FAIRICUBE –
F.A.I.R. INFORMATION CUBES

WP6 Dissemination

D6.7 Upscaling plan

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1 Introduction

This deliverable describes the upscaling plan developed for some of the FAIRiCUBE Key Exploitable Results (KERs). It is closely linked to the deliverable D6.10 Dissemination and Exploitation Plan and D6.9 Business Plan, since upscaling and business planning (see Figure 1) are important components of the overall exploitation of the FAIRiCUBE results. Upscaling is meant as the phase in which a project result is widely adopted, following a preliminary roll-out phase marked by early adoption of the prototype by few users/customers. Business planning is meant as the phase in which a business plan of the widely adopted project result is provided, containing also a provisional profit and loss account simulated for a period generally variable from 3 to 5 years.

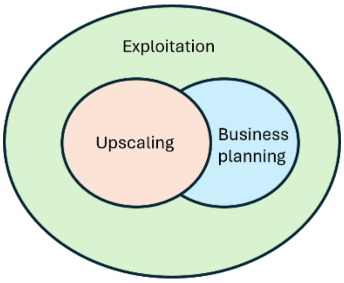

Figure 1: Exploitation, upscaling and business planning

Section 2 of the deliverable illustrates the methodology adopted to develop the upscaling plan. Section 3 contains the assessment of the level of maturity of the project KERs produced by the use cases. Section 4 presents the results of two surveys conducted during the physical meeting held at the end of May 2025 in Mendicino (IT), with a twofold objective: (i) to assess the use of FAIRiCUBE Hub services/apps made by the use cases to produce their KERs; (ii) to assess the support that FAIRiCUBE Hub new or enhanced existing services/apps could provide for the upscaling of KERs produced by the use cases. An upscaling plan for some KERs produced by the use cases is contained in section 5, whilst the upscaling of FAIRiCUBE Catalog and Knowledge Base Services is described in Section 6. Finally, section 7 draws the main conclusions.

2 Approach and Findings for FAIRiCUBE KER Upscaling

The methodology adopted to develop the upscaling plan described in this deliverable consists of the following components:

- Component 1: assessment of the level of maturity of the project KERs produced by the use cases,
- Component 2: assessment of the use of FAIRiCUBE Hub services/apps made by the use cases to produce their KERs,
- Component 3: assessment of the support that FAIRiCUBE Hub new or enhanced existing services/apps could provide for the upscaling of KERs produced by the use cases,
- Component 4: assessment of time and costs needed to develop new FAIRiCUBE Hub services/apps or to enhance the existing ones, based on the assessment made in Component 3,
- Component 5: assessment of time and cost (additional to those assessed in component 4) needed to upscale the KERs produced by the use cases.
- Component 6: upscaling of the FAIRiCUBE Catalog and Knowledge Base Services.

The FAIRiCUBE Hub services/apps under assessment, described in deliverable D4.5 and in the FAIRiCUBE Digital Library, are grouped into the categories listed in Table 1. The first four in the table are accessible via Analytics in the FAIRCUBE Hub home page shown in Figure 2 and representing the core component of the FAIRiCUBE Hub.

Table 1: Categories of FAIRiCUBE Hub services/apps

Data analysis and processing, including ML
Upload (ingest) and process your own data
Analysis or estimation of computing resources needed to run EO algorithms
Handle vector data—including support for upload, analysis, and integration with raster/EO data
Visualisation tool capabilities
Catalog services
Knowledge Base services

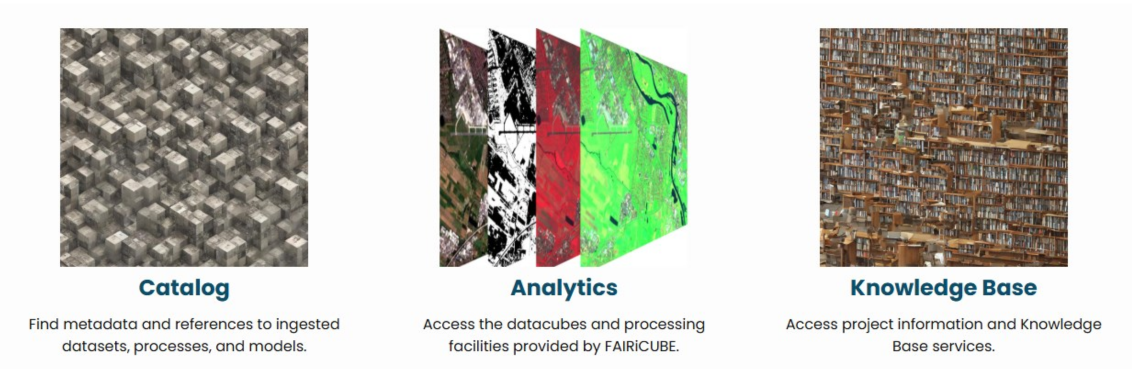

Figure 2: Main components of the FAIRiCUBE Hub

It’s to be highlighted that the upscaling of the project KER represented by the FAIRiCUBE Hub was focused on the services/apps (new or enhanced) considered useful by the use cases owners for the upscaling of their KERs. The upscaling of EOX and rasdaman platforms, not linked to the upscaling of the KERs produced by the use cases, was considered out-of-scope because these two platforms, considered separately, are two products already widely adopted in the market, according to marketing strategies led by the platform owners.

Component 1 of the methodology is described in section 3. Components 2 and 3 were made through two surveys conducted during the physical meeting held in Mendicino (IT) at the end of May 2025 and whose results are presented in section 4. Components 4 and 5 are described in section 5. Component 6 is described in section 6.

3 Assessment of the level of maturity of the project KERs produced by the use cases

The assessment of the level of maturity of the project KERs was based on a generic upscaling roadmap shown in Figure 3, which consists of four steps. The whole roadmap spans over a timeline which, besides step 1 having a duration equal for all KERs (from mid-May 2025 until the end of the project in September 2025), may have a different duration for each step for each KER. An explanation of the four steps is provided below:

- Step 1, consisting of a series of activities including the finalisation of the business model, a more detailed characterisation of the envisaged product/service and an identification of key activities, key partners and key resources needed to make the further steps.
- Step 2, consisting of a series of activities needed to produce a KER prototype, whose level of maturity should be based on a market analysis.
- Step 3, consisting of a roll-out phase, at the end of which the product/service is early adopted by few users/customers.
- Step 4, consisting of a true upscaling phase, at the end of which the product/service is widely adopted by the market.

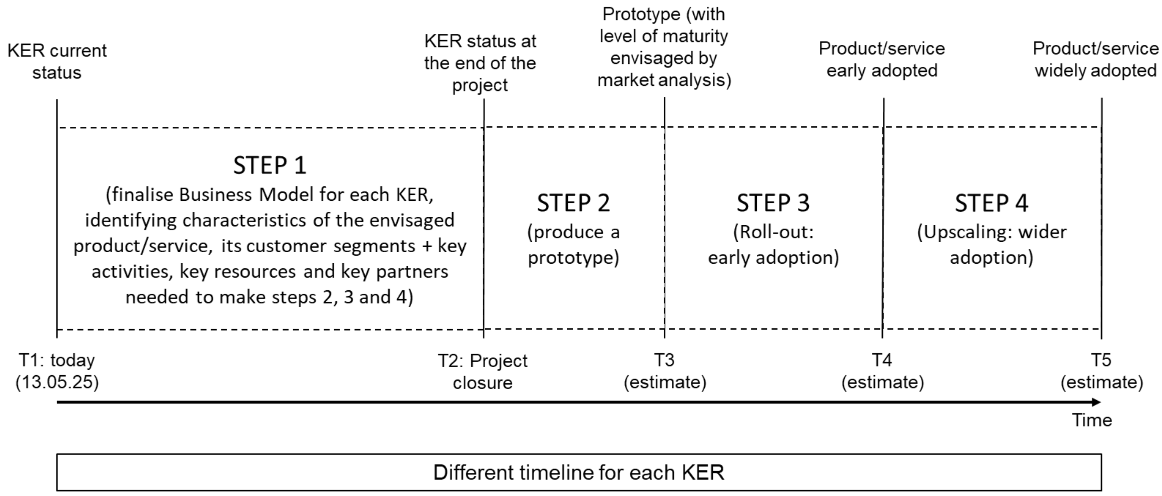

Figure 3: Upscaling roadmap

A coloured legend, shown in Figure 4, was used to express the generic KER status and its evolution over time:

- methodology under test and final product/service still to be identified
- prototype under production
- prototype ready
- product/service early adopted
- product/service widely adopted

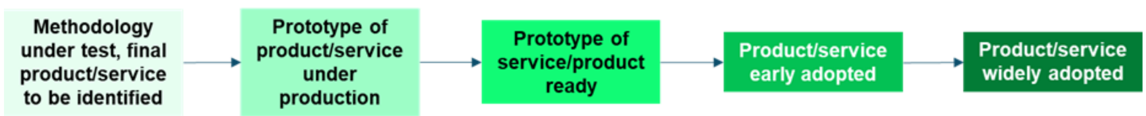

Figure 4: KER status legend

This legend was then applied to assess the current level of maturity of all KERs produced by the FAIRiCUBE, shown in Figure 5. In particular, KERs produced by use case 1 and use case 3 are considered as prototypes and therefore having completed the step 2 of the upscaling roadmap, whilst the KERs produced by the other three use cases are considered as methodologies under test, with final product/service still to be identified and therefore still within the step 1 of the upscaling roadmap.

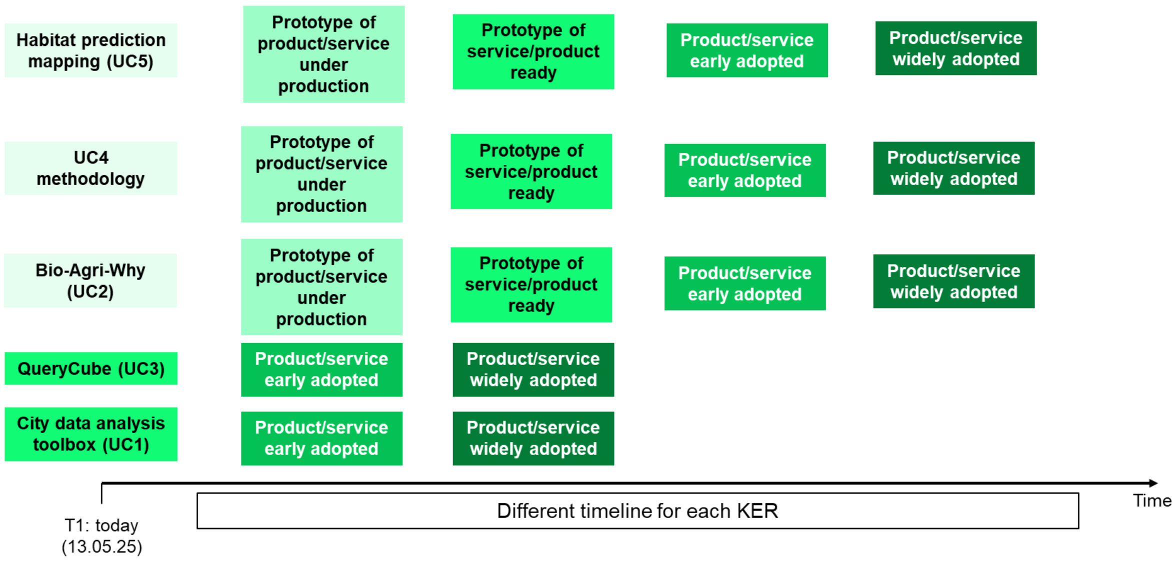

Figure 5: KER current status

The origin of the time axis in Figure 3 and Figure 5 is set at the 13th of May 2025, corresponding to the day when the roadmap was presented to the project partners and the first assessment of the KER status was made.

4 Upscaling surveys

During the physical meeting held at the end of May 2025 in Mendicino (IT), two surveys were done with a twofold objective:

- to assess the use of FAIRiCUBE Hub services/apps made by the use cases to produce their KERs
- to assess the support that FAIRiCUBE Hub new or enhanced existing services/apps could provide for the upscaling of KERs produced by the use cases

The ultimate goal was to receive, from the FAIRiCUBE Hub providers, feedback on the Hub upscaling demand coming from the Hub users' wish list for the upscaling of their KERs. The results of the surveys are shown in the following sections 4.1 and 4.2.

4.1 FAIRiCUBE Hub use: survey of current status and rating by users

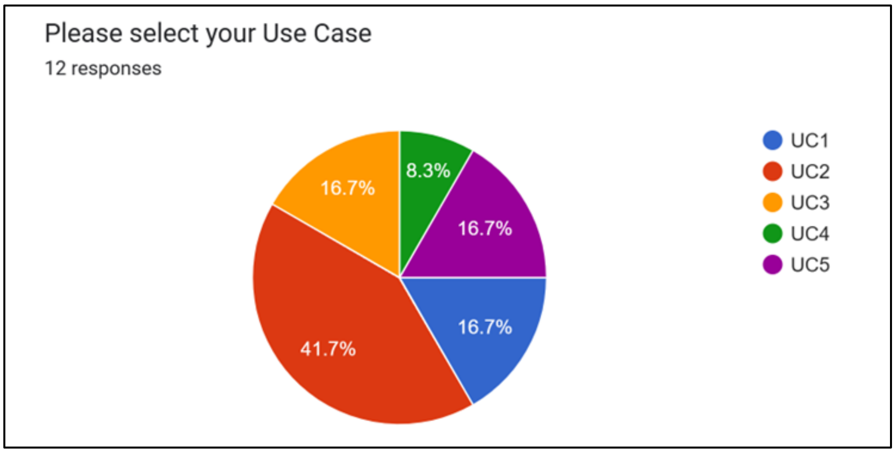

Figure 6: Distribution of responses provided by use cases

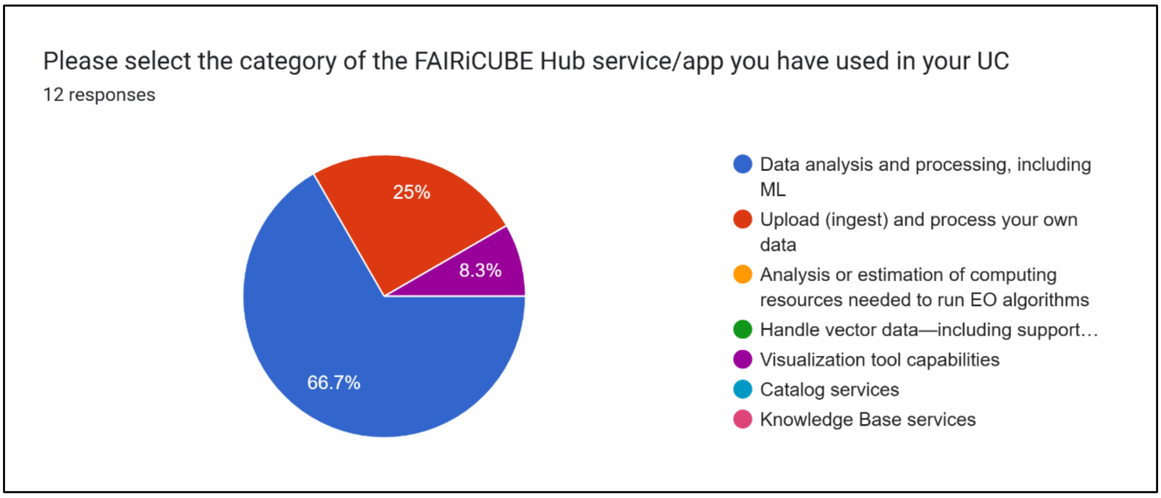

Figure 7: Distribution of surveyed FAIRiCUBE Hub services/apps

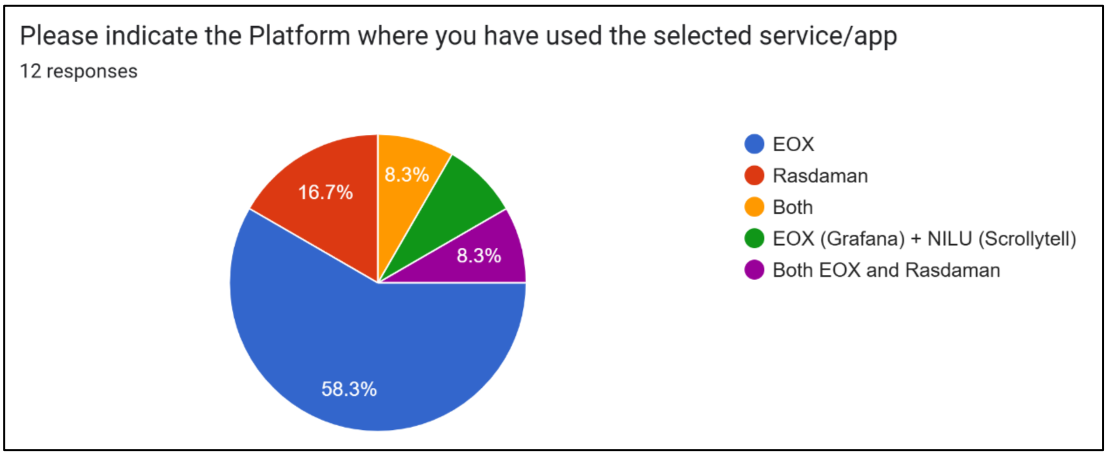

Figure 8: Platforms where the surveyed FAIRiCUBE Hub services/apps were used[1]

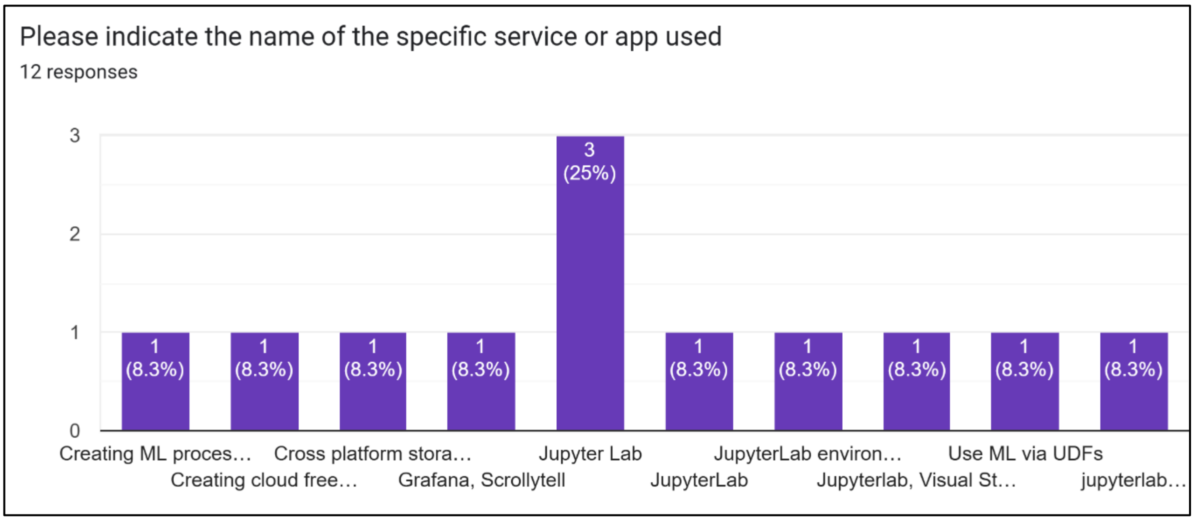

Figure 9: Name of the surveyed FAIRiCUBE Hub services/apps

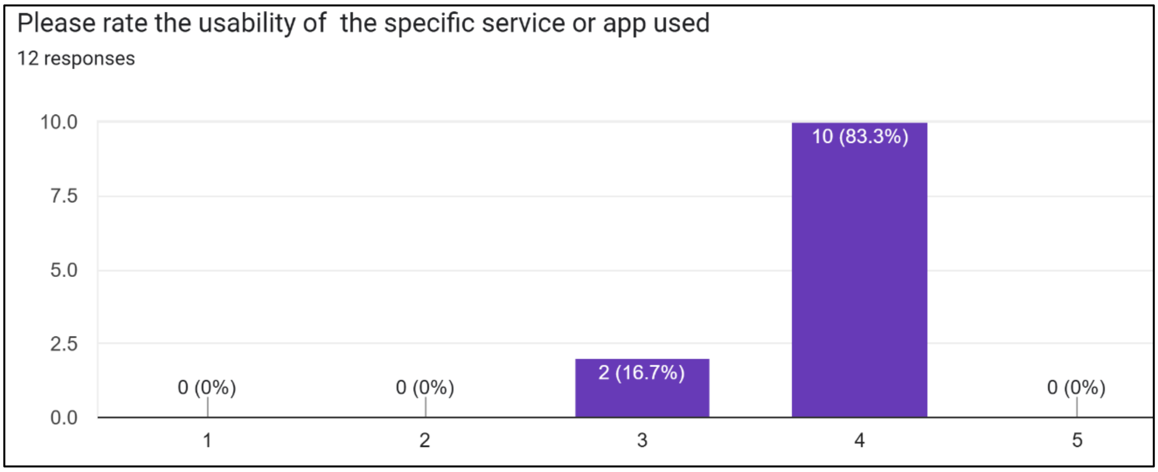

Figure 10: Name of the surveyed FAIRiCUBE Hub services/apps

[1] "Both" and "Both EOX and Rasdaman" should be read as the same answer

Table 2: Usability of surveyed services/apps

service/app usability rating (from 1 min to 5 max)	What worked well for you?	What challenges did you experience with the usability?
4	data analysis workspace, data upload	long login time, create new jupyter kernels
4	works well with "simple" dashboards, gets tricky with more advanced needs (e.g. custom colouring)	grafana: tricky to publish dashboards, scrollytell: needs some experience with maplibre/titiler to configure properly
3	Worked well to process and document Python scripts for processing	Python package dependency issues between platforms (EOX and rasdaman), and Jupyter kernels. Updating and transferring scripts between kernels and platforms was not always straight forward. Eventually it works with some support or by using older versions of packages.
4	Execute trained ML models (use for inference) by the rasdaman infrastructure.	Initial required use of C++, later improved to Python. Lack of guardrails; no clear progress indication (synchronous processing).
4	Initial test went well, but we could not fully implement it because it comes quite late when we were mostly done with modelling.	There was an issue with data type at import, but it seems it was fixed later.
3	While initial use worked well, we could not implement it extensively.	Set up through headless execution reduces possibilities for easy adaptation.
4	Creating mosaic by rasdaman	Multi-date image source combination.
4	standard python scripts, expected performance and features	Install packages (this is not FAIRiCUBE) specific
4	Simple implementation, execution, I/O of data and scripts	Installation and package management and interoperability of data and services
4	Jupyter lab, running scripts, headless execution	We were not able to run scripts using GPU through headless execution
4	memory availability	R scripts needed credential permissions to be installed, and it took some weeks to solve the problem
4	memory availability	Limited credentials permissions to install R packages

Table 3: Usefulness of surveyed services/apps

service/app usefulness rating (from 1 min to 5 max)	What did you find most useful and why?	What technical barriers currently limit its use?	How could this service or app could have been more useful for your Use Case?
4	backup, updates, data+code in one place, possibility to share data between team members	management/sharing of python environments, jupyter lab ui interface a bit limited (but vs code online is a good alternative)	faster loading time, unclear pricing scheme of aws
5	already hosted on the server	grafana: not all data can be published, scrollytell: learning how to use	more documentation, examples
3	Having access to flexible compute and storage at required scale for the processing. Being able to run Python code remotely.	Package dependencies, no self-management of kernels.	More synchronisation between EOX and rasdaman platforms; self-service Jupyter kernels, or deployments.
4	External processing close to the data, computational resources.	Access to accelerated hardware, such as GPUs. Often needed for ML.	Include training of models; timing of capability development and development of the use case.
4	No need to store data at locally or at server.	Not any known, but broader use is still needed to asses it.	If it would be available in earlier stage of project, we would not need to upload data on local directory (S3 bucket).
3	Implementation of platforms as ML flow.	Possibility of use ML models training alongside of inference.	Having direct access to GPU though self adjustable set up of used python packages.
4	Having consistent workflow for creating mosaics.	Existing app which would do process automatically.	If the process/workflow would be established as a common tool or app.
4	scalability and synchronisation	no	not that I know of
4	Remote access and computation; headless execution	Availability of computational resources and speed	More customisation opportunities
3	Common space to share scripts and data, because it is hard to upload data and scripts using other platforms (e.g., GitHub).	Data ingestion challenges (the need to use S3 browser). The limit of available resources. Slow start of server.	It could have been useful to have WMTS app available.
4	Memory usage availability	None	Having permissions to install the needed packages since the beginning
4	Use of S3 bucket	Credential permissions when installing R packages	Having credential permissions since the beginning

4.2 FAIRiCUBE Hub use: outlook (users wishes to support upscaling of their KERs)

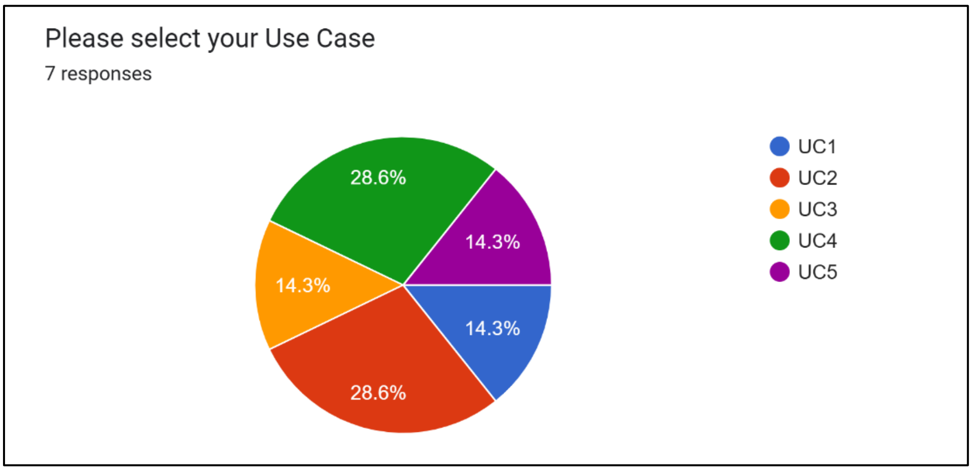

Figure 11: Distribution of responses provided by use cases

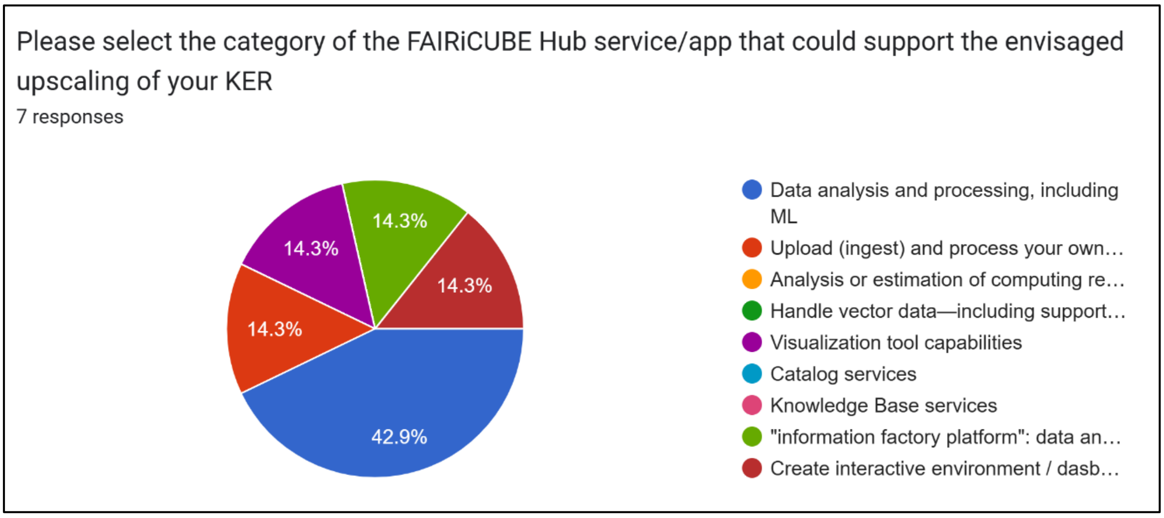

Figure 12: Distribution of Hub services/apps that could support the upscaling of the UC KERs

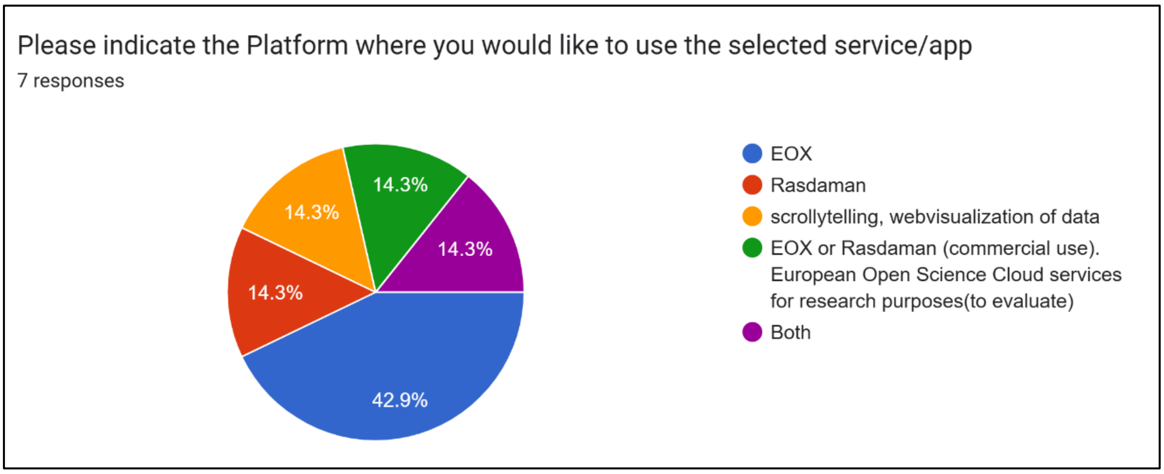

Figure 13: Platforms where to use the desired services/apps

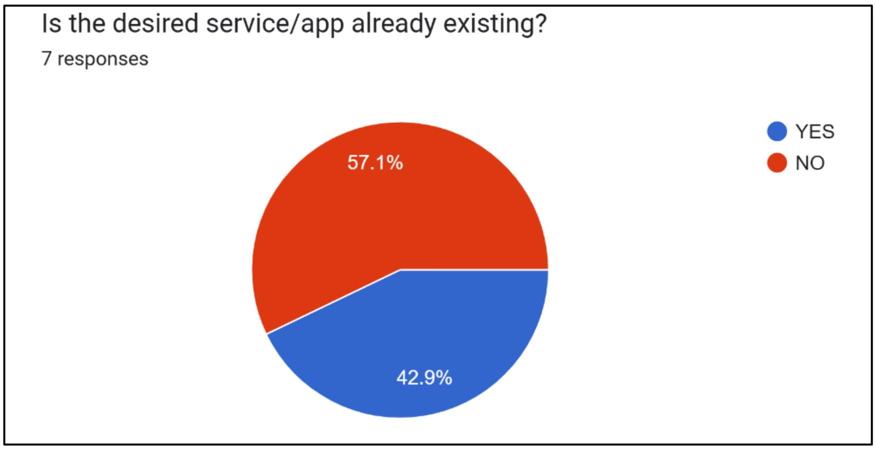

Figure 14: Existence of desired services/apps

Table 4: Features of the non-existing desired services/apps

Is the desired service/app already existing?	Platform	What the desired service/app should do?	How would this new service/app support the upscaling of your KER?	Is the service/app blocking the envisaged upscaling of your KER?
NO	EOX	platform to develop the complete workflow + "serve" the result e.g. through API (WMTS or other) (this part is missing)	stakeholders can easily access the analysis result and integrate in their service (e.g. geoportal)	NO
NO	EOX	Automate the detection-attribution workflow for causal modelling experiments based on different selections of input data, interventions, and hypothesised causal graphs.	It would allow easy experimentation by domain experts to prove expected causalities in environmental studies and test the robustness of the relations, which is otherwise very time consuming.	YES
NO	Both	Support of upload and process of vector data and use of non-standardised access protocols.	Better data integration and creating data cubes in continuous workflow.	YES
NO	EOX	run a model for a given OpenStreetMap building polygon	if we build a commercial KER, we will need such a service to build our product	NO

Table 5: Desired enhanced features of the existing desired services/apps

Is the desired service/app already existing?	Platform	Please indicate its name	How could this service or app be improved?	How would this enhanced service/app support the upscaling of your KER?	Is the service/app blocking the envisaged upscaling of your KER?
YES	rasdaman	QueryCube	Deeper embedding to rasdaman system, stronger tie to available webservices	Visibility, applicability; advanced feedback mechanism	NO
YES		maplibre, vis.fairicube.eu	robustness, extend to handle vector data	better visibility	NO
YES	EOX or rasdaman	SDM script	Programming time and strategy improvements	Service product offered to users	NO

5 Upscaling of FAIRiCUBE KERs produced by the use cases

As a follow-up of the survey whose results are provided in section 4.2, the two platform owners (EOX and CU) estimated time and costs needed to develop the new features described in Table 4 and to enhance the existing FAIRiCUBE services/apps described in Table 5. With reference to Table 4, EOX made the estimations reported in Table 6.

Table 6: EOX proposals to implement new services/apps

What the desired service/app should do?	How would this new service/app support the upscaling of your KER?	Estimated costs to implement the service/app
platform to develop the complete workflow + "serve" the result e.g. through API (WMTS or other) (this part is missing)	stakeholders can easily access the analysis result and integrate in their service (e.g. geoportal)	We propose to add a deployment of eoAPI to EOxHub v2 for this functionality. The costs would cover configuration of the deployment as well as coordination with the UC to develop the data structuring and visualization configuration and expose it via API. The actual data handling like loading, updating, etc. would be the responsibility of the UC. Our estimate is 24-48k€ for this functionality depending on the complexity of the data model. An EOxHub Workspaces subscription is needed to utilize this functionality.
Automate the detection-attribution workflow for causal modelling experiments based on different selections of input data, interventions, and hypothesized causal graphs.	It would allow easy experimentation by domain experts to prove expected causalities in environmental studies and test the robustness of the relations, which is otherwise very time consuming.	EOxHub v2 includes capabilities to run Argo Workflows from an eodash interactive dashboard instance which is proposed for this functionality. We'd assume the UC themselves to write the actual algorithm and thus only estimate support hours to deploy the algorithm, make it available via API, and develop an eodash configuration to call the algorithm with 9-12k€. An EOxHub Workspaces subscription including the Dashboard as a Service option is needed to utilize this functionality.
Support of upload and process of vector data and use of non-standardized access protocols.	Better data integration and creating data cubes in continuous workflow.	We propose to add a deployment of PostgreSQL/PostgREST to EOxHub v2 for this functionality. The costs would cover configuration of the deployment as well as coordination with the UC to develop a data model and expose it via API. The actual data handling like loading, updating, etc. would be the responsibility of the UC. Our estimate is 24-48k€ for this functionality depending on the complexity of the data model. An EOxHub Workspaces subscription is needed to utilize this functionality.

run a model for a given OpenStreetMap building polygon	if we build a commercial KER, we will need such a service to build our product	EOxHub v2 includes capabilities to run Argo Workflows which is proposed for this functionality. We'd assume the UC themselves to write the actual algorithm and thus only estimate support hours to deploy the algorithm and make it available via API with 3-6k€. An EOxHub Workspaces subscription potentially including GPU resources is needed to utilize this functionality.

With reference to the QueryCube existing FAIRiCUBE Hub service/app, based on the requirements contained in Table 5, a timeline ranging from 3 to 6 months to make the enhanced app available was estimated by CU, at a cost of 25 k€ per month as subcontracting cost to rasdaman GmbH. Two use case owners, S4E for UC1 and WER for UC2, made an assessment of time and costs (additional to those assessed by the platform owners) needed to upscale their KERs, which are provided in sections 5.1 and 5.2, respectively.

5.1 City data analysis toolkit

An estimation of key activities, key resources and related costs needed to perform steps 3 and 4 of the upscaling roadmap are provided in Table 7.

Table 7: Upscaling costs for "City data analysis toolkit"

STEP	Key activity different from development / maintenance of services/apps provided by FAIRiCUBE HUB	Human resources (person days)	Unit costs (€/PD)	Total personnel costs (€)	Other costs category	Other costs
STEP 3	Development of the Toolkit	20	700	14.000		
STEP 3	Data Acquisition & Harmonisation	5	700	3.500	acquisition costs of commercial data	tbd
STEP 3	Data Analysis & Consulting	minimum 5	700	3.500		
STEP 3	Training & Documentation	10	700	7.000		
STEP 3	Dissemination & Outreach	5	700	3.500		
STEP 4	Development of the Toolkit	10	700	7.000		
STEP 4	Data Acquisition & Harmonisation	5	700	3.500	acquisition costs of commercial data	tbd
STEP 4	Data Analysis & Consulting	minimum 5	700	3.500		
STEP 4	Training & Documentation	5	700	3.500		
STEP 4	Dissemination & Outreach	5	700	3.500		

				52.500		

5.2 Bio-Agri-Why

An estimation of key activities, key resources and related costs needed to perform steps from 1 to 4 of the upscaling roadmap are provided in Table 8

Table 8: Upscaling costs for "Bio-Agri-Why"

STEP	Key activity different from development / maintenance of services/apps provided by FAIRiCUBE HUB	Human resources (person days)	Unit cost (€)	Total personnel cost (€)	Other costs	Total costs (€)
STEP 1	Data acquisition, integration and pre-processing	40	750	30.000	Storage and processing	6.000
STEP 1	Species abundance, distribution model and richness prototypes	30	800	24.000	Storage and processing	8.000
STEP 1	Developing a causal model for test areas	30	850	25.500	Storage and processing	10.000
STEP 1	Create a business model	8	800	6.400		
STEP 2	Data acquisition, update, integration and pre-processing	10	750	7.500	Storage and processing	2.000
STEP 3	Farm based data acquisition	5	800	4.000	Data cost	4.000
STEP 2	Development of interaction platform – dashboard	30	800	24.000	Software, hosting and API services	4.000
STEP 2	Update of causal model and upscale to NL	15	850	12.750	Storage and processing	6.000
STEP 2	Built of stakeholder community team - early adopters - pilots	10	800	8.000		
STEP 2	Marketing and sales program development	10	800	8.000		
STEP 3	Stakeholder community team - extension and management	6	800	4.800		
STEP 3	Training program	8	800	6.400	Facilities	2.000
STEP 4	Stakeholder community team management	4	800	3.200		
STEP 4	Training program	8	800	6.400	Facilities	2.000
				170.950		**44.000**

6 Upscaling of FAIRiCUBE Catalog and Knowledge Base Services

In the deliverable D6.10 the FAIRiCUBE Catalog and Knowledge Base services, whose access page is shown in Figure 15 and Figure 16 respectively, were considered functional to the main and most innovative FAIRiCUBE Hub component "Analytics" (shown in Figure 2) and their exploitation was implicitly considered an integral part of the Analytics exploitation and therefore was not treated separately. Nevertheless, within the upscaling context described in this deliverable, their level of maturity can be assessed separately from the other project KERs.

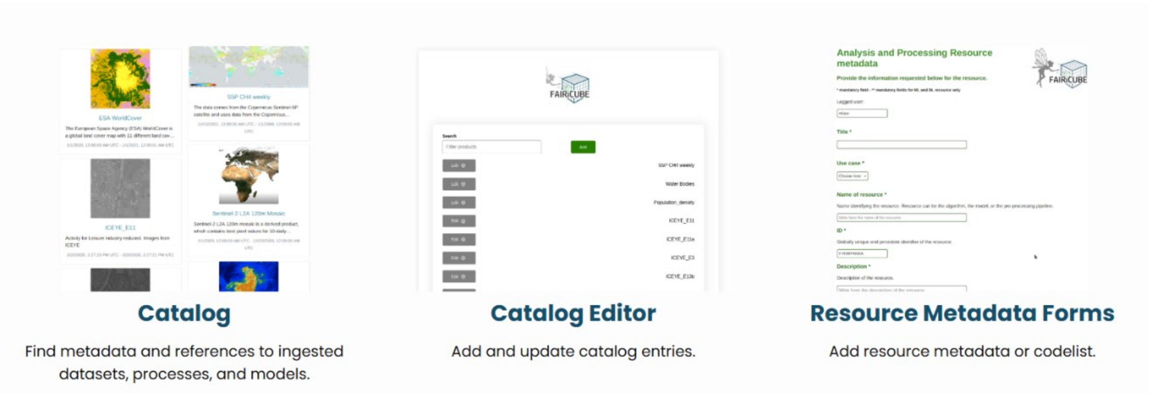

Figure 15: FAIRiCUBE Catalog services

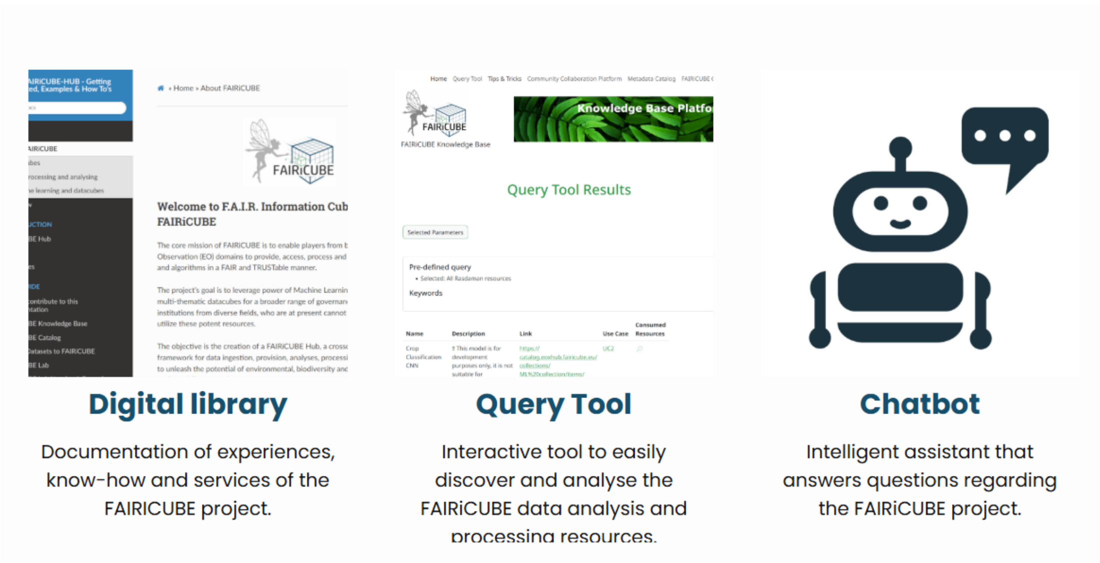

Figure 16: FAIRiCUBE Knowledge Base Services

Using the legend shown in Figure 4, five services (all those shown in Figure 15 and Figure 16 except the Chatbot) can be considered at the maximum level of maturity. Indeed, the Catalog, the Catalog Editor and the Digital library are already widely adopted, not only via the FAIRiCUBE Hub but also via other platforms (e.g. EOxHub). Regarding the Resource Metadata Editor and the Query Tool, they have been developed ad-hoc for FAIRiCUBE and, therefore, they have not been widely adopted yet.

However, they can be considered mature enough for their upscaling, not needing any further technological upgrade. Conversely, the FAIRiCUBE Chatbot has to be considered at prototype level and, therefore, subject to upscaling, as outlined in the following section.

6.1 Upscaling of FAIRiCUBE chatbot

The FAIRiCUBE chatbot could be upscaled according to one of the following alternative options. The first option is to use open-source LLMs (e.g., LLaMA, Mistral) hosted on GPU-as-a-Service platforms such as Amazon Web Services (AWS), Google Cloud (GCP), Microsoft Azure, Oracle Cloud Infrastructure (OCI), Lambda Labs, or CoreWeave. This option offers more control, customisation and potential cost-efficiency at scale, but requires DevOps expertise and performance tuning.

The second option is to integrate proprietary LLMs via API, such as OpenAI (GPT-4), Anthropic (Claude), or Google (Gemini), which provide fast access to high-quality models with minimal infrastructure, but at a higher recurring cost and with less control over customisation and data handling. The selection of the best option depends on several aspects, linked from one side to the need to perform further investigations on pros and cons of the two options and from the other side to the overall priorities and marketing strategies of the partner who developed the prototype (EPS), which are currently not yet defined with respect to the upscaling of the chatbot.

7 Conclusions

A methodology to support the upscaling of FAIRiCUBE Key Exploitable Results (KERs) was developed, based on assessing their maturity levels and following a four-step roadmap. This roadmap provides a flexible timeline, which varies depending on each KER's maturity and the key activities and resources required for implementation.

The methodology was applied to two KERs developed within distinct use cases. In particular, the upscaling of the FAIRiCUBE Hub focused on enhancing or developing new services/apps identified as valuable by the use cases for further KER deployment. In contrast, the upscaling of EOX and rasdaman platforms, considered separately, was considered out of scope, as they are already established solutions in the market, with ongoing upscaling guided by their respective owners' marketing strategies. Despite the varying levels of maturity among the project's KERs, the proposed methodology demonstrates its applicability and flexibility to guide the upscaling process for any KER.