Cos4Cloud

Co-designed Citizen Observatories Services for the EOS-Cloud

H2020 programme: Research and Innovation action

Deliverable 7.7
Sustainability strategy for Cos4Cloud services on EOSC hub

2023-02-28, Version 1.0

Type		
R	Document, report excluding the periodic and final reports	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, photos, etc.	
SOF	Software, technical diagram, etc.	
OTHER	Flyers, etc.	

Dissemination level		
PU	Public, fully open.	
CO	Confidential, restricted under conditions set out in Model Grant Agreement	X
CI	Classified	

Revision history

R#	Date	Description/Reason of change	Deliverable contributors
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Executive Summary

Cos4Cloud published a set of technological services aimed at the citizen science community, specifically citizen observatories (COs), for the first time on the EOSC Marketplace. The new services integrated cutting-edge technologies and were co-designed with end users to respond to the challenges of the COs. Among the benefits of Cos4Cloud services implementation are the optimization in the identification and validation of the observations, the notification of the use of the data to the end users, the automatic filtering of images and videos, a framework to facilitate the creation of mobile applications that make up of Do-It-Yourself sensors, to name but a few.

The services available on EOSC evolved from existing developments from members of the consortium. The services were created and are maintained by SMEs and research institutions. The challenge once published on EOSC is their sustainability. To this end, the following document consolidates an overview of the sustainability of the services and their challenges in the context of the EOSC. This document also includes the sustainability plans for each of the services, where the following dimensions are stated: Delivery Model, Intellectual Property, Access Model, Financial Model, Operate (legal vehicle), Government Model, Business Model and Funding Strategies. Some of these dimensions are covered in more detail in D7.5 Exploitation Plan.

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1 Citizen science-oriented services on EOSC

The EOSC catalogue and marketplace offer access to services and resources published by the European science community. The EOSC portal serves as a gateway to EOSC services and resources from various domains, allowing users to access and request services provided at institutional, national, and regional levels. This enables users to process and analyze data in a distributed environment. In order to develop a comprehensive platform that offers a wide range of services and resources, the participation of service providers is essential. The services and resources are provided and maintained by different providers under various licenses and access requirements. These include being accessible to users outside the original community, being described using a common template focused on value proposition and functional capabilities, having at least one service instance running in a production environment available to the user community, ensuring that research data is FAIR, having release notes and sufficient documentation available, and having helpdesk channels for support, bug reporting, and requirements gathering (Directorate-General for Research and Innovation -European Commission-, 2020).

Research infrastructures play a crucial role in the EOSC ecosystem as both data producers and service providers. They drive the development and implementation of advanced solutions for effective provisioning and use of high-quality scientific data with robust metadata descriptors, easy access, interoperability, and reusability while adhering to the FAIR principles. Through EOSC, data sharing and reuse can be extended beyond RIs, as it brings together not only RIs but also data, users, and service providers from different national and regional backgrounds. The importance of the FAIR principles has been acknowledged, but investment and convincing all actors to change their practices will require time. EOSC must support research communities in the process of making their resources FAIR by providing tools, training, and expertise. This support should be accompanied by policies that promote the adoption of FAIR principles and that are linked to research funding streams, and ensure alignment across Member States (Ibíd).

Citizen Observatories (COs) are the infrastructure of citizen science. They provide digital tools to collect, store, process, and share the data generated by these type of initiatives. The COs generate millions of data points from various disciplines - in greater numbers from environmental and biodiversity monitoring - and have a community of citizen scientists, scientists, amateurs, developers, and others, who create, validate, and use or disseminate the data. These technological platforms, largely open and collaborative, face important challenges in their development, maintenance, and sustainability. They have limited resources associated with projects that finance a defined establishment period but do not support the CO in the long term. COs are usually managed by research institutions or citizen initiatives that do not count marketing strategies to sustain or expand the CO, among other reasons. At European level, at least in the context of this report, there is a lack of awareness across COs around the existence of transnational or regional initiatives that finance and consolidate a citizen science infrastructure (Momino, J., Piera, J., Jurado, E., 2017).

COs are the main users of Cos4Cloud services. These services are aimed at improving the functionalities and therefore the experiences of the COs' end-users, minimizing the technological problems and the challenges they have in data management. Thinking about the sustainability of services implies considering the sustainability of COs. Given the limited financing available for these kinds of platforms, it is necessary to design strategies that guarantee, as much as possible, free and open access to the services by the COs.

Cos4Cloud services on EOSC

As of the generation date of this report six services are available on EOSC, two services have been submitted to EOSC and are under evaluation and two services have not yet been submitted (See Table 1). More information about the integration of Cos4Cloud services on EOSC is available in the deliverable D2.6 EOSC integration report.

Service	Provider	TRL	EOSC catalogue and marketplace link
Cos4Bio	Bineo Consulting SL	9 - Actual system proven in operational environment	https://marketplace.eosc-portal.eu/services/cos4bio?q=Cos4Bio
MOBIS	DDQ B.V.	8 - System complete and qualified	https://marketplace.eosc-portal.eu/services/mobis-mobile-observation-integration-service/details
FASTCAT-Cloud	DynAIkon	8 - System complete and qualified	https://marketplace.eosc-portal.eu/services/fastcat-cloud-flexible-ai-system-for-camera-trap-images-on-the-cloud?q=FASTCAT-Cloud%3A+Flexible+AI+SysTem+for+CAmera+Trap+images+on+the+cloud
Pl@ntNet API	Plantnet consortium (hosted by INRIA)	9 - Actual system proven in operational environment	https://marketplace.eosc-portal.eu/services/pl-ntnet-identification-service/details
AI-Geospecies	Plantnet consortium (hosted by INRIA)	8 - System complete and qualified	https://marketplace.eosc-portal.eu/services/ai-geospecies?q=AI-GeoSpecies
AUTHENIX	Secure Dimensions GmbH	8 - System complete and qualified	https://marketplace.eosc-portal.eu/services/authenix
Cos4Env	Bineo Consulting SL	8 - System complete and qualified*	Service submitted to EOSC
DUNS	Bineo Consulting SL	8 - System complete and qualified*	Service submitted to EOSC
AI-Taxonomist	Plantnet consortium (hosted by INRIA)	8 - System complete and qualified*	Service not submitted yet

Service	Provider	TRL	EOSC catalogue and marketplace link
GBIF-DL	Plantnet consortium (hosted by INRIA)	8 - System complete and qualified*	Service not submitted yet

Table 1. Cos4Cloud services published on EOSC

An analysis of the integration of the Cos4Cloud services in EOSC and mapping of the Cos4Cloud services and resources to the EOSC marketplace are available in the Deliverable 7.1 Exploitation Plan – ex-ante identification and evaluation of project opportunities.

2 Services sustainability in the context of EOSC Hub

The sustainability of the Cos4Cloud services in the context of the EOSC Hub is linked to the sustainability of the EOSC. According to the report 'Solutions for a sustainable EOSC: a FAIR Lady (olim Iron Lady) report from the EOSC Sustainability Working Group', EOSC does not yet have a defined and implemented sustainability model. The funding priority is in the EOSC core, which makes transversal services available to the various research communities, such as the portal, the authentication and authorization infrastructure, service management, helpdesk, policies, security, etc. In this case, the Cos4Cloud services are part of the EOSC Exchange oriented toward the citizen science community (See figure 1). Therefore, the funding strategies available from the EOSC for services as the Cos4Cloud are limited.
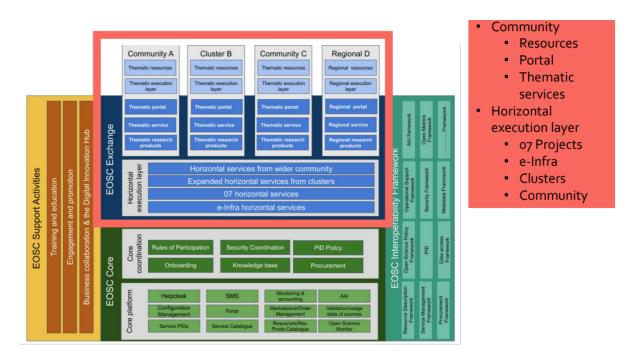

Figure 1. EOSC architecture: core and exchange

Considering the above, this section highlights general challenges and strategies for the sustainability of the services that are part of the EOSC Exchange.

Challenges to the services on EOSC

- **Funding can be geography or community limited:** In Europe; most research is supported at the national level. In many cases, services providers are constrained by their specific national and/or community responsibilities, making it difficult to arrange such funding to satisfy the needs of international research collaboration, particularly multidisciplinary research collaboration. The variety, complexity, and number of different restrictions associated with funding sources result in a less-than ideal-use of the combined Member States' investment in research resources. Consequently, everything that needs to be done to achieve EOSC ambitions is (rightly) seen as a problem because the lack of overheads undermines operational flexibility. So, activities such as cross-border service delivery, VAT, procurement and micro-payments represent severe obstacles to service expansion and integration (Directorate-General for Research and Innovation (JISC, D., and I. Campos. 2021)

- **Limited availability of the service vs research and context timelines:** matching a priori separate timetables across research programs, data protection periods, budget cycles, and service procurement is another problem mentioned in various comments. For instance, a research project could be financed for three years; the data generated by the study must be retained for ten years; the IT support organization receives a budget each year; and they have contracts with third-party service providers that cover a five-year period. It is obvious that managing these various timetables in a way that ensures constant access to researchers while preserving cost-effectiveness is a problem (Ibíd).

- **Lack of business-like skills for sustaining the services:** the EOSC community has a large number of highly qualified and driven individuals working to make sure it is successful. They are having trouble, though, with some of the more business-focused abilities, including accounting, market research, and company planning. If people with these talents could use them more easily in EOSC activities, it would improve the community and make sustainable operations more effective (Ibíd).

- **Undefined long-term data preservation by the services:** The preservation of digital data over the long term is not clearly defined within the context of EOSC, and the roles, responsibilities, and accountability for digital preservation are not well-defined. However, having access to long-term data preservation services is a valuable asset for EOSC. To improve the situation, it is necessary to establish clear roles and responsibilities, evaluate capabilities, and explore funding streams for preservation, including functions and salaries (Ibíd).

- **Services expectations vs services capacities**: researchers expect digital services to be easy to use and access. This includes the availability of single sign-on and that security and privacy requirements are taken care of. Access to e-infrastructures is expected to be free at the point of use. Researchers expect that e-infrastructures will support them in data management planning, that collaboration tools are available, repositories are trusted, and that e-infrastructures offer support and training where necessary (Ibíd).

Strategies addressing services challenges on EOSC

- **Recognize, fund, and promote citizen observatories as research infrastructures:** As a developing field, citizen science needs a specialized research infrastructure connected to EOSC, that can accommodate its unique requirements and social dynamics. For the continuous development and enhancement of the data produced by this sector, it is a priority to dedicate resources to support citizen observatories like the RIs for citizen science.

- **Use of EOSC-Exchange services as eligible cost in DMPs:** the agencies and organizations (such as the European Regional Development Fund and national programs) funding research in EOSC-participating nations should take into consideration making a policy decision to accept the use of EOSC-Exchange services as an eligible cost in data management plans and grant requests submitted by researchers to promote support for FAIR principles.

- **Create alliances and strategies to find private funding for services:** public funding sources, either nationally or globally, are the main financing source for the organizations in the current models of service sustainability. On the other hand, it would seem that private funding or other sources of income are an exception. Promoting public-private partnerships and mechanisms that make it easier for private funds to be received is necessary to maintain the services (EGI Foundation. 2019).

- **Use of in-kind business models:** the expansion and integration of services are severely hampered by practices including cross-border service delivery, VAT, procurement, and micropayments. Several of these cross-border problems have been avoided by certain research infrastructures by using in-kind contributions rather than financial contributions, which are a typical way for Member States (MS) and Associated Countries (AC) to contribute to such multinational initiatives.

- **Incentive the use of Virtual Access (VA) for EOSC-Exchange services**: the European Commission offers the Virtual Access (VA) tool to promote the sharing of research infrastructures and services that would otherwise not be accessible to global user groups. For European or international researchers, the services—also known as "installations"—must be offered "free of charge at the point of use." Open access is open, unrestricted access to services via communication networks to the resources required for research, without preference given to particular researchers (EGI Foundation. 2019).

- **Linking datasets[1] and federating infrastructure[2] in citizen science:** by linking datasets, researchers are able to access a wider range of data and perform more comprehensive analyses. By federating infrastructure, researchers can access a wider range of resources and collaborate more effectively across different disciplines and institutions. In EOSC, linking datasets and federating infrastructure are closely intertwined. By linking datasets, researchers can identify and access the data they need for their research, regardless of its location. By federating infrastructure, researchers are able to access the computing resources and other tools needed to process and analyze this data. Given the

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[1] Linking datasets refers to the process of connecting different datasets from various scientific disciplines and making them accessible through a unified platform. This is achieved through the use of common metadata standards, data formats, and data management policies.

[2] Federating infrastructure, on the other hand, refers to the process of connecting various research infrastructures across Europe to create a seamless and interoperable network. This includes connecting computing resources, data storage facilities, and scientific instruments.

interdisciplinarity and multistakeholder nature of citizen science, this strategy is necessary (EGI Foundation. 2019).

3 Sustainability plans for services

The sustainability plan is divided into eight categories based on three pillars: the financial model, the operational legal framework, and the governance framework. Infrastructure, Delivery Model, Intellectual Property, Access Model, Finance Model, Operation (Legal Vehicle), Government Model, Business Model, Financing Strategy, and Sustainability are the dimensions. Driving and limiting factors are listed as a consolidated sustainability analysis. The Decision authorizing the use of unit charges for actions involving virtual access under the Research Infrastructures Component of the Horizon 2020 Framework Project, served as the basis for the financial model.

For the purposes of these plans, sustainability refers to how to continue offering the Cos4Cloud services, which involves taking their governance, organization, and finance into consideration. Governance, which is about oversight, takes ownership and control of services into account; organization, which considers delivery, operation, and technological advancement of services, as well as user demand for services; and financing, which takes investment and payment for consumption into account. Sustainability is about more than simply money; it also involves larger implications, including fair access, weighing payment contributions against consumption, providing incentives for resource sharing, and the power of minority funders (JISC, D., and I. Campos, 2021).

The sustainability plans consider inputs from the deliverables D7.3 Strategic plan for the exploitation and dissemination of the results (PEDR) (potential actions to be implemented, implementation, and exploitation actions from the exploitation roadmap).

The deliverable D7.2 Dissemination and marketing strategy provides a detailed list of possible stakeholders for potential market expansion per service. Infographics, movies, study cases, and other materials were produced during the project's lifespan and are available for use by the team in charge of the services under deliverable D7.6 Set of Cos4Cloud documentation per stakeholder audience.

Other sustainability aspects connected to D7.7 are established in the deliverable D7.5 Exploitation roadmap V2 that includes: the markets to target and how to reach them; service pricing and sources of revenues; how to be competitive in the market; distribution channels, if relevant; organizational structures and operating partnerships; and non-profit aspects.

3.1   Sustainability plan template

Basic attributes of the service on EOSC

Access type	
Access mode	
Geographical availability	
Order type	

Sustainability components

Organization	
Delivery model	- IaaS: Infrastructure as a service - SaaS: Software as a service - PaaS: Platform as a service
Operate (legal vehicle)	- SME - Research Institution - University - Government agency - Public-private partnership - Other kind of partnership
Funding	
Service costs	Costs to provide access to the service. Including building, promoting, and maintaining Considering costs of interoperable metadata and the operational support services. (European Commission. 2019) - Personnel cost of administrative, technical, and scientific staff directly assigned to the functioning of the service and to the support of the users. - Costs of contracts for maintenance and repair (including specific cleaning, calibrating, and testing) specifically awarded for the functioning of the installation (if not capitalised). - Costs of consumables specifically used for the installation. - Costs of contracts for installation management, including security fees, insurance costs, quality control and certification, and upgrading to national and/or EU quality, safety, or security standards (if not capitalised) specifically incurred for the functioning of the installation. - Costs of energy, power and water supplied specifically for the installation. - Costs of the software licence, internet connection or other electronic services for data management and computing supplied specifically for the installation when they are needed to provide virtual access services. - Costs of specific scientific services included in the access provided or needed for the provision of virtual access by the installation.

Business model	**Open and free** **Membership** -by affiliation - i.e.: anyone affiliated with the organisation is granted access. **Transactional model:** also known as the marketplace model, is an online business model whereby users engage in transactions, and revenue is generated by charging these users a fee or "commission" on each successful transaction. **Excellence-driven access mode:** access primarily depends on the scientific excellence of an application. The access depends on scientific excellence, originality, quality, and technical and ethical feasibility of an application. The access is competitive and requires a user selection based on the service access process and modalities. **Market-driven access:** access to the service is defined through an agreement between the service and the User; the access may be tailored to the user's needs and may lead to access that may remain confidential.
Funding strategies	Tailored funding strategies
Governance	
Intellectual property	- Type of license - Level of reuse or expansion
Decision-making	- Individual - Collaborative - Federative - Other

3.2   Cos4Bio and Cos4Env

Basic attributes of the service on EOSC

Access type	Mail-in
Access mode	Free
Geographical availability	World
Order type	Open Acces

Sustainability components

Organization	
Delivery model	SaaS: Software as a service
Operate (legal vehicle)	SME: Bineo Consulting S.L.
Funding	

Service costs	● The cost for operating the service is established in the deliverable D7.5 Exploitation roadmap V2.
Business model	● **Open and free** ● **Transactional model:** also known as the marketplace model, is an online business model whereby users engage in transactions, and revenue is generated by charging these users a fee or "commission" on each successful transaction. ● The services are now provided without charge, but once they reach a stable point in development, they will be able to establish transactional model charging strategies.
Funding strategies	● Billing of the web services of the Cos4Bio platform in pay-as-you-go mode. ● Donations from Cos4Bio users. ● Financing by contract and calls for projects.
Governance	
Intellectual property	● Type of license: Creative Commons Attribution-NonCommercial-ShareAlike 4.0 ● https://www.safecreative.org/work/2110259629728-cos4bio ● Level of reuse: the license assigned to the service permits other parties to use it as long as it is for noncommercial purposes, and any results shared fall under the same license.
Decision-making	● Individual: SME

3.3   DUNS

Basic attributes of the service on EOSC

Access type	Mail-in
Access mode	Free
Geographical availability	World
Order type	Open Acces

Sustainability components

Organization	
Delivery model	● SaaS: Software as a service
Operate (legal vehicle)	● SME: Bineo Consulting S.L.
Funding	
Service costs	● The cost for operating the service is established in the deliverable D7.5 Exploitation roadmap V2.

Business model	• Open and free
Funding strategies	• Billing of the web services of the DUNS platform in pay-as-you-go mode. • Donations from DUNS users. • Financing by contract and calls for projects.
Governance	
Intellectual property	• Creative Commons Attribution-NonCommercial-ShareAlike 4.0
Decision-making	• Individual: BINEO Consulting S.L.

3.4   MOBIS

Basic attributes of the service on EOSC

Access type	Remote
Access mode	Paid, Free conditionally
Geographical availability	World
Order type	-

Sustainability components

Organization	
Delivery model	• PaaS: Platform as a service
Operate (legal vehicle)	• SME: DDQ
Funding	
Service costs	• The cost for operating the service is established in the deliverable D7.5 Exploitation roadmap V2.
Business model	• **Open and free** • **Transactional model:** also known as the marketplace model, is an online business model whereby users engage in transactions, and revenue is generated by charging these users a fee or "commission" on each successful transaction. • **Market-driven access:** access to the service is defined through an agreement between the service and the User; the access may be tailored to the user's needs and may lead to access that may remain confidential.
Funding strategies	• Consulting (sharing knowledge) • Providing tailor-made interfaces for external peripherals (sensors) • Hosting back-end as-a-service for scientific institutions

- Maintaining apps on the app store
- Customizing these services for new customers
- Join new (R) IA projects as a consortium partner

Governance	
Intellectual property	● Partly open source, some interface modules closed. Front-end software (except iSPEX2) GPLv3
Decision-making	● Individual: DDQ

3.5   Pl@ntNet Identification Service

Basic attributes of the service on EOSC

Access type	Remote
Access mode	Free conditionally, Paid
Geographical availability	World
Order type	-

Sustainability components

Organization	
Delivery model	● SaaS: Software as a service
Operate (legal vehicle)	● Other kind of partnership: PlantNet Consortium (hosted by Inria)
Funding	
Service costs	● The cost for operating the service is established in the deliverable D7.5 Exploitation roadmap V2
Business model	● **Open and free** ● **Membership** -by affiliation - i.e.: anyone affiliated with the organisation is granted access. ● **Transactional model:** also known as the marketplace model, is an online business model whereby users engage in transactions, and revenue is generated by charging these users a fee or "commission" on each successful transaction. ● **Market-driven access:** access to the service is defined through an agreement between the service and the User; the access may be tailored to the user's needs and may lead to access that may remain confidential.

Implementation and Exploitation

- Annual fees organizations or structures belonging to the Pl@ntNet consortium
- Direct sale of services
- Billing of the web services of the Pl@ntNet platform in pay-as-you-go mode
- Donations from Pl@ntNet users
- Financing by contract and calls for projects

Financing resources

- Number of users who signed for the pay-as-you-go version of the API: 15 users by 2022
- Number of queries submitted to the pay-as-you-go version of the API: 5 euros / 1K queries (2 million queries by 2022)
- Number of members of Pl@ntNet consortium paying annually
- Number of premium members (20K euros per year): 5 by 2022
- Number of standard members (10K euros per year): 3 by 2022
- Number of local actors (2K euros per year): 3 by 2022
- Number of donations made: 15k donators
- Value of donations:10 euros per donation

A more detailed Exploitation plan for services developed within the Pl@ntNet platform is provided in Annexe 1 of the deliverable D7.3 Strategic plan for the exploitation and dissemination of the results (PEDR)

Governance	
Intellectual property	• Pl@ntNet API: GPL-3.0 License
Decision-making	• Collaborative: Pl@ntNet Consortium

3.6   AI-Geospecies, AI-Taxonomist and GBIF-DL

Basic attributes of the service on EOSC

Access type	Remote
Access mode	Free conditionally
Geographical availability	World
Order type	-

Sustainability components

Organization	
Delivery model	• SaaS: Software as a service

Operate (legal vehicle)	● Other kind of partnership: PlantNet Consortium (hosted by Inria)
Funding	
Service costs	● The cost for operating the service is stablished in the deliverable D7.5 Exploitation roadmap V2
Business model	● **Open and free** ● **Transactional model:** also known as the marketplace model, is an online business model whereby users engage in transactions, and revenue is generated by charging these users a fee or "commission" on each successful transaction.
Funding strategies	● This service will be exploited in the context of Pl@ntNet, the funding strategies are detailed in Annexe 1 of the deliverable D7.3 Strategic plan for the exploitation and dissemination of the results (PEDR) that includes: ● Annual fees organizations or structures belonging to the Pl@ntNet consortium, with a principle of moving upmarket ● Direct sale of services ● Billing of the web services of the Pl@ntNet platform in pay-as-you-go mode ● Donations from Pl@ntNet users ● Financing by contract and calls for projects
Governance	
Intellectual property	● Type of license: Open-source software (MIT licence)
Decision-making	● Collaborative: Pl@ntNet Consortium

3.7   FASTCAT-Cloud

Basic attributes of the service on EOSC

Access type	Remote
Access mode	Free
Geographical availability	World
Order type	-

Sustainability components

Organization	
Delivery model	● SaaS: Software as a service
Operate (legal vehicle)	● SME: DynAIkon

Funding	
Service costs	● The cost for operating the service is stablished in the deliverable D7.5 Exploitation roadmap V2
Business model	● **Open and free** ● **Membership** -by affiliation - i.e.: anyone affiliated with the organisation is granted access. ● **Transactional model:** also known as the marketplace model, is an online business model whereby users engage in transactions, and revenue is generated by charging these users a fee or "commission" on each successful transaction. ● **Market-driven access:** access to the service is defined through an agreement between the service and the User; the access may be tailored to the user's needs and may lead to access that may remain confidential.
Funding strategies	**Offer paid-for-services:** ● more than a minimum number (to be determined) of images processed* ● video sequences processed* ● data annotation (we process your repository, and data sets, for a fee) *Processing offered: · For free: o (a) Up to 100 frames/stills (detection (empty, with a single animal, with multiple animal instances), classification (confidence levels on animal types) o (b) One short video sequence with similar features (detection, classification). **Paid services:** (a) No limits on number of stills (various packages), archiving/repository (processed). (b) Multiple video sequences, archiving/repository (processed/filtered). 2. License for commercial exploitation/integration of our software. 3. Consulting & Direct sales of services. 4. Financing by contract and calls for projects.

Governance	
Intellectual property	● Software: GPLv3 ● Hardware: CERN OHL-S
Decision-making	● Individual

3.8   Authenix

Basic attributes of the service on EOSC

Access type	Other
Access mode	Other
Geographical availability	World
Order type	-

Sustainability components

Organization	
Delivery model	● SaaS: Software as a service
Operate (legal vehicle)	● SME
Funding	
Service costs	● The cost for operating the service is established in the deliverable D7.5 Exploitation roadmap V2
Business model	● **Open and free** ● **Membership** -by affiliation - i.e.: anyone affiliated with the organisation is granted access. ● **Market-driven access:** access to the service is defined through an agreement between the service and the User; the access may be tailored to the user's needs and may lead to access that may remain confidential.
Funding strategies	The value of AUTHENIX as an OESC Community AAI to operators and users can be channelled into three different revenue streams: ● An operator that registers an API or service to provide access to their site and data could pay a subscription fee that is calculated by the number of users. ● An application implementer, offering novel participation across operators could pay a registration fee. ● Financing contracts with research or education institutions would enable access to Citizen Science platforms and data with their university login.
Governance	
Intellectual property	● Propietary
Decision-making	● Individual

Sustainability analysis

The types of organizations that create and manage the services have a relationship to the strategies for the sustainability of such services. The Cos4Cloud services offered in EOSC are managed under two different types of operational legal frameworks. Five of them were developed and are managed by small and medium-sized businesses (SMEs). While four of them are managed by a partnership made up of CIRAD, INRAE, INRIA, and IRD; these organizations are public entities with various backgrounds, including scientific and technological institutes, scientific and technological research establishments, public-sector industrial and commercial enterprises (EPICs), and not-for-profit government-funded public organizations.

In comparison to those managed by SMEs (FASTCAT-Cloud, MOBIS, Cos4Bio and Cos4Env), the services managed by PlantNet consortium (Pl@ntNet identification service, AI-Geospecies, AI-Taxonomist, and GBIF-DL) have a defined sustainability model. These services are part of a technological strategy connected to Pl@ntNet's citizen observatory, which has been running for more than twelve years. They are governed by a coalition made up of public organizations of various types. They have clearly defined value creation proposals for research organizations (massive participatory science data management and collection), for Pl@ntnet application users (a collaborative encyclopedia and pocket botanist), for players in environmental education and land management (attractive and easy-to-use tools to implement in projects), and for businesses developing applications (access to specialized and efficient services at a progressive cost). Their exploit

In the case of the services offered by SMEs, collaboration with public or private organizations like universities or research institutes that may support or contribute to a certain extent in-kind resources, such as services or human research expertise, may be an option to partially offset costs. Furthermore, given that these services are not geographically limited and even though they are community-focused, they may be used by other communities, this broadens the range of exploitation and sustainability.

On the other hand, the majority of the services' business models are free with conditions. As part of the Cos4Cloud philosophy, it was intended to provide free services to the community of citizen scientists and citizen observatories. Yet, it's crucial to recognize that the business model of providing services on the EOSC marketplace for free or in exchange for a set of restrictions can have both advantages and disadvantages.

 Advantages:

- Increased visibility: Offering free services can attract more users and potential customers to the services, leading to increased visibility and potentially more business opportunities.
- User feedback: Users are more likely to try out and provide feedback on a free service, which can be invaluable in improving the quality and features of the services.

- Potential for upselling: Offering a free service can be a good way to introduce users to the offerings, and potentially upsell them on more advanced or premium services.

Disadvantages:

- Revenue: Obviously, offering services for free can reduce the revenue potential. If the services' providers rely solely on the EOSC marketplace for revenue, they may struggle to make a profit.
- Perceived value: If users are accustomed to paying for similar services, they may question the value of a free offering. This can make it harder to establish Cos4Cloud services as a credible provider in the market.
- Limited features: In order to make a free offering viable, the services may need to limit their features or functionality. This can lead to a less competitive offering compared to paid alternatives.

The majority of services consider the freemium business model, where basic functionalities are provided for free but additional capabilities require a price, to address some of the drawbacks of the free model. The membership, transactional, and market-driven access models are among the options for implementing the payment for enhanced features.

It is vital to keep in mind when implementing this model that the Cos4Cloud services published in EOSC are targeted towards the community of citizen science. This community has just recently begun to become visible and integrate on EOSC, thus the services that are directed at them still have a significant curve of use and exploitation to develop.

In the deliverables D7.3 Strategic plan for the exploitation and distribution of the results (PEDR) and D7.5 Exploitation roadmap, specific actions are laid out for raising funds, expanding the market, and generally ensuring the financial sustainability of the services.

Conclusions

Six Cos4Cloud services are published on EOSC Marketplace, and four more are under way. The sustainability of these services -especially of the EOSC exchange- can be challenging for several reasons. First, funding: Developing and maintaining services requires funding. As mentioned Cos4Cloud services are mainly developed by small and medium-sized enterprises (SMEs) who may have limited access to funding sources. As a result, they may struggle to maintain the service over time. Second, lack of users: the services may fail to gain traction if they are not widely used. Without a critical mass of users, it may be difficult for a service to justify continued investment in development and maintenance. Third, rapidly changing technology: Technology is constantly evolving, and the services may quickly become outdated if they are not regularly updated. This requires ongoing investment in development, which may be challenging for services with limited funding. Forth, complexity: Services on the EOSC exchange may be complex and require specialized expertise to develop and maintain. SMEs may not have the necessary skills to keep the service up and running, leading to sustainability challenges.

To address these challenges, it is important to ensure that services published on the EOSC exchange have access to sustainable funding sources, keep using co-design methodology to maintain the focus on user needs, are regularly updated to keep pace with changing technology, and are developed in a way that is accessible to a wide range of developers with different levels of expertise. Additionally, collaborations between service providers and research communities can help ensure that services meet the needs of users and are sustainable over the long term.

Moreover, several business models must coexist in EOSC and be allowed to develop over time. Various models may be the foundation for various EOSC components. Establishing an EOSC financial support team is essential. This team should be made up of enterprising people whose goal is to make sure that no effort is spared when it comes to locating money for EOSC Core and EOSC Exchange. The team should be devoted to finding and obtaining funds.

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