu)

The objective of this practice was to demand a minimum effort from the Authors – the only actions requested were to provide feedback by compiling the survey questionnaire and then to revise the draft version of the Evolution sheets. The role of the PM was central to the project as both Authors and Editorial Board interacted only with the PM and never directly with each other. Editorial Board had a duty to supervise the whole process and to endorse the final outputs of the Update activity.

Survey structure

During the survey development phase, several references were taken into account, including "Sentinels Benefits Study (SeBS) Methodology"⁵. Specific considerations concerning were:

- Firstly, it appeared necessary to comprehend better the identity and role of specific beneficiaries of the 99 space-based solutions. At the same time, it was noticed that beneficiaries interact with the solution at different levels and often at different stages. Such attitude translates into a different types of services being used by different beneficiaries of the same solution. This consideration was translated into the "Value-chain" section of the Evolution sheets.
- Secondly, it proved useful to observe the benefits of single user stories, with an attempt to identify and quantify (as closely as possible) common parameters of a specific Benefit domain. Domains considered were the "Six Dimensions of Value" proposed by SeBS, namely: Economic, Environmental, Regulatory, Innovation and entrepreneurship, Science and Technology, and Societal domain.

The survey questionnaire was set up (Design phase) into seven sections as illustrated below:

- **Section 1 with subsections AUTHOR'S PERSONAL INFORMATION (survey respondent) and COPERNICUS4REGIONS USER STORY.** There are different ways in which Copernicus-based solutions can be exploited by PAs. Understanding how this works is useful for delineating the usage ecosystem.
- **Section 2 THE SPACE-BASED SOLUTION.** Over time, the technical solutions may have evolved, improving in accuracy, efficiency, or usability. Authors were asked if they consider their Copernicus-based solution now more technically advanced or if a solution was relying on new datasets available from Copernicus.
- **Section 3 BENEFITS TO PUBLIC ADMINISTRATION AND CITIZENS and BENEFITS TO USERS ACROSS SPECIFIC DOMAINS.** For all Benefits domains, Authors were allowed a multiple choice of indicators in the answer. An open option "Other" was present in each benefit domain for free text answers.
- **Section 4 USAGE MATURITY EVOLUTION.** There is a long path before the space-based solution can be fully adopted by the PA and integrated into its institutional processes. The questionnaire referred to a dedicated index Usage Maturity Level (UML) to evaluate the possible changes in the uptake process.

⁵ SeBS methodology was developed by the European Association of Remote Sensing Companies (EARSC) in 2020. It supports analyses to demonstrate the value of using Earth Observation data of the Copernicus programme. More information is available at: <https://earsc.org/sebs/wp-content/uploads/2020/12/SeBS-Methodology-2020.pdf>

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- **Section 5 CHALLENGES AND ACHIEVEMENTS.** LRA may encounter challenges that prevent the uptake of a technological solution. Luckily, there might be also some facilitating circumstances that help to accelerate the uptake. Analysis of possible common root causes was the objective of this section.
 - **Section 6 SUMMARY AND PERSPECTIVES.** In the closing, the Authors were asked to provide a concise free-text summary about how the Story has evolved in the last years and about any plans for the future.
 - **Section 7 LET'S KEEP IN TOUCH!** Interest in Copernicus4Regions was tested by asking the Authors to remain informed about the initiative.

In the Questionnaire, all parameters were developed to be as effective as possible for quantitative evaluation, with a focus on non-financial benefit domains. All indicators were described explicitly so that respondents (usually service providers and Tier 2 beneficiaries) could relate better to the answers. In this way, the Authors were fully autonomous in answering the questionnaire, even without one-on-one interviews.

When necessary, conditional survey branching and multiple choice questions were adopted so that the Author could provide the most exhaustive feedback on the advancements of the Use case with the least possible effort. The survey was published in a user-friendly interface and it was available for circa 10 months.

The Survey structure, questions, and all answer options are presented in detail in Annex I.

Data elaboration and main outputs of the Update activity

The collection of the feedback was conducted during the Development phase that lasted for circa 10 months. The data elaboration phase was conducted in parallel with data collection (Survey phase).

The final planned outputs of the Update activity were two:

- A publishable report about *The evolution of Copernicus4Regions user stories*, containing the results of the analysis including comprehensive statistics and graphics solutions (here on “Report”);
- A set of publishable *user story Evolution Sheets*, structured and designed for 55 user stories.

It is important to mention that, originally, to ensure better visibility of identified Benefits, the Value-chain aspect was not tackled in detail during the Questionnaire design. However, during the Data elaboration phase, it proved necessary to better understand the Beneficiaries/Services relationship in each Use Story. For this purpose, all 99 Value-chains were built by PM and based on the original information from the 2018 Publication.

For all 55 user stories replying to the questionnaire, the Value-chain was revised and confirmed by the Authors.

For 44 user stories, the feedback on advancements is still missing. For these stories, PM has developed the Value chain based on the original story published in 2018. This material is available but subject to the author's approval.

CHAPTER III FINDINGS OF THE SURVEY QUESTIONNAIRE

This chapter illustrates the overall results of the Survey questionnaire taking into account the Thematic tracks of the Stories, the type of Sentinel data and Copernicus service used, benefits across different domains, and different challenges and achievements of the single user stories. The results are illustrated for **55 questionnaire feedbacks** that have been submitted by the Authors.

The sections that follow illustrate the results per each section of the Survey (questionnaire).

YOUR COPERNICUS4REGIONS USER STORY - Findings in Survey Section 1

Findings on the Thematic areas

In 2018, Thematic Tracks were eight (8) with the following titles:

- Transports, Civil Infrastructure and Safety
- Cultural Heritage, Tourism, and Leisure
- Biodiversity and Environmental Protection
- Territorial Management and Urban Planning
- Public Health
- Civil Protection
- Agriculture, Food, Forestry, and Fisheries
- Climate, Water, and Energy

These Tracks have been maintained within the Survey questionnaire to monitor the answer statistics over specific thematic areas. The distribution over Thematic Tracks of the **55 submitted Survey answers** is shown in Table 1.

Table 1 Submissions per Thematic Tracks: distribution in 2018 and 2022

Submissions per Thematic Track	Num. of original user stories (2018)	Num. of answers submitted (2021/22)
Transports, Civil Infrastructure and Safety	6	5
Cultural Heritage, Tourism, and Leisure	2	2
Biodiversity and Environmental Protection	17	13
Territorial Management and Urban Planning	14	8
Public Health	2	2
Civil Protection	10	5
Agriculture, Food, Forestry, and Fisheries	32	13
Climate, Water, and Energy	16	7

It can be observed that Tracks such as i) Cultural Heritage, ii) Tourism and Leisure, iii) Public Health, and iv) Transports, Civil Infrastructure, and Safety have fully covered their representation. On the other side, Agriculture, Food, Forestry, and Fisheries (a track that received major interest from the Authors back in 2018) accounts for a very low number of responses (13 of 32). Other tracks received feedback equivalent to 50-75% of user stories originally presented in 2018.

Findings of “Value chain” analysis

There are different ways in which Copernicus-based solutions can be exploited by the Public Administration. Understanding how this works is useful for delineating the ecosystem of usage. Table 2 illustrates fourteen (14) combinations of Service Provider/End users relationships that have been identified by the Authors.

Here, “other users” were intended as “companies, professionals, agencies, associations, single citizens”.

Table 2 Number of answers for each combination of “Value chain”

Value chain description	No. of Answers Submissions (2021/22)
Copernicus-based solution produced by a commercial company for a Public Administration	7
Copernicus-based solution produced by a commercial company for Public Administration and other users	1
Copernicus-based solution produced by a commercial company for Public Administration and other users (including scientific entities)	1
Copernicus-based solution produced by a commercial company for other users	3
Copernicus-based solution produced jointly by a commercial company and a scientific entity for Public Administration and other users	2
Copernicus-based solution produced jointly by a commercial company and a scientific entity for a Public Administration	1
Copernicus-based solution developed by the Public Administration for internal use	2
Copernicus-based solution developed by the Public Administration for other users	6
Copernicus-based solution developed by the Public Administration for internal use and other users	1
Copernicus-based solution produced jointly by a scientific entity and by the Public Administration for their (PA) internal use	2
Copernicus-based solution produced jointly by a scientific entity and by the Public Administration for their (PA) internal use and other users	2
Copernicus-based solution produced by a scientific entity for a Public Administration	14
Copernicus-based solution produced by a scientific entity for other users	9
Copernicus-based solution produced by a scientific entity for Public Administration and other users	4

It should be noted that the option "Copernicus-based solution produced by a scientific entity for a Public Administration" accounts for a majority of responses (14 of 55).

THE SPACE-BASED SOLUTION - Findings in Survey Section 2

In time, space-based technical solutions can evolve, improving accuracy, efficiency, or usability, or taking stock of new datasets available from Copernicus. The authors were here asked to identify such advancements if any. In 9 cases no noticeable modifications have been declared and the solution is the same as it was in 2018. For all remaining 46 cases some improvements, over different categories, have been implemented. Figure 3 illustrates these changes in more detail.

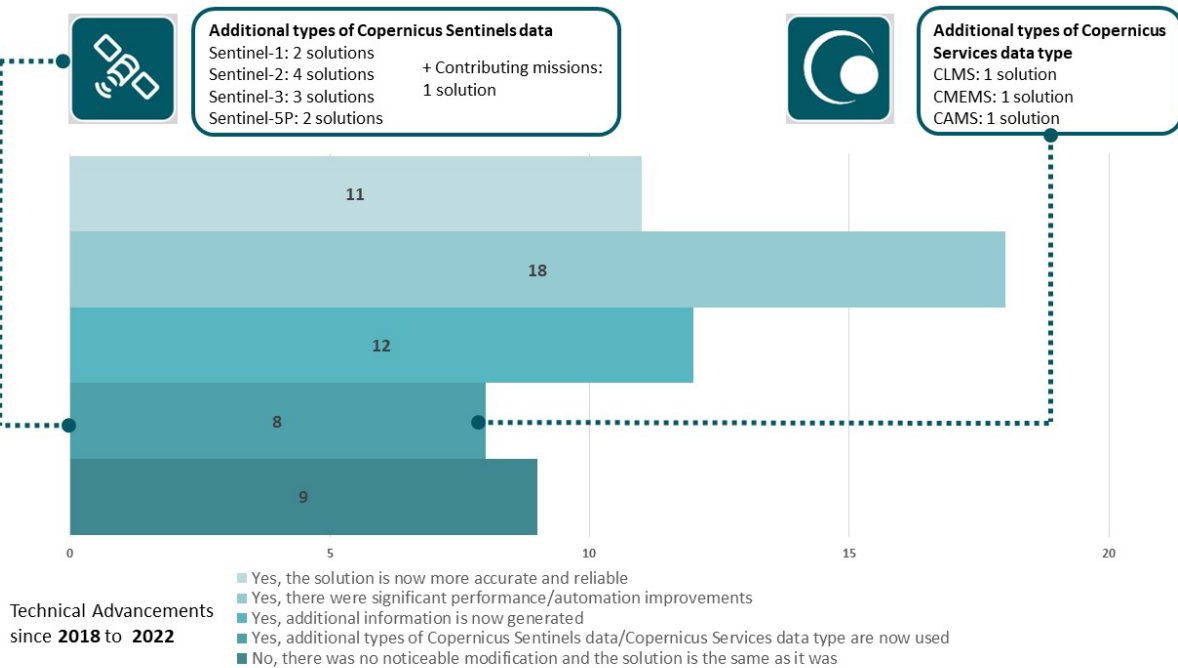


Figure 3 Technical advancements since 2018: number of use cases per category

BENEFITS TO PUBLIC ADMINISTRATION AND CITIZENS ACROSS SPECIFIC DOMAINS – Findings in Survey Section 3

The Benefit domains considered by the Survey questionnaire are Economic, Environmental, Regulatory, Innovation and entrepreneurship, Science and Technology, and Societal domains (Figure 4).



Figure 4 Graphical solution of overall benefits ©ESA – EOGB

NOTE. The following paragraphs consider the overview of **31 user stories that identify additional benefits concerning the article published in 2018**. More information on a single application is contained in the updated user story sheets under the section “Overall benefits”.

Economic domain

Twenty-five (25) out of 31 user stories identify benefits in the Economic domain. Specifically, the Authors have described their solutions in detail, as presented in Figure 5.

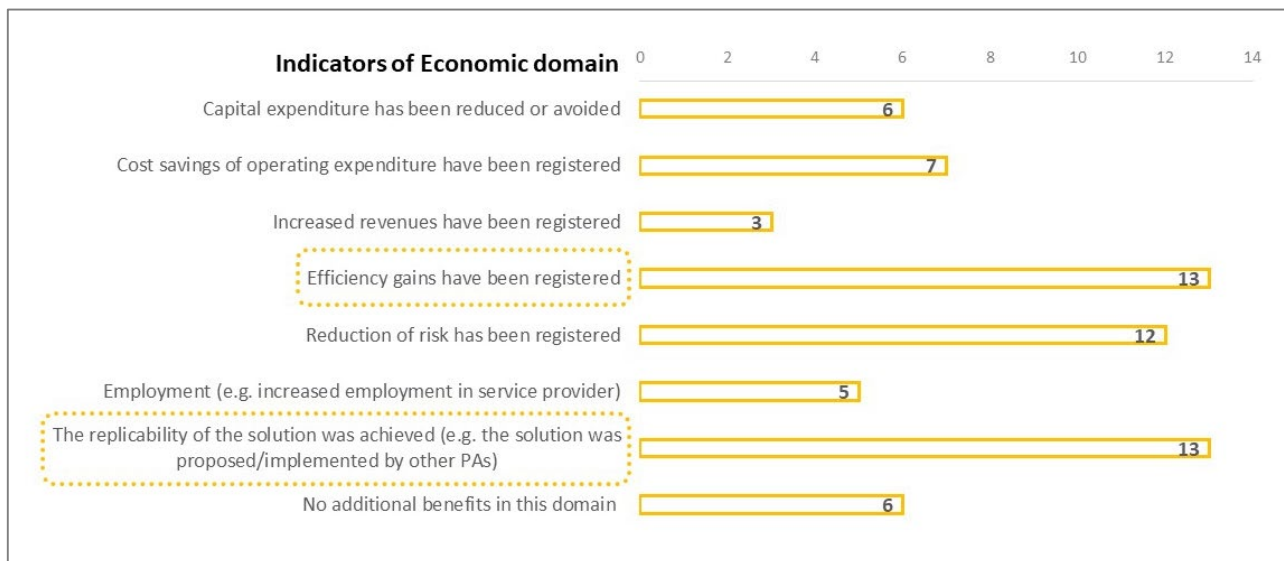


Figure 5 Indicators overview in percentage: Economic benefits domain

Environmental domain

Nineteen (19) out of 31 user stories identify benefits in the Environmental domain. Specifically, the Authors have described their solutions as presented in Table 3.

Table 3 Environmental domain: number of answers per indicator

Indicators of the Environmental domain	No. of User stories
Reduced pollution	4
Reduced impact on biodiversity	3
Reduced depletion of natural resources (e.g. reduced water consumption, reduced soil sealing ...)	11

Also, the Authors identify a set of additional indicators that were relevant to their Copernicus-based solution in this domain:

- Improved territorial planning strategies and environmental protection;
- More efficient management plans elaborated for the fire-affected areas;
- Faster identification of events that allows on-time treatment ;
- Improved knowledge of regional flood events;
- New data that contribute to the management of sensitive ecosystems such as Special Areas of Conservation (protected under the EU Habitats Directive);
- Improved risk assessment, land maintenance, land planning, and reconstruction.

Ten (10) user stories identify "No noticeable additional modification/impact on the functioning of the Public Administration nor on the lives of the citizens since 2018". Additionally, one user story reports that "no benefits

have been identified yet, but better maintenance of agricultural land is expected", while another story states that this specific benefit area has not yet been assessed.

Regulatory domain

Twenty-five (25) out of 31 user stories identify benefits in the Regulatory domain. Specifically, the Authors have described their solutions as presented in Figure 6.

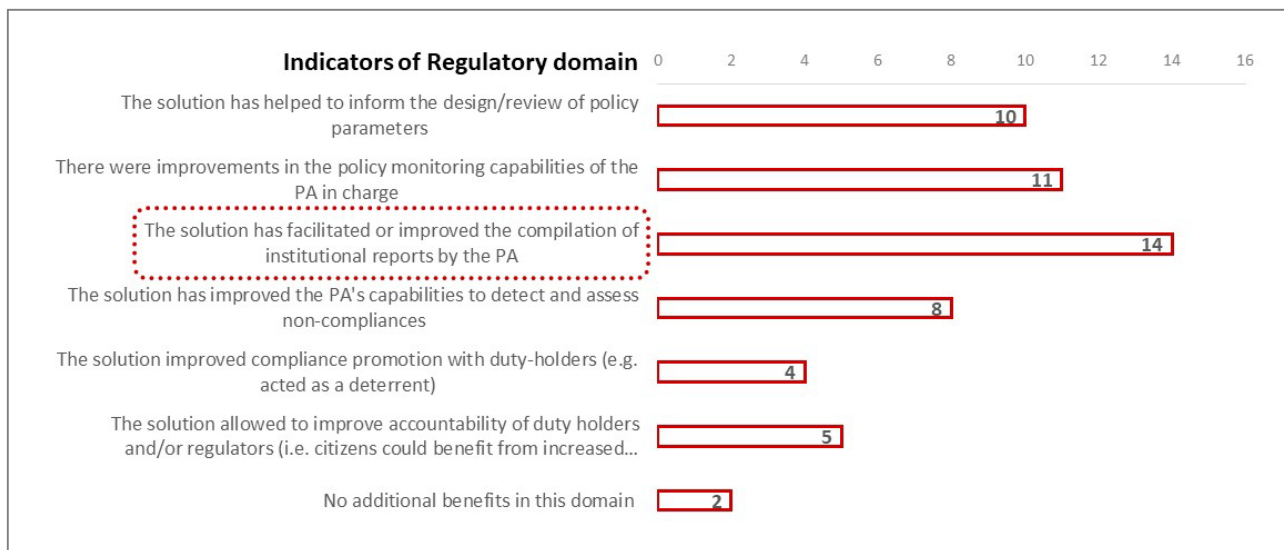


Figure 6 Indicators overview in percentage: Regulatory benefits domain

Innovation and Entrepreneurship domain

Twenty-five (25) out of 31 user stories identify benefits in of Innovation and Entrepreneurship domain. Specifically, the Authors have described their solutions as presented in Table 6. In addition, one user story identifies *“New funding acquired”* as a relevant factor for their Copernicus-based solution in the Innovation and Entrepreneurship domain.

Table 4 Innovation and Entrepreneurship domain: number of answers per indicator

Indicators of Innovation and Entrepreneurship domain	No. of User stories
The solution has helped to introduce some innovation in the functioning of the Public Administration (e.g. adopting more efficient or effective business practices)	18
The solution has helped to create some new businesses (e.g. a spin-off or a new start-up)	4
There were positive market externalities (i.e. the service provider expanded its market share)	13

Six (6) user stories identify “No noticeable additional modification/impact on the functioning of the Public Administration nor on the lives of the citizens since 2018”.

Science and Technology domain

Twenty-nine (29) out of 31 user stories identify benefits in Science and Technology domain. Specifically, the Authors have described their solutions as presented in Figure 7.

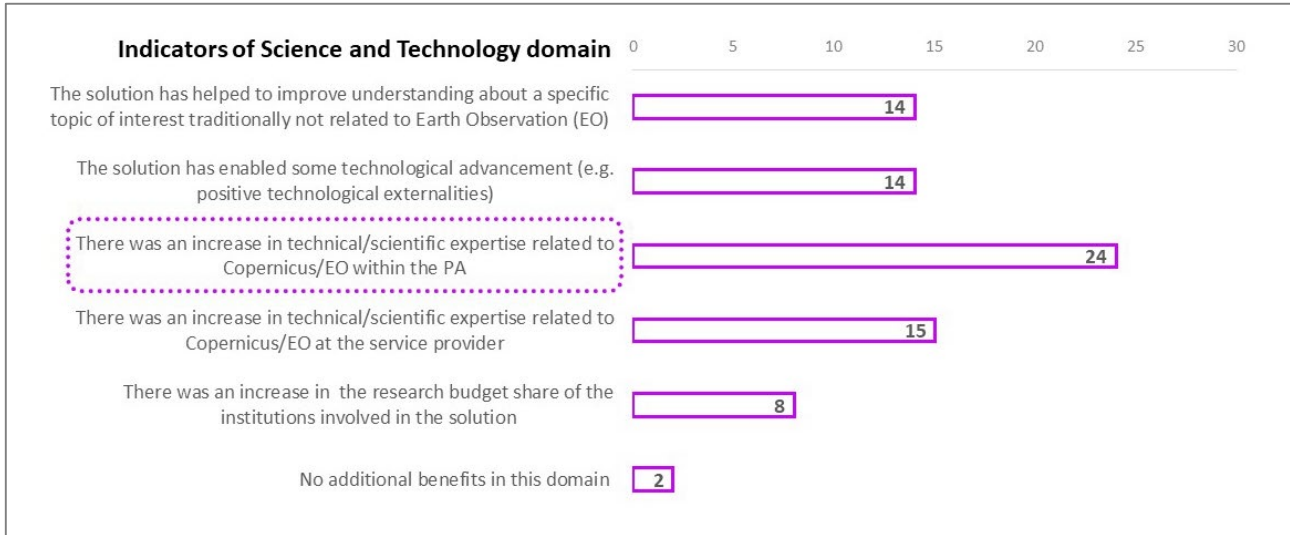


Figure 7 Indicators overview in percentage: Science and Technology benefits domain

Societal domain

Twenty-seven (27) out of 31 user stories identify benefits in the Societal domain. Specifically, the Authors have described their solutions as presented in Figure 8.

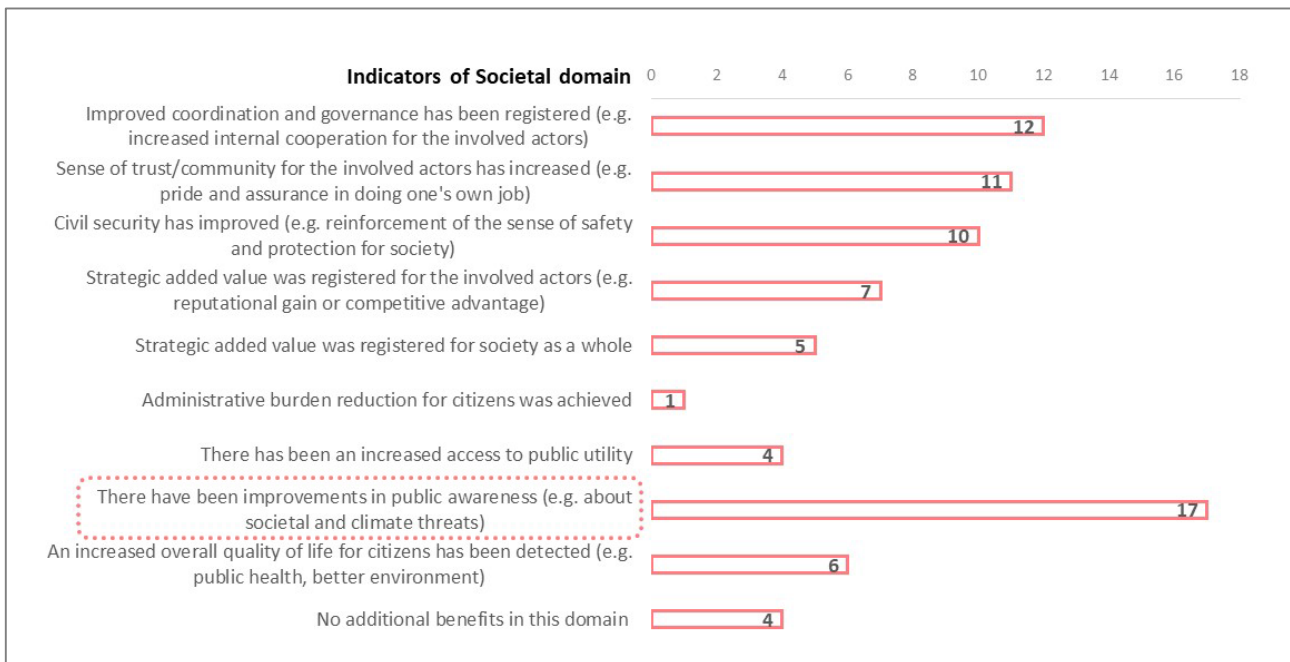


Figure 8 Indicators overview in percentage: Societal benefits domain

USAGE MATURITY EVOLUTION – Findings in Survey Section 4

In 2018 User Maturity Level was defined by the publication *"The ever growing use of Copernicus across Europe's Regions. A selection of 99 user stories by local and regional authorities"*. The document identified five (5) specific Levels of maturity: UML 1 – Explorer; UML 2 – Ad-hoc user, UML 3 – Pilot/Experimental tester; UML 4 – Early adopter; UML 5 – Operational user.

Authors have been asked to specify the current UML of their solution proposed in 2018 (even if it stayed the same). Table 5 illustrates the number of Authors' answers across five UMLs.

Table 5 Overview of Usage Maturity Level advancements: number of answers per UML

Usage Maturity Level (UML) in 2021	No. of user stories
UML 1 – Explorer	2
UML 2 – Ad-hoc user	10
UML 3 – Pilot/Experimental tester	15
UML 4 – Early adopter	12
UML 5 – Operational user	16

Additionally, Authors were asked to reply if they would consider that the current usage is more mature now than in the period of the original user story publication. It was suggested that, whatever the UML, the choice would imply that the user organisation has still an active interest in adopting the solution. The options proposed were:

- No, the solution was eventually dropped (OPTION A)
- No. Actually, when looking at the period since the Copernicus4Regions publication, we would now assign a lower UML (OPTION B)
- No, it remained more or less at the same UML (OPTION C)
- Yes, we transitioned to a higher level (OPTION D)

Table 6 illustrates the selection of 54 user stories Authors (result missing for one user story unaware of these reasons).

Table 6 the Evolution of the Usage Maturity Level (UML) since 2018

Usage Maturity Level (UML) – Evolution since 2018	No. of user stories
No, the solution was eventually dropped (OPTION A)	0
No. Actually, when looking at the period since the Copernicus4Regions publication, we would now assign a lower UML (OPTION B)	0
No, it remained more or less at the same UML (OPTION C)	20
Yes, we transitioned to a higher level (OPTION D)	34

CHALLENGES AND ACHIEVEMENTS – Findings in Survey Section 5

In this section, the Authors were asked to identify any challenges that have prevented the uptake of a technological solution in a Public Administration or, on the contrary, any facilitating conditions that had helped to accelerate the uptake process.

Findings on Copernicus user stories in which UML remained more or less at the same

The reasons for UML remaining at the same stage across different user stories are illustrated in Table 12. The answers presented below regard 20 user stories.

Table 7 Reasons for choosing “OPTION C” per number of user stories (Total of 20)

Reasons proposed for the solution remaining at the same stage since 2018	No. of user stories
During the last period, there was no need/opportunity to perform any other trial/activity (e.g. to face an emergency). However, the solution remains in the interest of the organisation	7
In-house expertise is still being developed (e.g. training being organised)	1
The necessary administrative process (e.g. formal approvals, allocation of funds...) is still to be finalised	3
In-house expertise has been lost and still needs to be renewed (e.g. the contract of the person who had pursued the solution has expired / the person who had pursued the solution left and the gap is still to be filled)	1
Activity is on stand-by because validation is still ongoing (e.g. the administration needs to verify that the solutions fit all the requirements)	2
No changes have been made due to the Covid-19 crisis	0
The solution remained at the same (high) UML stage and it has been better integrated into the workflow of the administration	3

In addition to the answers proposed, three (3) user stories have replied differently, identifying other reasons. These answers are reported in detail here below:

- ID74_EARTH OBSERVATION AND PARTNERSHIPS TO SUPPORT LAND USE MANAGEMENT (Track BIODIVERSITY AND ENVIRONMENTAL PROTECTION) declares that ***“liaisons with the Public Administration have left”***.
- ID77_HOW COULD COPERNICUS DATA SUPPORT GRASSLAND CONSERVATION? (Track BIODIVERSITY AND ENVIRONMENTAL PROTECTION) states that the solution was used for ***“data product generation in other projects/activities; gained know-how has been used for the development of new Sentinel satellite data-based solutions”***.
- ID90_KEEPING TRACK OF RETREATING GLACIERS IN ICELAND (Track CLIMATE, WATER, AND ENERGY) declares that ***“the task has moved to another institution”***.

Findings on Copernicus user stories that have transitioned to a higher UML

The reasons for UML remaining at the same stage across different user stories are illustrated in Table 12. The answers presented below regard 34 user stories.

Table 8 Reasons for choosing “OPTION D” per number of user stories (Total of 34)

Reasons proposed for the solution transitioning to higher UML	No. of user stories
New funds were allocated within the organisation itself (e.g. transition to UML)	3
New funds outside the space program (e.g. agriculture, cohesion, recovery, and resilience) were allocated by an external entity (e.g. EU Cohesion funds, Recovery Plan for Europe, others)	1
New space funds were allocated (e.g. national space funds or funds provided by National Space Agencies, ESA, EC) to uptake the space-based solutions into territorial practices	7

New expertise was acquired in the organisation (e.g. personnel was trained and/or new staff was hired)	2
Increased awareness about the Copernicus programme at the decision-making level (from external sources)	7
Increased recognition of the effectiveness of the solution at the decision-making level based on the achieved results and return-of-experience	9
The solution was integrated into the workflow of the administration	5

In addition to the answer proposed two user stories elaborated on their choice in detail, both recalling novel expertise at the end-user. Specifically:

- ID37_TRACKING STORMS AND HURRICANES USING SAR IMAGES (Track CLIMATE, WATER, AND ENERGY) identifies several reasons that are summarised here: "i) Increased recognition about the effectiveness of the solution at the decision-making level based on the achieved results and return of experience; ii) new space-funding (ESA Cyclone Monitoring Service) and iii) **new expertise acquired at the end user level** (e.g. World Meteorological Organisation).
- ID41_MONITORING HERITAGE AT RISK WITH SENTINEL-2 (Track CULTURAL HERITAGE, TOURISM, AND LEISURE) identifies ***“New training, capacity building and dissemination [at the end-user side]”*** as a relevant cause for solution better uptake.

USER STORY SUMMARY AND PERSPECTIVES – Findings on Survey Section 6

All 55 user stories have provided more detailed information regarding two aspects: i) concise summary about ***“how did your story evolve in the last years”*** and ii) about ***“what are the plans for the future”***.

Such information was used to fill user story Evolutions sheets; more specifically evolution information was used for Sections ***“Abstract”*** and ***“Interesting facts”*** while plans for the future were translated into the ***“Outlook to the future”*** section. For more detailed information, refer to single user stories Evolution sheets.

More information and details about each user story can be found in the Evolution sheets in Annex II and are published on the Nereus website.

SUMMARY OF THE MAIN FINDINGS OF THE QUESTIONNAIRE

Here below a summary of the main findings of the survey questionnaire:

- There are 14 possible relationship combinations between Service Providers and End users. The most frequent value-chain scenario is “scientific entity producing a solution for a PA”.
- More than 80% of user-stories, there was some technical advancement of the Copernicus-based solution, with focus on automation and performance improvements.
- For more than 50% of Authors “Replicability” of the solutions was achieved as an Economic benefit.
- Reduction of depletion of natural resources is the most recognized Environmental benefit (20%).
- More than 75% of User stories recognise an “increase in technical and/or scientific expertise related to Copernicus or EO within the Public Administration”. This indicator is confirmed across all eight thematic areas and for solutions with different UML.
- There is a tendency of the applications to advance in specific categories of User Maturity Level, precisely in categories “UML 2 - Ad hoc user” and in “UML 5 - Operational user”.
- Copernicus’ benefits are recognised at decision making level, as declared by more than 25% of respondents.
- Allocation of “New space funds” is the most popular facilitating circumstance for the solution to transition to the higher UML.
- Six applications provide concrete operational solutions within institutional workflows.
- Four out of these six operational solutions belong to the traditional EO thematic track “AGRICULTURE, FOOD, FORESTRY AND FISHERIES”.

CHAPTER IV DISCUSSION OF THE FINDINGS: MAIN OUTCOMES AND RECOMMENDATIONS

This Chapter of the Report presents a discussion of the main findings obtained through an in-depth analysis of the results. The findings are structured in response to the main objectives introduced in the Background chapter (chapter I) and suggest some main outcomes of the overall activity.

OBJECTIVE 1 | Have Sentinel-based services and products been incorporated into the flow of daily administrative processes?

Main outcomes

The “Value-chain” analysis identifies **14 possible relationship combinations of providers/End users**. **“Scientific entity producing a solution for a PA” (14 solutions)**, registers as the most frequent “value-chain” scenario. A high number of solutions (10-15% of all answers) declare that Copernicus based solution was produced by a **commercial company for a PA or by a scientific entity for other users**, while an interestingly high number of solutions, circa 10%, were developed **PA for other users**.

It can be argued that there is still a tendency of Public Administration to assume a traditional role of a client, which will then request for a tailor-made solution development to an external Service Provider. Moreover, a group of applications (11% of respondents) confirms solution development **by the PA for other users**. Such an indicator could point out that PAs might be investing in internal resources for EO-based solution development.

In detail...

The **“Science and Technology”** Benefits domain further supports the “investment in internal resources” possibility: for more than 75% of user stories Authors declare that an **“increase in technical and/or scientific expertise related to Copernicus or EO within the Public Administration”** has occurred. More specifically, this indicator is confirmed across all eight (8) thematic areas and for solutions with different UML (UML 2 to 5).

In terms of additional benefits expressed and integration of applications in the administrative processes, the **“Regulatory domain”** was one of the most interesting to consider. The parameter **“The solution has facilitated or improved the compilation of institutional reports by the PA”** accounts as important for almost half of user stories that identify additional overall benefits of the solution in the period after 2018. In detail, this indicator is confirmed across all eight (8) thematic topics and for solutions with a medium-high UML (UML 3 to 5). The other two indicators rank quite high as descriptors for circa 30% of user stories, respectively **“Improvements in the policy monitoring capabilities of the PA in charge”** and **“The solution has helped to inform the design/review of policy parameters”**.

From the perspective of the **“Economic domain”**, indicators on **“Efficiency gains [...] registered”** and **“Replicability”** [has been achieved] account for more than 40% of user stories each. In the **“Societal domain”** the main emphasized parameters can be interpreted in this manner: more than half of the Authors declare that there have been **“improvements in public awareness”**, while high numbers of

Authors declare *“Improved coordination and governance”* and *“Increased sense of trust/community for the involved actors”*.

The scenarios here analysed imply that the benefits of space-based applications have been recognized in the actual everyday work practice of the LRAs. A positive impact of these changes could contribute to a more collaborative environment across sectors in the future.

USER STORY HIGHLIGHT! ID91_DON’T POUR MONEY DOWN THE DRAIN - FIX IT! (Track CLIMATE, WATER AND ENERGY) | Authors evaluates (Tier2 – Primary user) that *“a marked increase in awareness and collaborative with public entities (national agencies, regional and municipal), and across sectors is an ongoing driver for innovation”*.

USER STORY HIGHLIGHT! ID03_03_EO FOR SUSTAINABLE URBAN PLANNING (Track TERRITORIAL MANAGEMENT AND URBAN PLANNING) | A fruitful collaboration with a unique example of *“in-house expertise development”* occurred: An Author states: *“At the time of the publication, I was in the research unit who developed the product. I’m now inside the PA and in charge of the administration of this subject. My interest [in the initiative] is high. I’m convinced about Copernicus service but in conjunction with the regional dataset. Communication and transfer of knowledge between regions should be improved and more budget on downstream service should be invested to make operational use of the Copernicus data”*. Nathalie Stephenne, Service Public de Wallonie (SPW), Belgium

A significant figure for Objective 1

Figure 9 illustrates how the type of Value-chain solutions varies over the percentage of user stories.

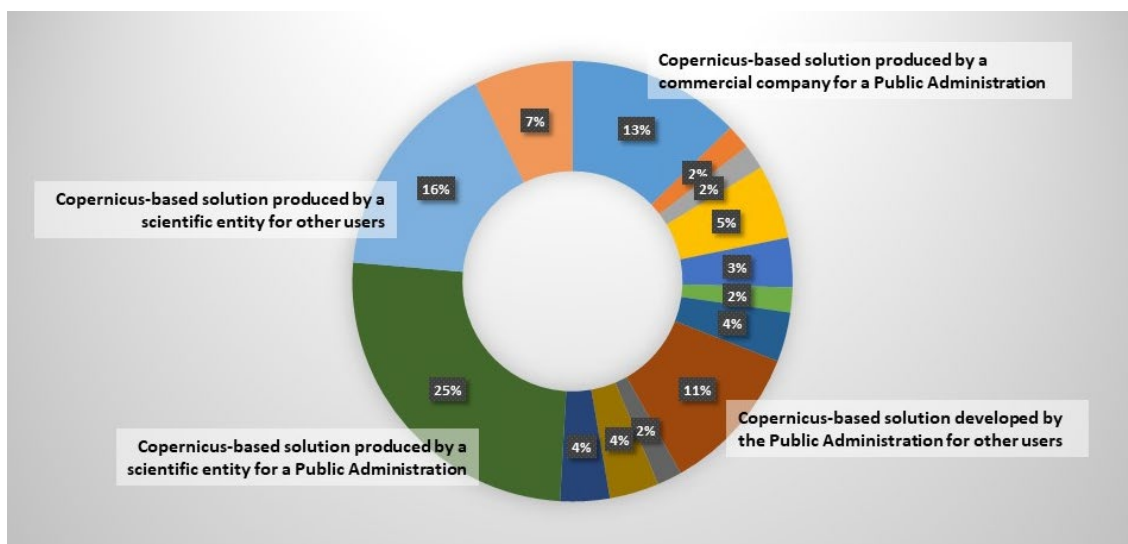


Figure 9 "Value-chain" of Copernicus-based solution - percentage on a sample of 55 user stories

OBJECTIVE 2 | Was the space solution institutionalized, if the Public Administration grew increasingly engaged?

Main outcomes

Observations can be made on why (if any) solutions became institutionalised, that is to say if they became operational solutions within the institutional workflow. In this respect, the results regarding UML variations and the feedback on challenges and achievements have been analysed.

Firstly, variations of the User Maturity Level show a tendency of the applications to advance in specific categories (levels). Figure 10 illustrates this tendency specifically in the categories of “UML 2 - Ad hoc user” (an increase from 7 to 9 applications) Users and in the category “UML 5 - Operational user” (an increase from 9 to 17 applications). It must be noted that none of the 55 user stories declares a drop in UML, hence both of these shifts to UML2 and UML 5 are to be read as positive tendencies (increase in numbers).

The explanations for changes in UML were further searched through analysis of i) the main obstacles for the solution advancement; ii) the reasons for the solution possibly staying at the same level and iii) the situations that have facilitated the solution transition to a higher UML.

A significant figure for Objective 2

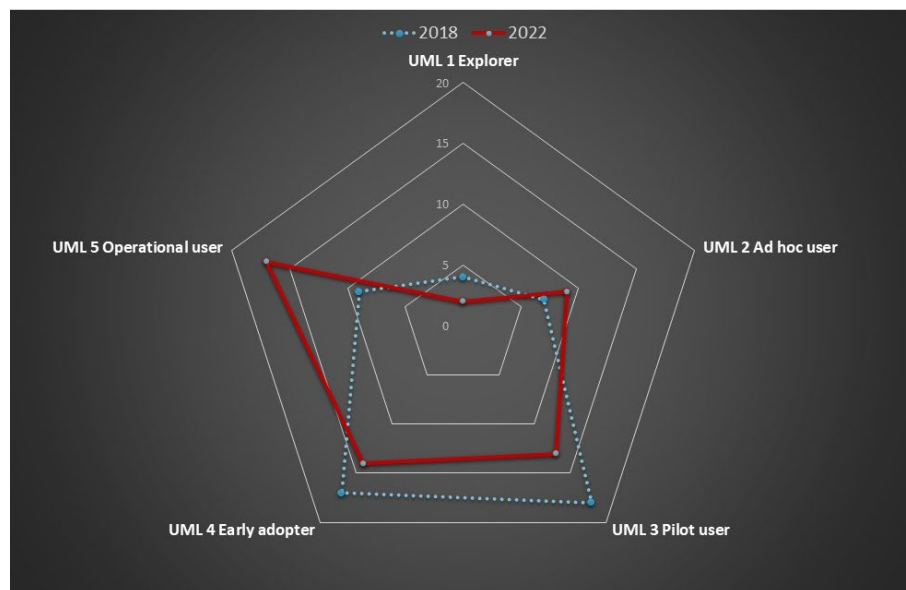


Figure 10 A tendency to advance with the User Maturity Level uptake in 55 user stories analysed

In detail...

SCENARIO 1 Copernicus-based solution remained at the same UML: what were the reasons?

A loss of liaisons within the PA or a task (solution implementation) being moved to another institution could be seen as a negative outcome. On the other side, if the solution was used to build upon and develop other services, this should be seen as a positive consequence of the original Copernicus-based application.

For the **"Activity in stand-by because validation is still ongoing"** parameter, for example, one Story identifies the current search for funding. Another Story declares that the solution stayed at the same UML **because there were no additional emergencies, for which the 2018 solution was originally designed.** This motivation is the main reason for the **highest number (7) of user stories** in the batch. What comes to mind is that such Stories could reflect a more "traditional" generation of EO applications. Given that the Copernicus programme is a successor of Global Monitoring for Environment and Security (GMES), **it was likely that some of the original applications (even at a high UML) have been developed for specific emergencies.** It can be argued that such original solutions have a targeted and very high technological performance, but perhaps a shorter life span (or one-off application opportunity), compared to solutions used for continuous or at least more systematic monitoring.

USER STORY HIGHLIGHT! ID30_A SMARTPHONE APPLICATION DELIVERING METEO-MARINE DATA TO THE PUBLIC (Track TRANSPORTS, CIVIL INFRASTRUCTURE AND SAFETY) stayed at already very high UML 5: *"There is increasing awareness at all levels, including the general public, about the importance of marine data especially for informed decisions even in everyday situations such as those associated with safety at sea. We need to strive to give improved and more relevant data that is easily understood by users and directly satisfies their needs". Prof. Aldo Drago, Physical Oceanography Research Group, Dept. of Geosciences, University of Malta, Malta*

SCENARIO 2 Copernicus-based solution transitioned to higher UML: what were the facilitating circumstances?

The reasons for the solution transitioning to a higher UML were studied considering 34 user stories feedback. The results show that in the majority of cases the reason for success is reflected in **"Increased recognition about the effectiveness of the solution at the decision-making level based on the achieved results and return-of-experience"**. This could imply that a trial- or demo phase, reveals as necessary to prove the benefits of Copernicus-based (and probably more generally for space-based) solutions. Hence, EO-based solutions probably still require to justify the investment and their effectiveness before being included more systematically in the decision-making process.

USER STORY HIGHLIGHT! ID_95 COPERNICUS DATA GIVE PROSPECTS (Track CIVIL PROTECTION) reports **"Increased awareness about Copernicus programme at decision-making level"**, and states: *"The Municipality of Thessaloniki, is taking part in a Steering Committee for the "Earth Observations Toolkit for Sustainable Cities and Human Settlements". This Committee consists of nineteen (19) members that represent cities, countries, research institutes, academia, and non-profit parties [...] to share expectations and identify unmet needs and ways to help encourage the use of EO data."* **Mr. Simos Misirloglou, GIS Department, Municipality of Thessaloniki, Greece**

SCENARIO 3 Copernicus-based solution has transitioned to higher UML: what are the new funding typologies allocated for the solution development?

Additional funding plays a crucial role in solution development (and survival) even after the first envisaged period.

Eleven (11) user stories identify new funding possibilities. In specific cases there was a strong institutional will, hence **“New funds were allocated within the organisation itself”** for the transition to the higher level. This occurred specifically for three (3) solutions that were developed under different “Value chain” profiles in different regions, specifically:

- ID56_A NEW DETAILED CROP AND NATURAL LAND MAP (Track AGRICULTURE, FOOD, FORESTRY AND FISHERIES), developed by the scientific entity and PA for PA’s internal use and other users (CASTILLA Y LEON, SPAIN);
- ID14_A SPACE-BASED SOLUTION FOR OIL SPILL DETECTION (Track BIODIVERSITY AND ENVIRONMENTAL PROTECTION), developed by the scientific institution for the Public Administration (CENTRAL MACEDONIA, GREECE).
- ID03_EO FOR SUSTAINABLE URBAN PLANNING (Track TERRITORIAL MANAGEMENT AND URBAN PLANNING), developed by the scientific institution for the Public Administration (WALLONIA, BELGIUM).

Seven (7) solutions identify a parameter **“New-space funding”** as a facilitator for passing to a higher UML.

One other solution identifies as a reason for the success (the allocation of) **“New funds outside the space program”**. Although the solutions were based on a traditional EO topic of hazards monitoring, the domain of application is the "non-traditional" field of Cultural Heritage (ID42_PROTECTION OF EUROPEAN CULTURAL HERITAGE FROM GEOHAZARDS).

A significant figure for Objective 2

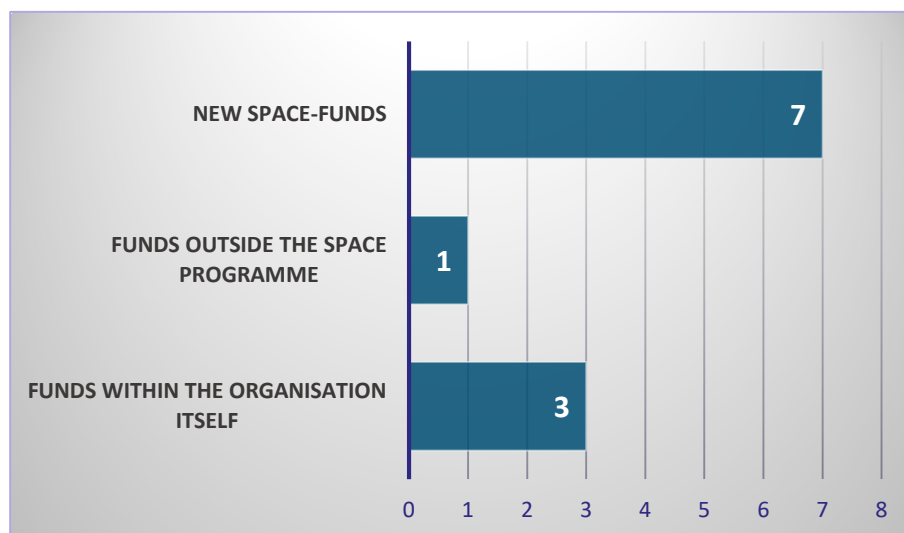


Figure 11 Funding typologies allocated for the solution development

SCENARIO 4 Copernicus-based solution has transitioned to a higher UML and is now operational within an institutional workflow

Five (5) applications declare to provide concrete operational solutions within institutional workflows. An additional solution (1) chooses the answer "The solution remained at the same (high) UML stage and it has been better integrated into the workflow of the administration".

More information on single user stories can be found in the contents of the Evolution sheets.

USER STORY HIGHLIGHT!

There are six (6) operational Copernicus-based solutions, implemented within institutional workflows. Four out of six solutions belong to the more traditional EO track "AGRICULTURE, FOOD, FORESTRY AND FISHERIES".

A significant figure for Objective 2

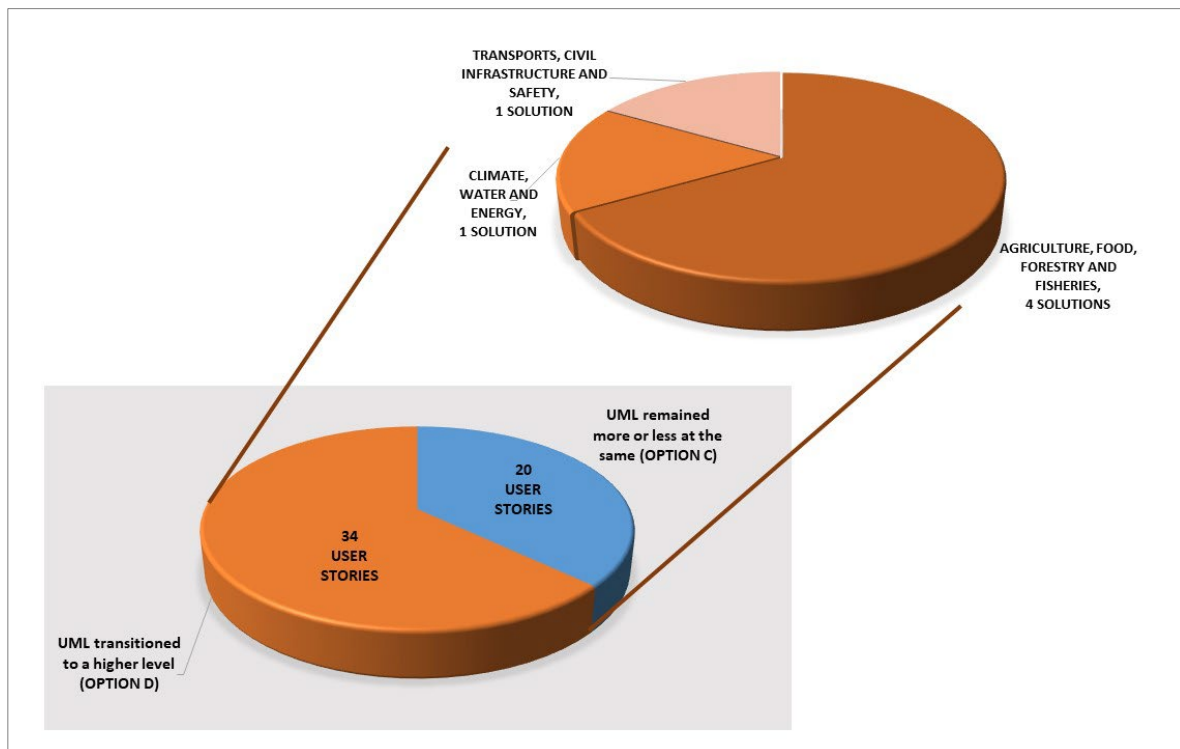


Figure 12 Challenges and Achievements: UML variations and solutions integrated into the organisational workflow

OBJECTIVE 3 | Have any new applications emerged from the portrayed user stories?

Main outcomes

Four (4) feedbacks state that *“The solution has helped to create some new business”*. Three such solutions belong to the track Forestry and Biodiversity:

- ID70_SATELLITES MONITOR FOREST CHANGES IN FINLAND (Track AGRICULTURE, FOOD, FORESTRY AND FISHERIES)
- ID75_ENABLING EARTH OBSERVATION FOR PROTECTED AREAS (Track BIODIVERSITY AND ENVIRONMENTAL PROTECTION)
- ID76_EO FOR BIOTOPE-TYPE MAPPING IN THE ALPINE ZONE IN AUSTRIA (BIODIVERSITY AND ENVIRONMENTAL PROTECTION)

One (1) user story belongs to the Cultural heritage domain.

- ID42_PROTECTION OF EUROPEAN CULTURAL HERITAGE FROM GEOHAZARDS (Track CULTURAL HERITAGE, TOURISM AND LEISURE)

It can be argued that Copernicus-based solutions generating new business belong to more "traditional" sectors of Earth Observation. However, a non-traditional sector such as the "Cultural heritage" domain is also benefitting from several new opportunities.

More information on single user stories can be found in the contents of the Evolution sheets.

USER STORY HIGHLIGHT! ID75_ENABLING EARTH OBSERVATION FOR PROTECTED AREAS, track BIODIVERSITY AND ENVIRONMENTAL PROTECTION. The Author recognises as an added value of the solution for the *“establishment of a permanent exhibition at the Centre for Alternative Technology”*.

A significant figure for Objective 3

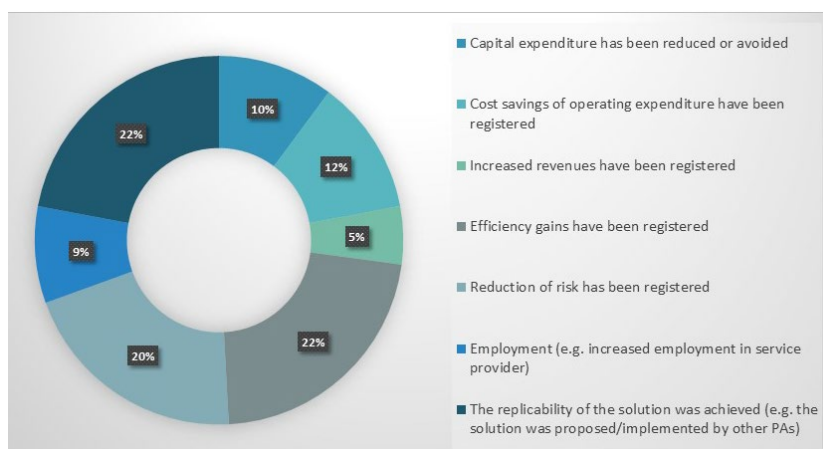


Figure 13 Relevance of indicators in the Economic domain, as identified by Authors of 55 user stories

OBJECTIVE 4 | Have any of the space-based solutions made it to the market?

Main outcomes

This was an optional objective of the survey. However, some considerations can be made concerning the Benefit domain of "Innovation and Entrepreneurship". Here almost half of the Authors (14 of 31) reply that ***"There were positive market externalities i.e. the service provider expanded its market share thanks to the solution"***.

USER STORY HIGHLIGHT! ID 28_MONITORING THE HEALTH OF WATER SEWERAGE NETWORKS (track TRANSPORTS, CIVIL INFRASTRUCTURE AND SAFETY). The solution has evolved as Rheticus® Network Alert a cloud-based service designed to provide Copernicus-based data and analytics to utility companies. It integrates Artificial Intelligence to provide new insights and features. The services are currently adopted by several utility companies in Europe and worldwide: HERA, VEOLIA, Municipalities of Santiago del Chile and Madrid, to name some.

ADDITIONAL OUTCOMES

Additional outcome 1 | Analysis of the User Maturity Level (UML) variations

Who has replied to the survey?

- i) Stories at a relatively high initial UML (original story in 2018) account for 80% of all respondents.
When observing the User Maturity Level in relationship to the feedback provided, it can be demonstrated that the stories that have provided feedback to the survey were the ones declaring **UML = 3 i.e. Pilot – Experimental tester level** back in 2018. The total number of such stories accounts for **18 out of 55 responses**. The second most frequent category was UML = 4 – i.e. Early adopter for **17 out of 55 responses** and then **UML=5 i.e. Operational user** that accounts for **9 out of 55 responses**. Hence, it could be argued that Authors of user stories with initially relatively high UML (i.e. 3 to 5) were more confident to report their user stories evolution, be it with positive or less positive outcomes.
- ii) It is important to notice that seven (7) user stories that state UML =2 in 2018 (i.e. Ad-hoc user) have replied to the survey. Four (4) of these user stories testify a transition to a higher UML since 2018.
- iii) Most user stories (specifically 29 of 43 user stories, UML 3 to 5 in 2018) declare that their solution has transitioned to a higher level or in the case of initial UML 5 that it stayed at the same (high) UML.
- iv) On the contrary, a **high number of user stories (25) with UML 3 in 2018 has not provided any feedback**. Such applications (Pilot/Experimental tester category) were often developed within European-funded projects. **The scenario analysed could suggest that after the project funding has ended, there was probably no follow-up in solutions development and implementation.**

A significant Table for UML variations analysis

Table 9 Numbers of Stories providing and still missing evolution feedback in comparison to their UML in 2018

UML Value in 2018	N. of user stories providing evolution feedback	N. of user stories missing evolution feedback
UML 1 – Explorer	4	4
UML 2 – Ad-hoc user	7	2
UML 3 – Pilot/Experimental tester	18	25
UML 4 – Early adopter	17	8
UML 5 – Operational user	9	5

Additional outcome 2 | Copernicus for cross-regional cooperation

Several cases give evidence of how Copernicus-based solutions have enabled cross-regional collaborations in case of similar challenges faced by Public Administrations. Specifically, this occurs in the domains of AGRICULTURE, FOOD, FORESTRY AND FISHERIES, TERRITORIAL MANAGEMENT AND URBAN PLANNING, and BIODIVERSITY AND ENVIRONMENTAL PROTECTION.

Authors find that in cross-border situations, possible trans-national extensions of Copernicus-based solutions could be valuable for investigations such as highly urbanized areas near borders that are facing similar challenges in several topics such as land planning and territorial management, implementation of European and national environmental policies, flood risks of trans-national river basins and others.

USER STORY HIGHLIGHT! ID05_AGRICULTURE CAP SUBSIDIES CONTROL (Track AGRICULTURE, FOOD, FORESTRY AND FISHERIES) | In the next years, this Copernicus-based solution foresees an expansion of commercial CAPCON service into the Baltic Sea region and northern Europe - Latvia, Estonia, Poland, Germany, Denmark, Sweden, and Ireland in support of Common Agriculture Programme (CAP) implementation.

Recommendations based on the Update activity outcomes

This section summarises several recommendations for possible future activities. The following recommendations can be considered a direct outcome of the Copernicus4regions Update Activity.

Recommendation 1. Environmental benefits and policy targeting

European Green Deal cites: [EU needs to] *“increase significantly the large-scale deployment and demonstration of new technologies across sectors and across the single market”*. In this context, *“New technologies, sustainable solutions, and disruptive innovation are critical to achieve the objectives of the European Green Deal”*. The overall results of this Report and the Evolution sheets show that Copernicus-based solutions and applications have the potential to support European public administration in their everyday practices of policy implementation.

For example, specific Environmental benefits can vary depending on the Thematic area of the application. User stories feedback suggests a need for an improved assessment of parameters in this domain of benefits. Hence, in the future, leverage could be made on both Environmental benefits and benefits for specific policy implementation, keeping the perspective of the broader geospatial framework in which European PAs already operate proactively.

Recommendation 2. Need for more systematic contact with Public administrations

The findings of this Report allow arguing that most of the original stories were linked to personal or group research, or carrier development. Probably, many solutions were not originally fully integrated into the processes of public administration. In several cases, the main Authors have changed their affiliations or they were not anymore in charge of the original stories presented in 2018. Many Authors that did answer in the first few months were already personally motivated and well acquainted with the Copernicus4Regions initiative. Hence, in addition to contacts with Authors responsible for one or a few solutions, the recommendation would be to establish long-term contact and promote the work of the public administration which was involved in solution implementation.

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Selected sitography

Copernicus programme | <https://www.copernicus.eu/en>

Sentinel online | <https://sentinel.esa.int/web/sentinel/home>

Copernicus User Uptake | <https://www.copernicus-user-uptake.eu/about>

The new common agricultural policy: 2023-27 | https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/new-cap-2023-27_en

Agile Alliance | <https://www.agilealliance.org/>

LIST OF ANNEXES

Annex I: Original survey questions

Annex II: User stories Evolution Sheets (PDF version of 55 publishable documents)

ANNEX I

ORIGINAL SURVEY QUESTIONS

LET'S MAKE THE COPERNICUS4REGIONS STORIES EVOLVE!

Welcome to the Copernicus4regions questionnaire!

NEREUS in cooperation with European Space Agency and the European Commission intends to analyse the evolution of the 99 Copernicus4regions user stories. By replying to the following questions, you can help us to understand how applications have evolved and if there were any common challenges or quick wins. The analysis will feed discussions on the evolution of Copernicus User Uptake: the outcomes will be presented to politicians and Copernicus decision-makers in a dedicated webinar. We will also publish an "evolution sheet" dedicated to your own User Story!

Let's start!

Copernicus4region homepage URL: <http://www.nereus-regions.eu/copernicus4regions/about>
(<http://www.nereus-regions.eu/copernicus4regions/about>).

::: Privacy statement :::

Responsible party: the party responsible for the contents of this questionnaire is
NEREUS – Network of Regions Using Space Technologies
c/o representation of Hesse to the European Union
21, rue Montoyer
1050 Brussels, Belgium

Legal notice: We collect your information only with your consent and in line with GDPR 2016/679. We collect only a minimum amount of personal information that is fit to fulfil the purposes of your interaction with us. For more information please consult: <https://www.nereus-regions.eu/privacy-and-data-protection/>
(<https://www.nereus-regions.eu/privacy-and-data-protection/>).

* Required

AUTHOR'S PERSONAL INFORMATION (survey respondent)

1

Name of the author *

2

Surname of the author *

3

Affiliation of the author (expanded name of the institution, name of the Department) *

YOUR COPERNICUS4REGIONS USER STORY

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Your Copernicus4regions User Story: TITLE

Insert the title of your article in the Copernicus4regions Publication. You can easily find it here:

<http://www.nereus-regions.eu/copernicus4regions/user-stories-sheets/> (<http://www.nereus-regions.eu/copernicus4regions/user-stories-sheets/>). *

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Your Copernicus4regions User Story: THEMATIC AREA *

- AGRICULTURE, FOOD, FORESTRY AND FISHERIES
- BIODIVERSITY AND ENVIRONMENTAL PROTECTION
- CIVIL PROTECTION
- CLIMATE, WATER AND ENERGY
- CULTURAL HERITAGE, TOURISM AND LEISURE
- PUBLIC HEALTH
- TERRITORIAL MANAGEMENT AND URBAN PLANNING
- TRANSPORTS, CIVIL INFRASTRUCTURE AND SAFETY

Your Copernicus4regions User Story: VALUE CHAIN

There are different ways in which Copernicus-based solutions can be exploited by the Public Administration. Understanding how this works is useful for delineating the ecosystem of usage. Among the possible "value chain"* descriptions below, please select the one which describes best your User Story?

**Value chain definition according to Sentinel Benefits Study (SeBS) developed by EARSC
More information about SeBS initiative available here: <https://earsc.org/sebs/>
(<https://earsc.org/sebs/>). **

- Copernicus-based solution produced by a commercial company for a for a Public Administration
 - Copernicus-based solution produced by a commercial company for other users (e.g. companies, professionals, agencies, associations, single citizens)
 - Copernicus-based solution produced by a scientific entity for a for a Public Administration
 - Copernicus-based solution produced by a scientific entity for other users (e.g. companies, professionals, agencies, associations, single citizens)
 - Copernicus-based solution developed by the Public Administration for internal use
 - Copernicus-based solution developed by the Public Administration for other users (e.g. companies, professionals, agencies, associations, single citizens)
 - I don't know
 -
- Other

SECTION 2 THE SPACE-BASED SOLUTION

Along time, the technical solutions may have evolved, improving in accuracy, efficiency or usability, or taking stock of new datasets available from Copernicus.

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With respect to your article in 2018, would you consider that the Copernicus-based solution is now more technically advanced? *

- No, the solution was dropped and no further improvement was made
- No, there was no noticeable modification and the solution is the same as it was
- Yes, additional types of Copernicus Sentinels data/Copernicus Services data type are now used
- Yes, additional information is now generated
- Yes, there were significant performance/automation improvements
- Yes, the solution is now more accurate and reliable
- I don't know
- Other

Please specify the additional types of Copernicus Sentinel data and/or additional Copernicus Services data type now used. *

- Sentinel-1
- Sentinel-2
- Sentinel-3
- Sentinel-5P
- Sentinel-6
- Copernicus contributing missions
- Copernicus Atmosphere Monitoring Service (CAMS)
- Copernicus Marine Monitoring Service (CMEMS)
- Copernicus Land Monitoring Service (CLMS)
- Copernicus Climate Change Service (C3S)
- Copernicus Security Service (SECURITY)
- Copernicus Emergency Monitoring Service (CEMS)

If "YES" please provide some details. For example, were any new outputs generated; were there any significant performance/automation improvements in the solution; is the solution now more reliable?

SECTION 3A: BENEFITS TO USERS

BENEFITS TO PUBLIC ADMINISTRATION AND CITIZENS

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Benefits to users can stem over time, as usage is consolidated and more widespread, or following upgrades in the technical solution or a more operational usage.

With respect to your article published in 2018, have you noticed any additional benefits to the functioning of the public administration (PA) and/or any benefits to the citizens? *

- No, there was no noticeable modification/impact on the functioning of the public administration nor on the lives of the citizens
- Yes, there were noticeable impacts in the functioning of the public administration and on the lives of the citizens

SECTION 3B: BENEFITS TO USERS ACCROSS SPECIFIC DOMAINS

If you replied "YES" in the previous question, please help us to understand better in what domains* have these benefits occurred.

**the domains according to Sentinel Benefits Study (SeBS) developed by EARSC*

More information about SeBS initiative available here: <https://earsc.org/sebs/> (<https://earsc.org/sebs/>)



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If benefits have been noticed in the ECONOMIC domain, please select the appropriate indicators below or add in "Other": *

- Capital expenditure has been reduced or avoided
 - Cost savings of operating expenditure have been registered
 - Increased revenues have been registered
 - Efficiency gains have been registered
 - Reduction of risk has been registered
 - Employment (e.g. increased employment in service provider)
 - The replicability of the solution was achieved (e.g. the solution was proposed/implemented by other PAs)
 - No benefits in this domain
 -
- Other

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If benefits have been noticed in the ENVIRONMENTAL domain, please select the appropriate indicators below or add in "Other": *

- Reduced pollution
 - Reduced impact on biodiversity
 - Reduced depletion of natural resources (e.g. reduced water consumption, reduced soil sealing...)
 - No benefits in this domain
 -
- Other

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If benefits have been noticed in the REGULATORY domain, please select the appropriate indicators below or add in "Other": *

- The solution has helped to inform the design/review of policy parameters
 - There were improvements in the policy monitoring capabilities of the PA in charge
 - The solution has facilitated or improved the compilation of institutional reports by the PA
 - The solution has improved the PA's capabilities to detect and assess non-compliances
 - The solution improved compliance promotion with duty-holders (e.g. acted as a deterrent)
 - The solution allowed to improve accountability of duty holders and/or regulators (i.e. citizens could benefit from increased transparency on the services provided by the PA)
 - No benefits in this domain
 -
- Other

If benefits have been noticed in the INNOVATION AND ENTREPRENEURSHIP domain, please select the appropriate indicators below or add in "Other": *

- The solution has helped to introduce some innovation in the functioning of the public administration (e.g. adopted more efficient or effective business practice)
 - The solution has helped to create some new business (e.g. a spin-off or a new start-up)
 - There were positive market externalities (i.e. the service provider expanded its own market share thanks to the solution)
 - No benefits in this domain
 -
- Other

If benefits have been noticed in the SCIENCE AND TECHNOLOGICAL RESEARCH domain, please select the appropriate indicators below or add in "Other": *

- The solution has helped to improve understanding about a specific topic of interest traditionally not related to Earth Observation (EO)
 - The solution has enabled some technological advancement (e.g. positive technological externalities)
 - There was an increase in technical/scientific expertise related to Copernicus/EO within the PA
 - There was an increase in technical/scientific expertise related to Copernicus/EO at the service provider
 - There was an increase in the research budget share of the institutions involved in the solution (either the PA or others)
 - No benefits in this domain
 -
- Other

If benefits have been noticed in the SOCIETAL domain, please select the appropriate indicators below or add in "Other": *

- Improved coordination and governance has been registered (e.g. increased internal cooperation for the involved actors)
 - Sense of trust/community for the involved actors has increased (e.g. pride and assurance in doing its own job)
 - Civil security has improved (e.g. reinforcement of the sense of safety and protection for society)
 - Strategic added value was registered for the involved actors (e.g. reputational gain or competitive advantage)
 - Strategic added value was registered for society as a whole
 - Administrative burden reduction for citizens was achieved
 - There has been an increased access to public utility
 - There have been improvements in public awareness (e.g. about societal and climate threats)
 - An increased overall quality of life for citizens has been detected (e.g. public health, better environment...)
 - No benefits in this domain
 -
- Other

ADDITIONAL COMMENTS. Please feel free to add here any other indicator/comment if not included in the previous options or to elaborate on selected indicators.

SECTION 4: USAGE MATURITY EVOLUTION

There is a long path before the space-based solution can be fully adopted by the Public Administration and integrated within its institutional processes. We make use of a dedicated index Usage Maturity Level (UML) to evaluate the maturity in the uptake.

In 2018 UML* was defined by the publication "THE EVER GROWING USE OF COPERNICUS ACROSS EUROPE'S REGIONS. A selection of 99 user stories by local and regional authorities".

For more information see: http://www.nereus-regions.eu/wp-content/uploads/2017/10/PUBLICATION_Copernicus4regions_2018.pdf (http://www.nereus-regions.eu/wp-content/uploads/2017/10/PUBLICATION_Copernicus4regions_2018.pdf).

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Please specify current UML* of the solution proposed in 2018 (even if it stayed the same). *

The Usage Maturity Levels				
UML 1 Explorer	UML 2 Ad-hoc user	UML 3 Pilot - Experimental tester	UML 4 Early Adopter	UML 5 Operational user
The LRA has never really made use of the Copernicus-based solution but it has planned ad-hoc tests to assess its potential benefits (e.g. as a project user).	The LRA has used the Copernicus-based solution ad hoc in some specific cases but without an explicit interest to trial repeated usage (e.g. the test followed the initiative of single individuals within the organisation).	The LRA has already used the Copernicus-based solution in one or more trials and is concretely considering its integration within its standard practices.	The LRA has confidently used the Copernicus-based solution and is working to incorporate it as part of its processes (e.g. update of internal procedures, staffing, training...).	The LRA is using the Copernicus-based solution and it has integrated it within its standard processes. The related resources (i.e. staff, budget, facilities) are allocated or readily deployable.

- 1
- 2
- 3
- 4
- 5

With respect to your article in 2018, would you consider that this usage is now more mature? Please refer your answer to the period after the publication of the 2018 user story.

NOTE. Whatever the UML, this choice implies that the user organisation has still an active interest in adopting the solution. *

- OPTION A. No, the solution was eventually dropped
- OPTION B. No. Actually, when looking at the period since the Copernicus4regions publication, we would now assign a lower UML
- OPTION C. No, it remained more or less at the same UML
- OPTION D. Yes, we transitioned to a higher level
- I don't know

SECTION 5 CHALLENGES AND ACHIEVEMENTS - OPTION A/B

Local and Regional Authorities may encounter challenges of different nature that prevent the uptake of a technological solution in a Public Administration. Luckily, they might sometimes also encounter fly-bys that help to accelerate the uptake. Understanding and analysing possibly common root-causes can concretely help to design better policies for exploiting the available solutions.

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OPTION A/OPTION B: In case the solution has lowered its UML or it has been dropped, can you please explain the main reasons for this? *

- The solution had been developed in the frame of a project which has since been stopped and has not been renewed
- The solution was considered not any longer convenient /not worth to be pursued
- The solution was found too technically challenging (e.g. lack of in-house expertise)
- It was too difficult to access the Sentinel data
- The solution had become too expensive
- The in-house expertise has been lost and not renewed (e.g. the contract of the person who had pursued the solution has expired/expert left)
- A more convenient solution, still based on Copernicus, was eventually found and adopted
- A more convenient (non space-based) solution was found
- The solution was dropped or its UML has lowered due to the Covid-19 crisis
- Other

If willing, please describe your answer in more detail.
For example, you can briefly describe the preferred solution. Otherwise, you can specify if "due to Covid-19 crisis reason" considers cuts in personnel, cuts in resources, other.

SECTION 5 CHALLENGES AND ACHIEVEMENTS - OPTION C

Local and Regional Authorities may encounter challenges of different nature that prevent the uptake of a technological solution in a Public Administration. Luckily, they might sometimes also encounter fly-bys that help to accelerate the uptake. Understanding and analysing possibly common root-causes can concretely help to design better policies for exploiting the available solutions.

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OPTION C: In case the solution remained at the same stage, can you please explain the main reasons for this? *

- During the last period, there was not the need/opportunity to perform any other trial/activity (e.g. to face an emergency). However, the solution remains in the interest of the organisation
 - In-house expertise is still being developed (e.g. training being organised)
 - The necessary administrative process (e.g. formal approvals, allocation of funds...) is still to be finalized
 - In-house expertise has been lost and still needs to be renewed (e.g. . the contract of the person who had pursued the solution has expired / the person who had pursued the solution left and the gap is still to be filled)
 - Activity is in stand-by because validation is still on-going (e.g. the administration needs to verify that the solution fits all the requirements)
 - No changes have been made due to the Covid-19 crisis
 - The solution remained at the same (high) UML stage and it has been better integrated in the workflow of the administration
 -
- Other

If willing, please describe your answer in more detail.
For example, you can specify if "No changes have been made due to Covid-19 crisis" considers cuts in personnel, cuts in resources, other.
Otherwise, if the solution has been better integrated in the workflow of the administration specify how.

SECTION 5 CHALLENGES AND ACHIEVEMENTS - OPTION D

Local and Regional Authorities may encounter challenges of different nature that prevent the uptake of a technological solution in a Public Administration. Luckily, they might sometimes also encounter fly-bys that help to accelerate the uptake. Understanding and analysing possibly common root-causes can concretely help to design better policies for exploiting the available solutions.

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OPTION D: In case the solution was up-taken, can you please explain what were in your opinion the main reasons that helped this transition? *

- New funds were allocated within the organisation itself (e.g. transition to UML5)
- New funds outside the space program (e.g. agriculture, cohesion, recovery and resilience) were allocated by an external entity (e.g. EU Cohesion funds, Recovery Plan for Europe, other)
- New space-funds were allocated (e.g. national space funds or funds provided by National Space Agencies, ESA, EC) to uptake the space-based solutions into territorial practices
- New expertise was acquired in the organisation (e.g. personnel was trained and/or new staff was hired)
- Increased awareness about Copernicus programme at decision-making level (from external sources)
- Increased recognition about the effectiveness of the solution at decision-making level based on the achieved results and return-of-experience
- The solution was integrated in the workflow of the administration
-
- Other

If willing, please describe your answer in more detail.

For example, give some details on the type of allocated funds; new training activities adopted; awareness rising activities adopted; examples of recognition of effectiveness.

Or, if the solution has been integrated in the workflow of the administration specify how.

SECTION 6 SUMMARY AND PERSPECTIVES

In this section, please provide a concise summary about how your story has evolved in the last years and about your plans for the future.

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How did your story evolve since the publication?

Please provide here a very short summary of the evolution of your story: this will be featured in your own User Story evolution sheet.

Instructions: You can assume that readers are already knowledgeable about your story. As applicable, refer to the original article: this will highlight consistency of action.

You can start like this: "In the last few years..."

Please use between 200 to 400 characters including spaces. *

What are your plans for the future?

Please provide a brief overview of your perspectives for the next period: this will be featured in your own User Story evolution sheet.

Instructions: As applicable, refer to the original article: this will highlight consistency of action.

You can start like this: "For the future..."

Please use between 200 to 400 characters including spaces. *

SECTION 7 LET'S KEEP IN TOUCH!

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Do you wish to remain informed about the Copernicus4regions initiative? *

Yes

No

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Please provide your updated contact details so we can inform you about the follow up of the initiative and the next actions of the Copernicus4regions community.

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If you wish, please feel free to share with us any additional comments on the Copernicus4regions initiative.
For example, what was your motivation to participate in the first place; do you have any suggestions for improvements; what kind of events would you participate to; what type of content would you be interested in etc.