EOSC Future

D5.2b

EOSC Front-Office Requirements Analysis

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D5.2b/EOSC Front-Office Requirements Analysis

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Abstract

This deliverable describes a part of the wider EOSC co-creation engagement programme outlined in the EOSC Future project general objectives 3 ("Scale up Capabilities and Deliver an EOSC Execution Framework") and 7 ("Reach Out and Engage with EOSC Communities and End Users"). The user engagement programme is implemented in collaboration with similar activities in Work Package 4, as well as jointly with Work Packages 6 and 10. The user engagement, requirements gathering and analysis is a contiguous process - it draws upon the results of the EOSC-hub and EOSC Enhance projects, evaluates their outputs and introduces modifications to the processes they developed in order to advance the existing knowledge of users' requirements and therefore the value proposition of EOSC.

Version History

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List of Abbreviations

Acronym	Definition
SEO	Search Engine Optimization
UX	User Experience

Glossary

EOSC Future project Glossary is incorporated by reference: https://wiki.eoscfuture.eu/x/JQCK

1 Executive Summary

This document details the activities that were undertaken to categorise, collect, analyse, prioritise and implement the requirements for the addition and/or improvement of several EOSC Front-Office components. It builds on, and, where appropriate, refers to the previous iteration of the Front-Office requirements analysis process, as documented in Deliverable 5.2a [1].

Section 2 Introduction provides the context for the activities described in later sections.

Section 3 Front-office evolution briefly describes the changes in our understanding of the Front-Office, its relations with other components, enhancements based on the requirement analysis and the steps taken to develop and refine the requirements.

Section 4 Requirement gathering, and user experience activities recapitulates the Front-Office requirements gathering and structuring process, which was extensively described in Deliverable 5.2a. In addition, it chronicles the collaborative work between WP5 and several other work packages and outlines the five themes that the domain was divided into: **Data inclusion, Enhanced/improved Discovery, Knowledge Hub (**which consists of the **Training Catalogue** and **Learning Platform), User Dashboard** and the **Recommender System**.

Sections 5-9 deal with each of the five themes listed in the previous chapter by means of process implementation (which includes internal brainstorming and a description of the focus groups), exploratory analysis to ensure the results from the focus groups are valid and applicable, and business analysis to identify and articulate the need for change.

Section 10 Results and design covers, for each theme, the main outcomes and presents a series of mock-ups built based on the specifications produced by the theme-based requirements elicitation activities.

Section 11 presents the main **Conclusions** for each individual theme, including, where applicable, suggestions for future work.

Samples of questionnaires used with the focus groups are contained in the various appendices.

2 Introduction

The EOSC Platform Front-Office (referred to throughout as "the Front-Office") is a set of components in the EOSC Platform focused on the delivery of user-centric functionalities supporting research activities in Europe.

This document details the activities that were undertaken to categorise, collect, analyse, prioritise and implement the requirements for the addition and/or improvement of several EOSC Front-Office components. It builds on, and where appropriate refers to the previous iteration of the Front Office requirements analysis process, as documented in [1].

It begins by describing the evolution of the Front-Office, in terms of its form and function prior to the start of the EOSC Future Project and its relationship to other major components of the EOSC ecosystem. Subsequently, it describes the process used for gathering and analysing the Front-Office requirements. It also lists and briefly describes the requirements themes - **Data inclusion, Enhanced/improved Discovery, Knowledge Hub (which consists of the Training Catalogue and Learning Platform), User Dashboard and the Recommender System**. Each theme is described in detail, showing how the various steps of the requirements analysis process were applied. Finally, the conclusions are presented in the last chapter, including suggestions for future work.

3 Front-Office evolution

Prior to the start of the EOSC Future project, the Front-Office was a relatively simple system that allowed users to discover and access resources, find information and updates on EOSC (its governance and stakeholders, the projects contributing to its realisation, funding opportunities for EOSC stakeholders, relevant European and national policies and recent developments), browse Open Science information (a collection of indicators and visualisations that help interested stakeholders better understand the open science landscape across various European countries) and receive simple recommendations for other resources that may be of interest to them.

The Front-Office consisted of three main components: the **EOSC Portal website** [10]; the **EOSC Catalogue** and **Marketplace** [3]; the first generation **EOSC Marketplace Recommender System**. It also incorporated the **Open Science Observatory** [11].

The first phase of the Front-Office requirements analysis activity identified several enhancements, which can be summarised as:

- Resource composition;
- Access to more types of resources (data, publications, other research outputs);
- Interaction with the Front-Office using a personalised dashboard;
- Access and contribute to EOSC knowledge;
- Access to Open Science statistics;
- Obtain support;
- Receive personalised recommendations

The requirements analysis in support of these enhancements was partitioned into five themes, as described in section 2.

For each theme, several steps were taken to develop and refine the requirements:

- **Brainstorming**, in which the team develops initial ideas describing the functions and their dependencies that should be available in the Recommender System. In addition, the meaning of core concepts relevant for recommendations, as well the assumptions concerning the user perception are also defined.
- **Focus groups meeting**, in which the assumptions are validated with a dedicated user group.
- **Analysis and extraction of key insights** from the focus group meeting. The main objective is to understand the insights and their dependencies and identify the ones that need to be further clarified.
- **Clarification of the insights** in a series of individual interviews with selected members of the user group. The one-on-one format allows for a more thorough discussion of the identified insights with a sample of prospective users representing various domains of the research.
- **Aggregation of the extracted insights** collected during the individual interviews, to create an objective and possibly holistic perspective of the design functions.

A series of mock-ups, based on the specifications produced by the theme-based requirements elicitation activities, were produced and these, along with the refined requirements, were passed into the engineering process.

4 Requirement gathering and user experience activities

The approach taken to requirements gathering is based on the use of the User Experience template which was introduced in the first iteration of this document [1]. To recap, the template prompts the analyst to provide the following:

4.1 Analysis 101

- Topic Definition - Initial, short description of the recognised issue to be analysed.
- Main Goals - What are the expected outputs of the analysis.

4.2 Exploratory analysis

4.2.1 Knowledge structuring

- Relevant functional requirements - A list of the functional requirements relevant to the theme.
- Relevant non-functional requirements - A list of the non-functional requirements relevant to the theme.
- Relevant EOSC Front-Office user types - Taken from the underpinned requirements.
- Relevant functional components - Taken from the underpinned requirements.
- Relevant technical components - Taken from the underpinned requirements.
- Relevant stakeholders for the brainstorming - The consultations should always include user types identified above.
- Relevant documentation - Links to the documents related to the analysis.
- Comparable solutions - Adequate functionalities/solutions that can be found among other EOSC/commercial tools.

4.2.2 Defining the problem and solution hypotheses

- Remarks (brainstorming) – Brainstorming conducted by the project partners.
- Problem statement – A broader description of the theme under analysis, based on the analysis conducted so far.
- Important findings - Important points from the analysis that cannot be omitted in the further analysis and design.
- First ideas for the solutions (solution hypotheses) - At this stage of the analysis there might be an intuition about the possible solutions for the posed problem.
- Identified steps for the Business analysis - Initial proposition of specific actions to be taken during the business analysis phase.

4.3 User group research

Questions to be asked during the consultations with the relevant stakeholders.

4.4 Business analysis

- Data analysis – The essence of the statistical research.
- Identified business value – Intended key value proposition for the identified target groups that will benefit from the solution.
- Identified objectives – The key high-level assumptions made when identifying business value.

- Identified steps for the design phase - Initial proposition of specific actions to be taken during the design phase.

4.5 Design

- Related features – Features that are available and related to the concept currently being designed.
- Solution proposal – Definition of the assumptions for the design concept.
- Feedback for solution proposal – Feedback gathered from the User Experience research activities.
- Minimal viable product definition – Selected set of functionalities to be delivered in the first iterations of the product development.
- Graphical design proposals – Sketches, prototypes, wireframes or User Interface mock-ups.
- Feedback for graphical design proposals – Feedback gathered from the research team, project partners or results of the conducted User Experience research activities.
- Other related ideas – Ideas for other product development activities not directly related to the topic.

4.6 Collaboration

Many of the steps above required close collaboration with other members of the project and, most importantly, interaction with potential users of the EOSC Front-Office.

The composition and assembly of the focus groups was conducted by WP10 based on the characteristics of the users (in terms of research fields, discipline, geographical distribution, level of seniority, level of knowledge of EOSC/EOSC-portal, etc) defined by WP5. WP10 also acted as the conduit for distributing surveys to and arranging meeting dates with the focus groups. The focus groups provided a User perspective of the proposed User Interface layouts and feature sets, for each of the **Requirements Themes.**

WP9 are responsible for specifying the Knowledge Hub requirements. In order to understand and refine those requirements and agree the feature sets of the various releases of the Learning Platform and Training Catalogue components, a series of joint meetings were held.

Many of the new features of the Front-Office require modifications in the Provider Portal (e.g. support for bundles and adoption of resource profile v4.00). As such, regular joint meetings were held together with WP4 to co-ordinate the development.

4.7 Requirements Themes

In order to make the requirements analysis task more tractable, the domain was broken into several themes, and a small team was allocated to each. The themes are briefly described below.

- **Data inclusion** - make data universally accessible and allow users to easily search and find research data.
- **Enhanced/improved Discovery** – provide more intuitive ways for users to search and browse the available resources.
- **Knowledge Hub** – consists of the Training Catalogue and Learning Platform;
  - Training Catalogue - holds a collection of training resources relating to EOSC;
  - Learning Platform – an execution environment for interactive course materials;
- **User Dashboard** - a user-centric space which includes elements relevant or possibly relevant to the user activity in the Front-Office.
- **Recommender System for enhanced User Experience -** provides recommendations concerning the resources (data, services, training, projects and publications) that could be of interest to users, based on a multi-focal perspective.

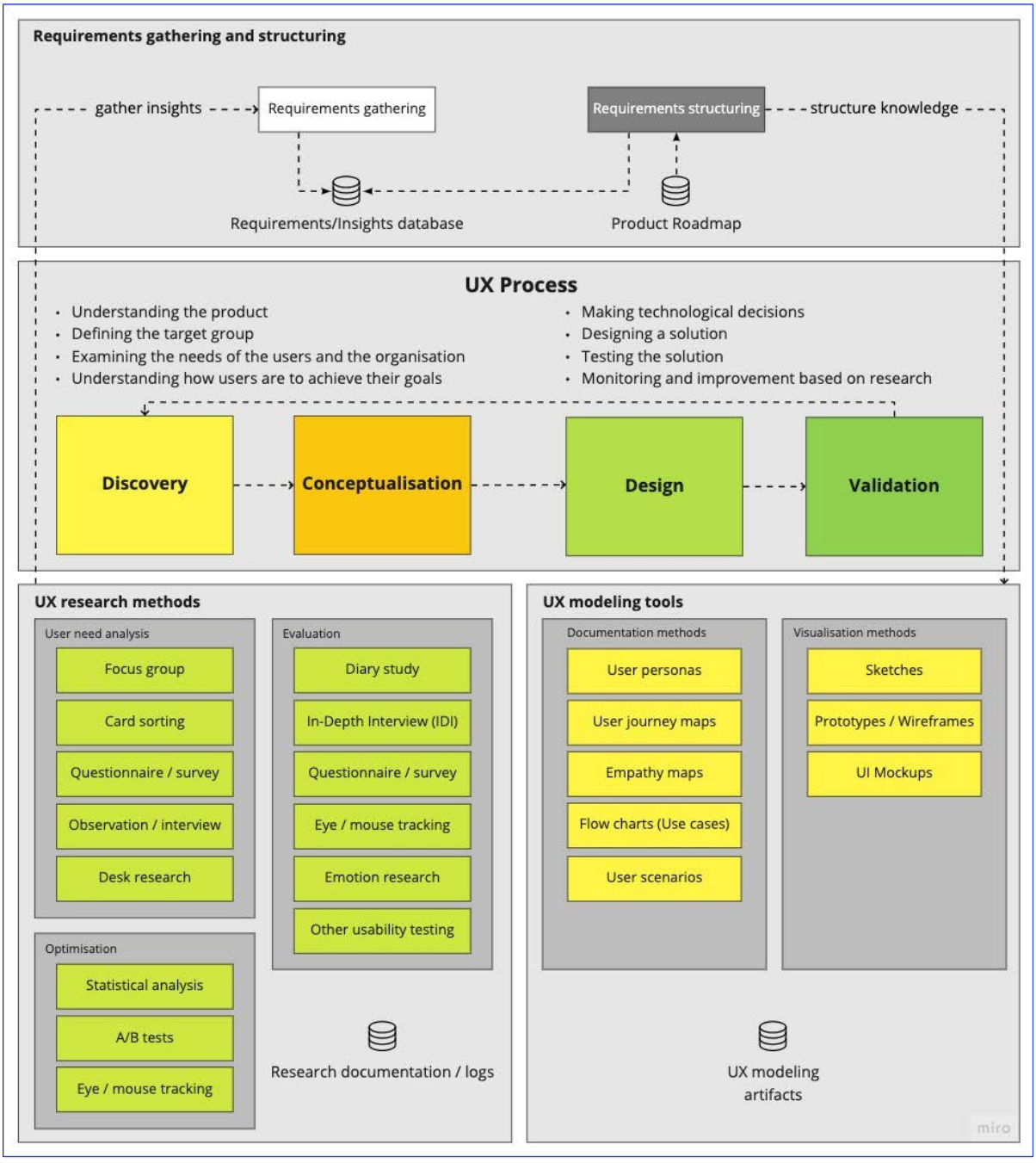

Figure 4.1: UX process building blocks, research methods and tools overview

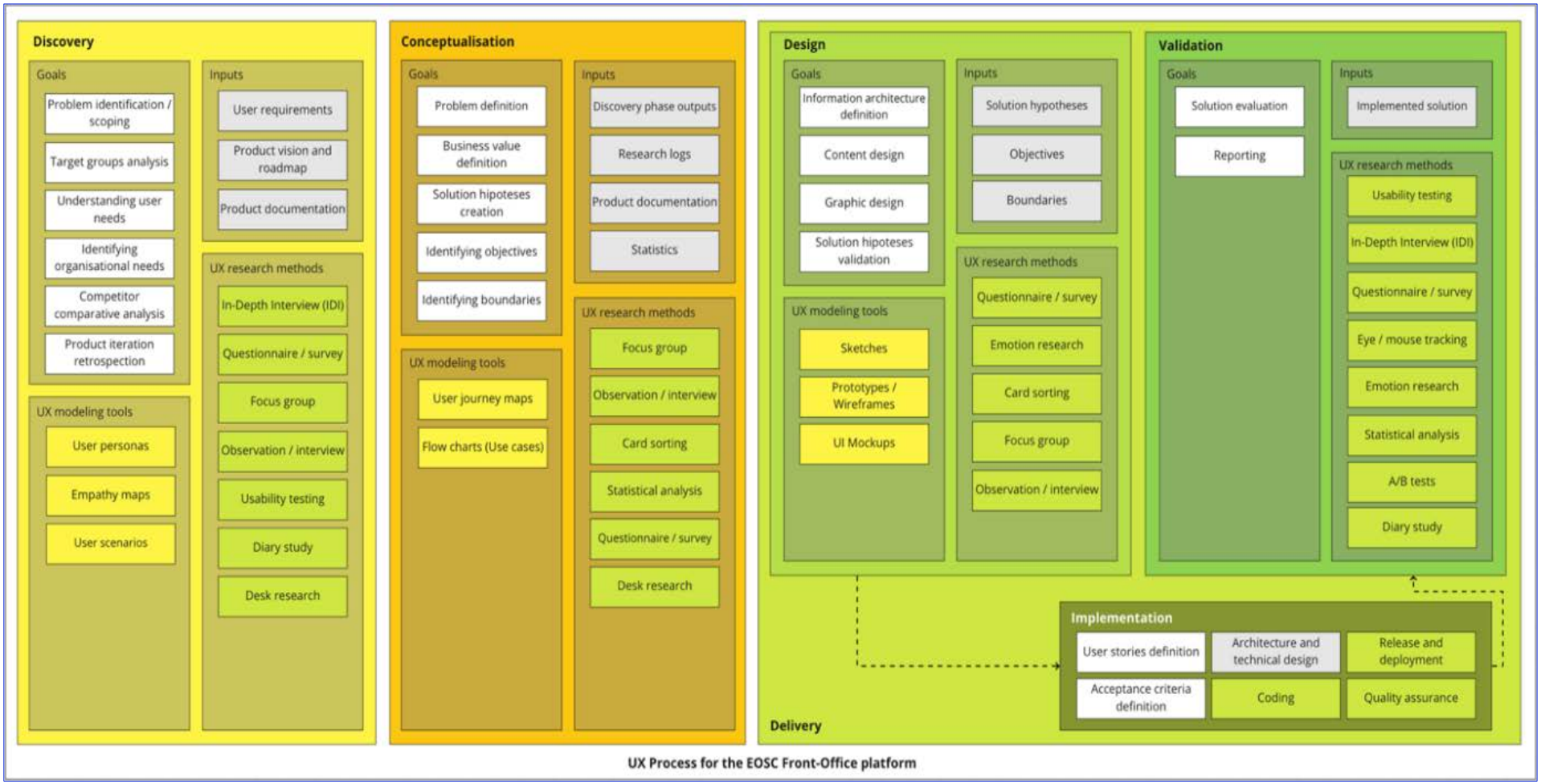

Figure 4.2: EOSC Front-Office platform UX Process

5 Data inclusion in the Front-Office

Data inclusion refers to an EOSC service that makes research data universally searchable, findable and accessible (following the European Commission definition[1], *research data* refers to information, in particular facts or numbers, collected to be examined and considered as a basis for reasoning, discussion, or calculation). This service enables researchers, using a simple keyword search or a series of filters, to find and discover research data of interest across hundreds of repositories spread over Europe and re-use them for their research.

5.1 Process implementation

Searching and discovering data sources can vary a lot based on the origins of the data and the disciplines, career stages and habits of the researchers. Therefore, to provide a good service for the search engine to discover the data sources in EOSC, a focus group (the *Focus Group on Data Finding*) was assembled by WP10 (see Figure 5.1 and Figure 5.2 for the members' characteristics) and the consultations had the following aims:

1. To understand researchers' usual habits when searching for data.
2. To get hints on preferred features currently missing in the usual services (to identify gaps).
3. To test a beta version of the EOSC data search engine based on OpenAIRE Explore [18] (for convenience, referred to in this report as "EOSC Explore" although there is no decision yet regarding the final name).

The questionnaires and tasks given to the Focus Group on Data Finding are collected in **Appendix I: Data Inclusion in the Front-Office.**

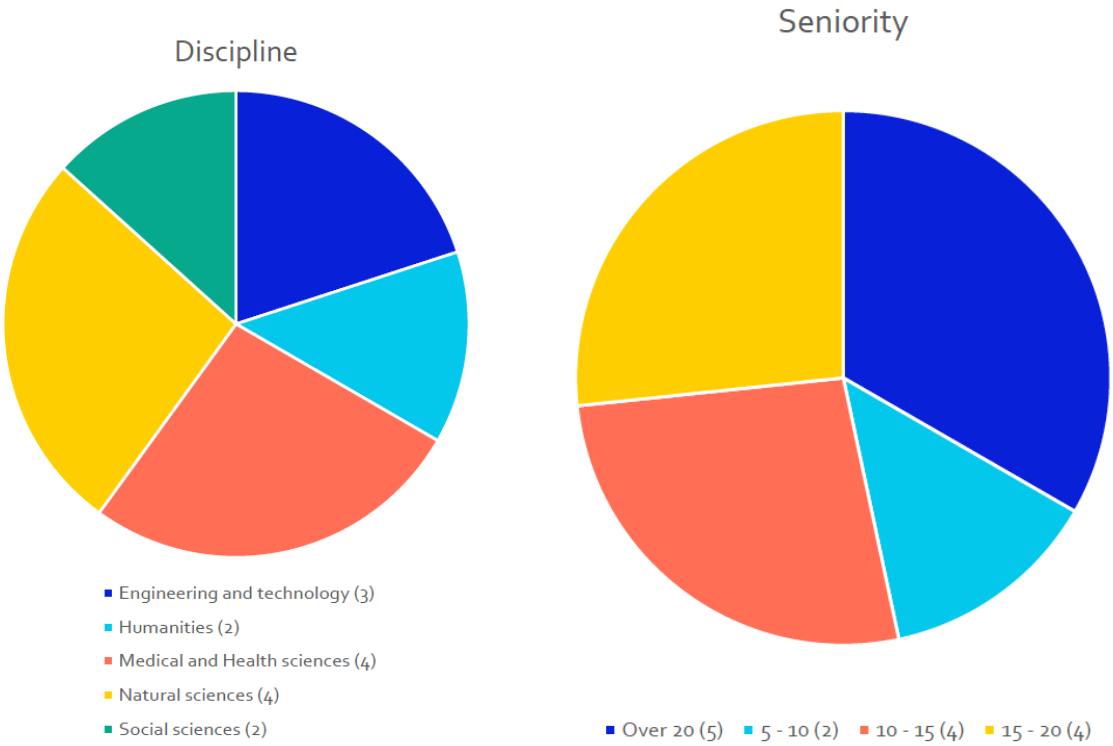

Figure 5.1: Characteristic of the members of the Focus Group on Data Finding

[1] https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

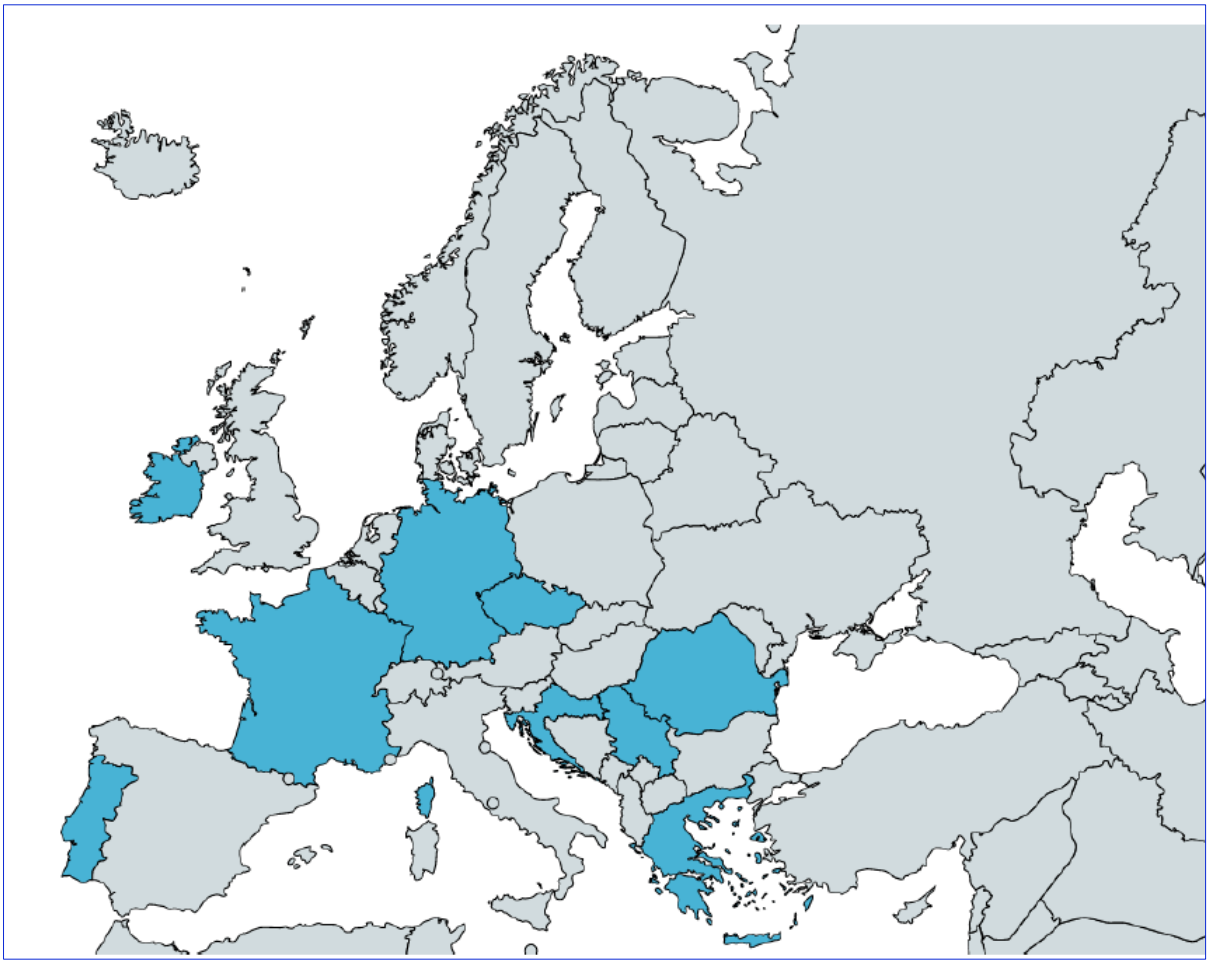

Figure 5.2: Geographical distribution of members of the Focus Group on Data Finding

5.1.1 Internal Brainstorming and Focus Group Consultation

The Task 5.1 team discussed the preparation of the questions for the first interview of the *Focus Group in Data Finding* performed in April 2022 in the form of a webinar with a live survey. An assessment of the status of EOSC was also explored during this meeting. Based on the desired features spotted by the interviewers, a beta version of "EOSC Explore" was realised by the OpenAIRE technical team. A second consultation was conducted in July 2022 to test the beta version and to improve the user experience. The main findings are summarised in the next paragraphs.

5.2 Exploratory analysis

The main findings on the exploratory analysis performed during the interviews of the Focus Group follow.

5.2.1 Researchers' habits for data discovery

- The researchers were asked to report their general strategy for data discovery, which was described by the following steps:
  1. Identifying the best search engine, providers, and level of trust of the data sources (*e.g.* DOI) for a specific query.
  2. Searching the keywords then refining the research by applying alternative keywords and filters such as dates, authors, source, location, licencing, instruments used, open datasets.
  3. Digging deeper when the relevant information is found (*e.g.* reading metadata, looking for additional files, search the data sources, related articles, etc).

- Strategy applied for discovering data outside of the expertise of the researcher or in interdisciplinarity fields:

1. Using a generic search engine as Google search [12], Google Scholar [13], Google Dataset search [14], Academia [15], ResearchGate [16], PubMed [6] or Open Platform for French public data [17].
2. Asking for help from colleagues in the appropriate area of expertise.

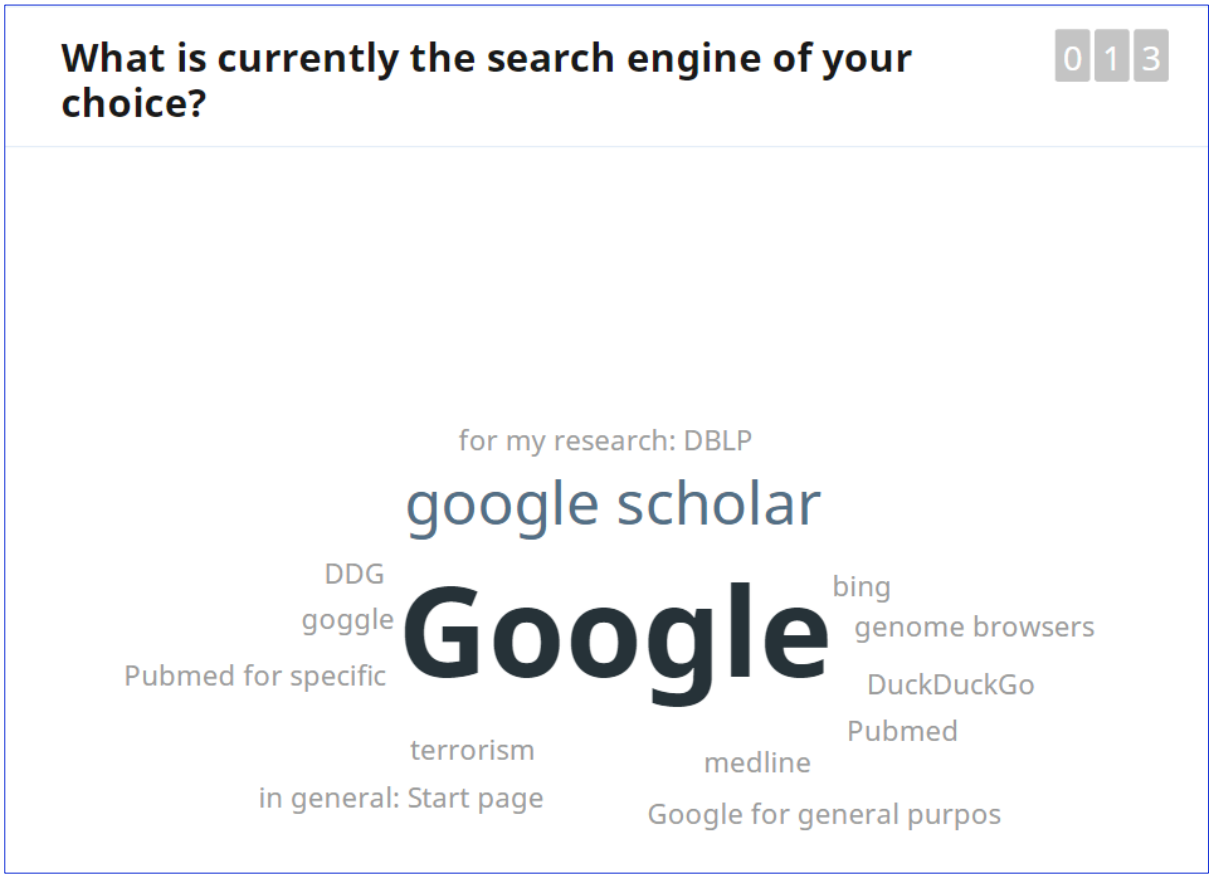

Figure 5.3: Heat map – researchers' strategies for discovering data outside of their area of expertise

5.2.2 Assessment of the search engine in EOSC Catalogue and Marketplace (April 2022)

Ten researchers from the Focus Group on Data Finding were asked to test the search engine of EOSC. The following is a summary of the results (see also Figure 5.4):

- **Search for the EOSC website:**
  The researchers had been asked to find the EOSC website: 22% landed in the EOSC Association website, 56% in the EOSC Portal and just 11% reached the EOSC Catalogue and Marketplace; 11% found other websites.
- **Search of a specific dataset in the EOSC Catalogue and Marketplace:**
  The researcher had been asked to find a specific dataset. 75% did not find the dataset and the other 25% was not sure if it had found it, i.e. none of them could be said to have found it.
- **Criteria for searching data:**
  55% researchers searched by scientific domain, 27% by categories, 36% using other criteria
- **Filters applied:**
  Most of the researchers were not able to filter any search queries in the 15 minutes time they were given and abandoned the search, finding "no relevant data". Others browsed by categories and scientific domain
- The overall experience was considered "not intuitive at all" by 64% of researchers, "not intuitive" by 18% and the remaining 18% was neutral.

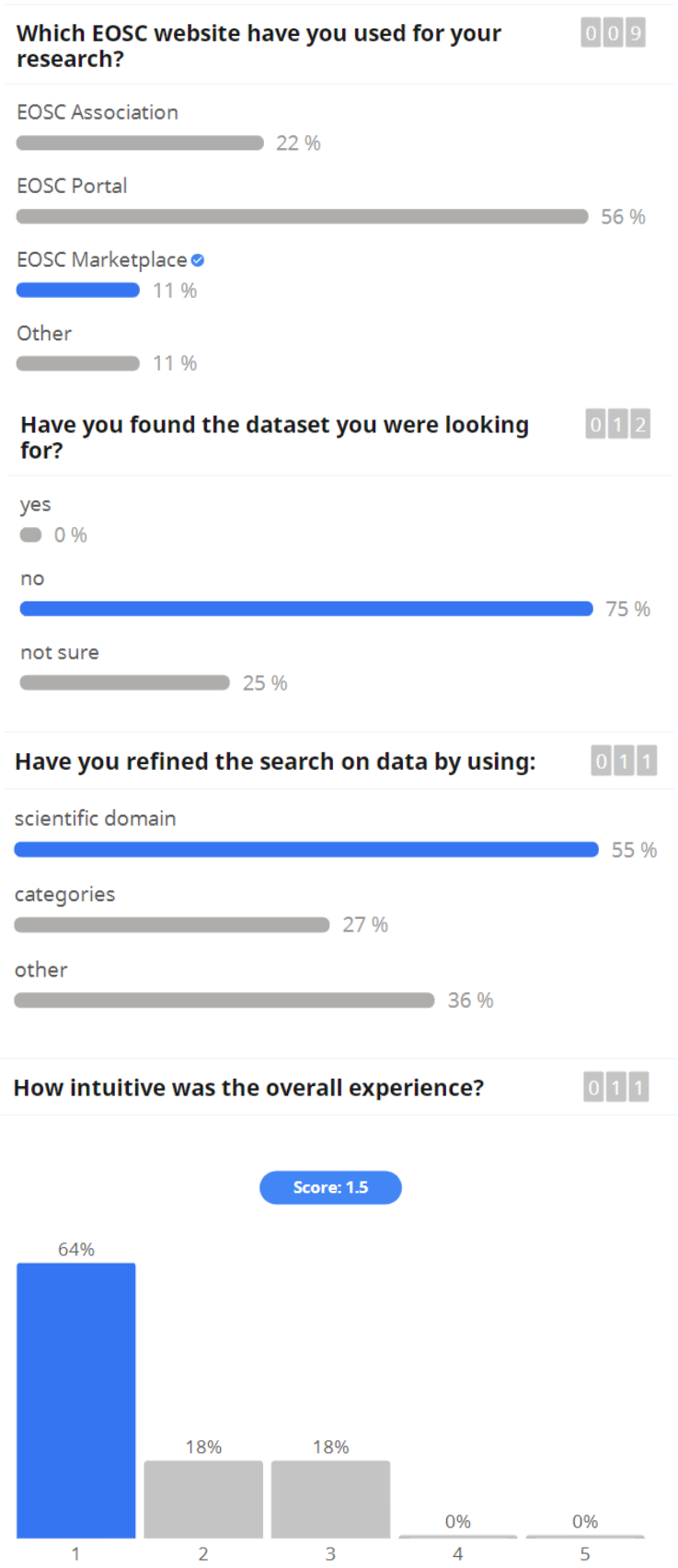

Figure 5.4: Combined summary of researchers' responses (EOSC catalogue search survey and focus group sessions)

5.2.3 Data discovery using the beta version of EOSC Explore (June-July 2022)

Six researchers in the Focus Group on Data Finding volunteered to test the beta version of EOSC Explore and performed specific tasks regarding finding publications, datasets, and software. Of note, the beta version is not as responsive as the production version will be and may include bugs that will not be present in the final version.

The general feedback received is shown in Table 5-1.

Table 5-1: General feedback from members of the data inclusion User Panel

Positive comments / suggestions	Negative Comments
It went well, easy to use, user friendly	*Extremely difficult*
it is a great progress relative to what it used to be! Congrats!	*Challenges with data format*
Quite good	*The word "research product" for both publications and datasets is a terrible choice*
I found what was expected	*The position of the filters (especially for advanced search) was not intuitive*
Maybe the links could be improved as for example these were just text	*When switching to "advanced search" all filters get lost (without selecting "Clear All")*
Why not have a "software" choice instead of "research product"?	*Filters are kept, when changing the text of "scholarly works" (without switching from simple to advanced (or vice versa)*
It would be nice to have some help for structural search. Is the engine case-insensitive? Does it use term similarity (and how deep), or just searches for the terms entered?	*Some incompatibility with the "Dark Mode" (Firefox with Dark Reader add-on) by which I was not able to introduce keywords in the "simple search" form nor dates in the "advanced search" form.*

The overall impression in terms of improvements was positive. The following is a summary of the results (see also Figure 5.5 to Figure 5.9):

- Findability of a specific data: about the 83% of the researchers had been successful in finding the correct result for a publication; all researchers were successful in finding specific datasets and software.
- Findability of data known by the researchers interviewed: the research was successful for all researchers, only one person experienced issues due to the beta version. The suggestions for improvement were:
  - *The results should be sorted starting from the most recent by default.*
  - *Not intuitive.*
  - *Research is slow.*
  - *I would expect "software"/ "data sets" in the menu.*
  - *More info on the advanced search history would be commendable.*
  - *I wish to move between different filters.*
  - *It's confusing what is better to introduce: the domain, keywords, author.*
  - *Search results can be sorted "by relevance" – but it is unclear, what this means or what numbers are used for this way of sorting. A short explanation would be helpful.*
  - *Taking into account some semantics would perhaps improve the relevance of the search results*
  - *Kindly consider adding help to the filters.*
  - *The domains and subdomains must be more visible and introduced in the master search engine. They must prevail the other criteria.*

- Satisfaction of researchers (5 responded in total):
  - Overall experience using EOSC Explore was not very good for 20% of respondent, neutral for 20% of respondent, good for 40% and very good for the last 20% of researchers;
  - Usability: very easy for 40%, easy for 40%, not very easy for the remaining 20%
  - Satisfaction on the terminology used: 20% not satisfied, 40% neutral, 40% satisfied
  - Satisfaction on the data finding: 20 % was very satisfied, 40% satisfied, 20% not satisfied and another 20% was not satisfied at all
  - When asked how likely it was that they would be use the service again, 20% of researcher answered not at all, 40% said not likely, and 40% answered it was very likely.

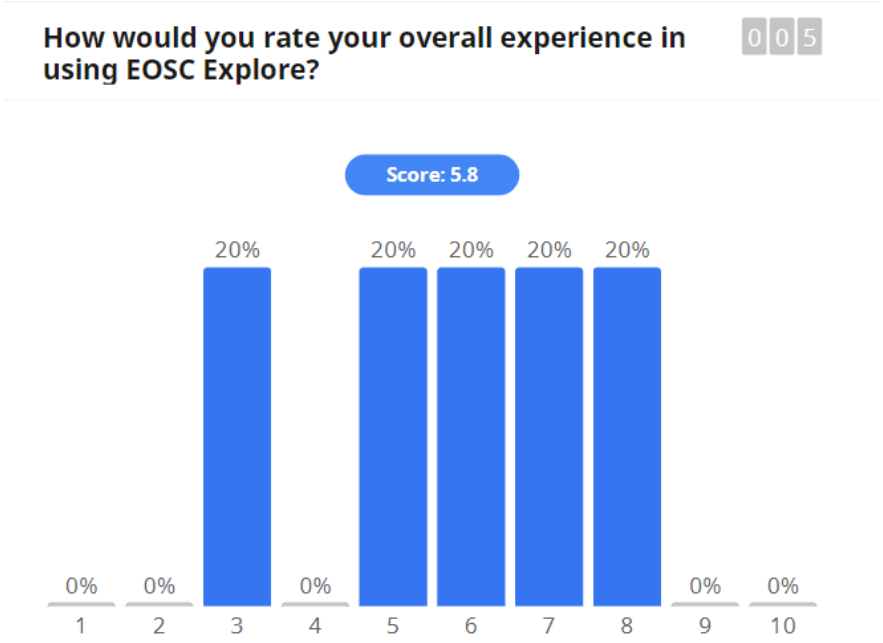

Figure 5.5: EOSC Explore overall user experience rating

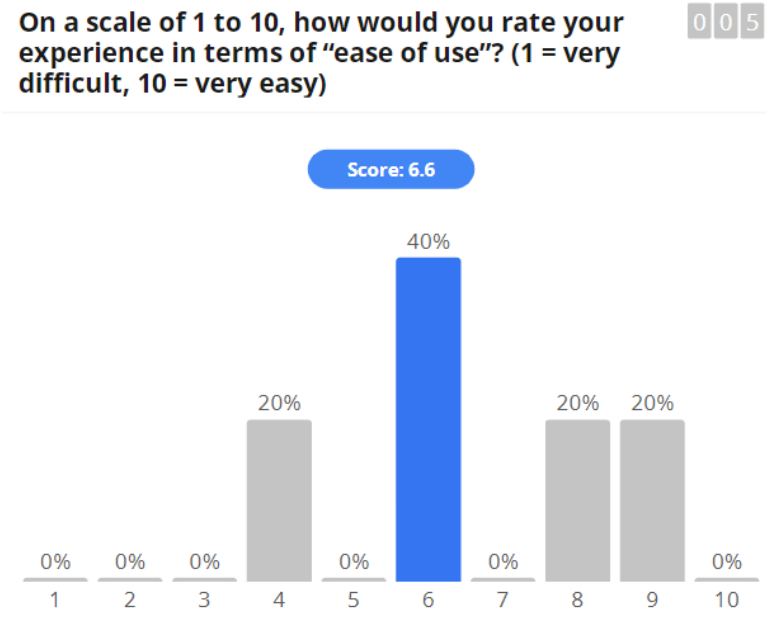

Figure 5.6: EOSC Explore ease of use rating

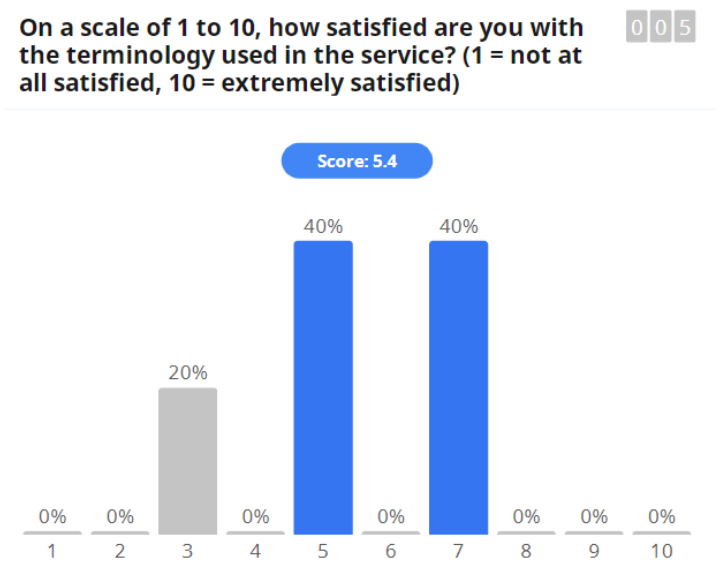

Figure 5.7: EOSC Explore satisfaction with terminology rating

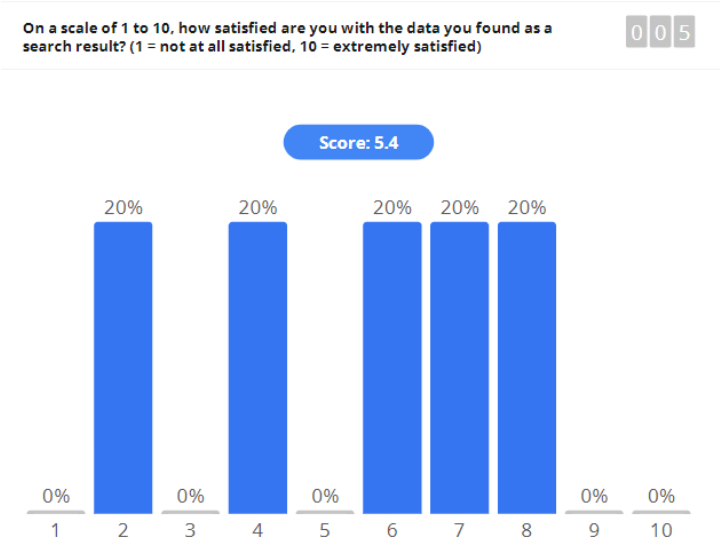

Figure 5.8: EOSC Explore data search results rating

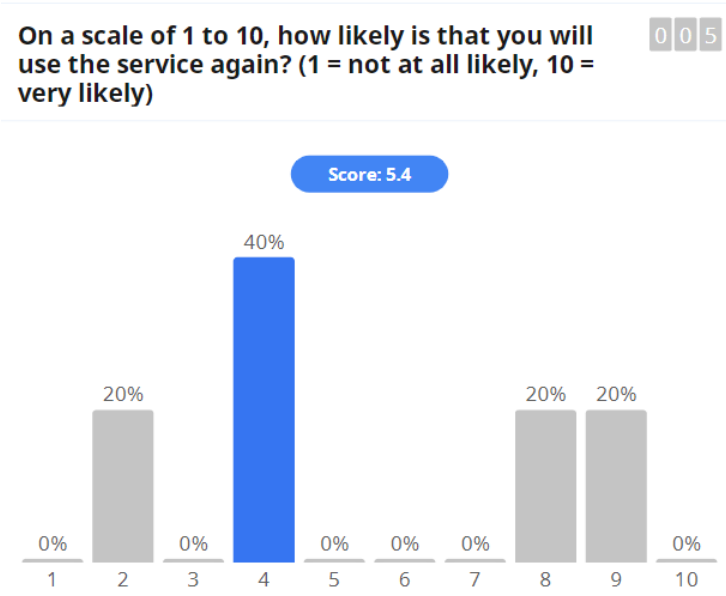

Figure 5.9: EOSC Explore likelihood of reuse rating

The majority of respondents did not have any technical problems in using the improved EOSC Explore. It meets the requirements of a search engine and the special requirements for scientific or data-based queries. The identification of useful filters and the corresponding search options were predominantly recognized as useful. Searching for known data and free search for areas of interest were tested. The former is common when following recommendations from the research community. The second is common when searching inspirationally. Different search strategies and different application of keywords and filters are used in each case. In the second survey, EOSC Explore was tested using both search strategies and the results were mostly positive. Using keywords and filters is one of the important ways of searching. When evaluating EOSC Explore and talking to the "test group" at a certain point in the evaluation, individual habits must also be considered, because it is part of the user experience and therefore provides less information regarding the technical functionality of EOSC Explore. Based on the data of this survey, one result is that the search engine is basically set at a good level and only minor improvements seem necessary.

5.3 Business analysis

The usual habits of researchers confirmed that the most used search engines for data are either domain specific (e.g. PubMed or genome bank browsers) or very general ones, such as Google, Google Scholar, and Google dataset search. The interviewees were not familiar with OpenAIRE Explore or other competitive services identified in the Value Proposition Canvas (Figure 5.10).

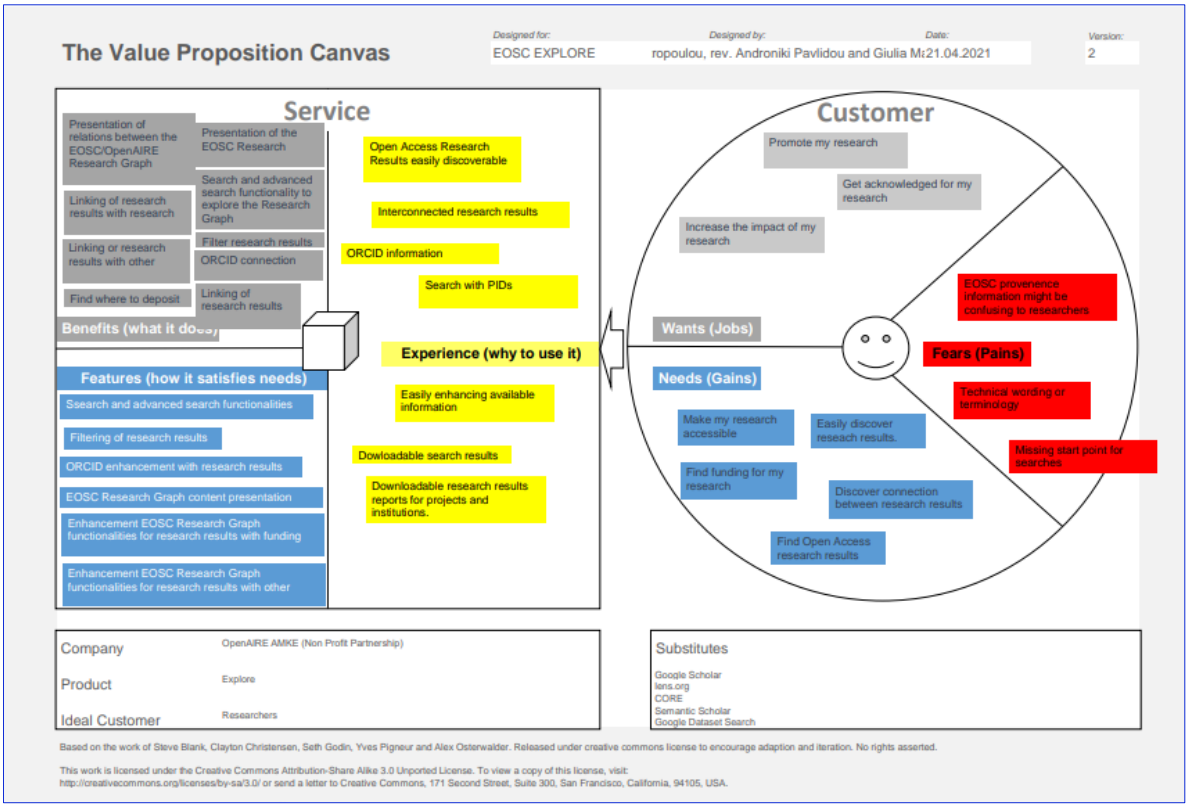

Figure 5.10: Infographic on the Value Proposition Canvas

When asked how satisfied they were with the search engines they use, just 50% of the respondents answered "satisfied"; 33% were neutral and 17% not very satisfied. This suggest that an EOSC search engine for data may be of great interest and use for researchers. The gaps between what their current search engine of choice offers and what they would like to see in the EOSC search engine were elicited and are shown in Table 5-2.

Table 5-2: Hot topics for members of the data inclusion User Panel

What researchers are missing	Present in Explore	In the development	Comments
Backlinks to link the data with publications and other sources	Yes	N/A	N/A
Non-biased search vs. rating by other users (options)	No	Not in the short-term plan	Technical Team is evaluating this implementation for the future
Keywords/tag-based research and domain specific filters	Yes	New tags: EOSC, Sustainable Development Goals, Field of Science	New tags will be visible in the short term
Semantic search	No	Yes, in the context of a project recently funded	The implementation will depend on the results of the project
Filter mechanisms	Yes	User feedback is well received for further implementation	N/A

Worldwide coverage of the sources	No, but international sources exist	EOSC Providers onboarding and other opportunities are explored	Depends on the adoption of the OpenAIRE Guidelines from the source Providers and the licence
Licence visibility	Yes	UX/UI in process to highlight this function	Depends on the metadata from Providers
Geographical filters	Partially	N/A	Depends on the metadata from Providers
Boolean combination	Yes	N/A	N/A
Filtering per type of data, size and format	Partially	Depends on the metadata from Providers	Depends on the metadata from Providers

6 Enhanced/improved discovery

"Discoverability, in the context of product and interface design, is the degree of ease with which the user can find all the elements and features of something new when they first encounter it. That ability is an important consideration in user interface and user experience design. Discoverability is also one component of learnability, a measure of how easily someone can find, access and make use of the components and features of a new system. Learnability, in turn, is an element of usability, which is an assessment of a product's potential to accomplish the goals of the user."[2].

Discoverability information is essentially a combination of the content in a service contract and metadata in the corresponding registry record. Most discovery processes and technologies are currently geared toward humans. The human discovery process essentially consists of **querying** and **filtering**. Querying is based on entering a search term or phrase, filtering specifies what to include in/exclude from the results returned by the query.

6.1 Process implementation

The Discovery step has many sub-processes that can be selected (see Figure 4.1 and Figure 4.2). The following have been used to date.

6.1.1 Internal Brainstorming

Initial brainstorming was conducted by members of the T5.1 task team with the focus on enabling and augmenting resource discovery in the EOSC Catalogue and Marketplace. Each participant had previous experience of discovery from using well know services such as Amazon, Netflix, eBay etc. It produced an output of remarks, propositions and ideas after an initial thorough exploration of the User Interface of the EOSC Catalogue and Marketplace.

The team proposed seven items to enhance discoverability in the EOSC Catalogue and Marketplace (see **Business analysis** section below). Each item/proposition was then explored in more detail in the following sessions to clearly define the general idea behind it. Furthermore, team members explored features that implement the ideas behind each proposition in similar systems/services and thoroughly documented the user experience (providing also flows and screenshots, as shown in Section 14.1 **Screenshots**). The EOSC Catalogue and Marketplace User Interface was a constant point of reference for exploration, with team members comparing implementations of the proposed features with the existing ones, stating similarities, differences, pros and cons.

A major part of the process was the effort put in to compose a framework that organises the issues identified in the gap analysis (contained in the first iteration of Front-Office requirements analysis [1]) and the ideas produced by the internal brainstorming session, into proposed action items. Each action item is then described by a summary of the general idea behind it, along with any related best practises and solutions employed in similar products/services. There was also an attempt to gather as much academic information available about the topics behind each proposed action with references to state of the art papers.

The cost of each action, in terms of components affected and technical effort needed to introduce it in the existing system, has been estimated where possible. Also, each item is accompanied by an analysis of its associated business value, focusing on identifying the user pains and struggles and the ways they are alleviated if this action item is implemented. It was recognised from the beginning that this would be an iterative process, starting with assumptions that later are going to be verified by the focus groups. Thus, each action item defined through this framework was re-examined during the evaluation of focus group results and the initial assumptions were re-evaluated. A new action item was added to the list after evaluating the results of the first focus group meeting.

6.1.2 Focus Group

The focus group meetings followed the internal brainstorming session. A focus group is a group interview involving a small number of demographically similar people or participants who have other common traits/experiences. The participants for the study were carefully selected by WP10 to represent the larger population of potential users and came from a mixture of scientific domains (see Figure 6.1 and Figure 6.2 for

characteristics of the focus group). Some had experience of using similar services to the ones that were under discussion, others did not.

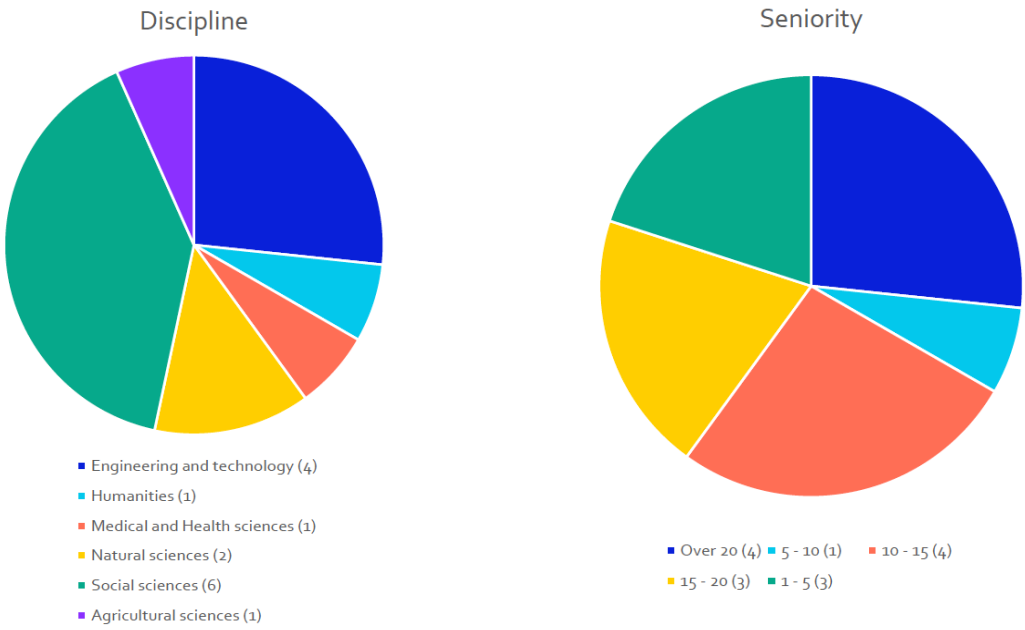

Figure 6.1: Characteristic of the members of the Focus Group on enhanced/improved discovery

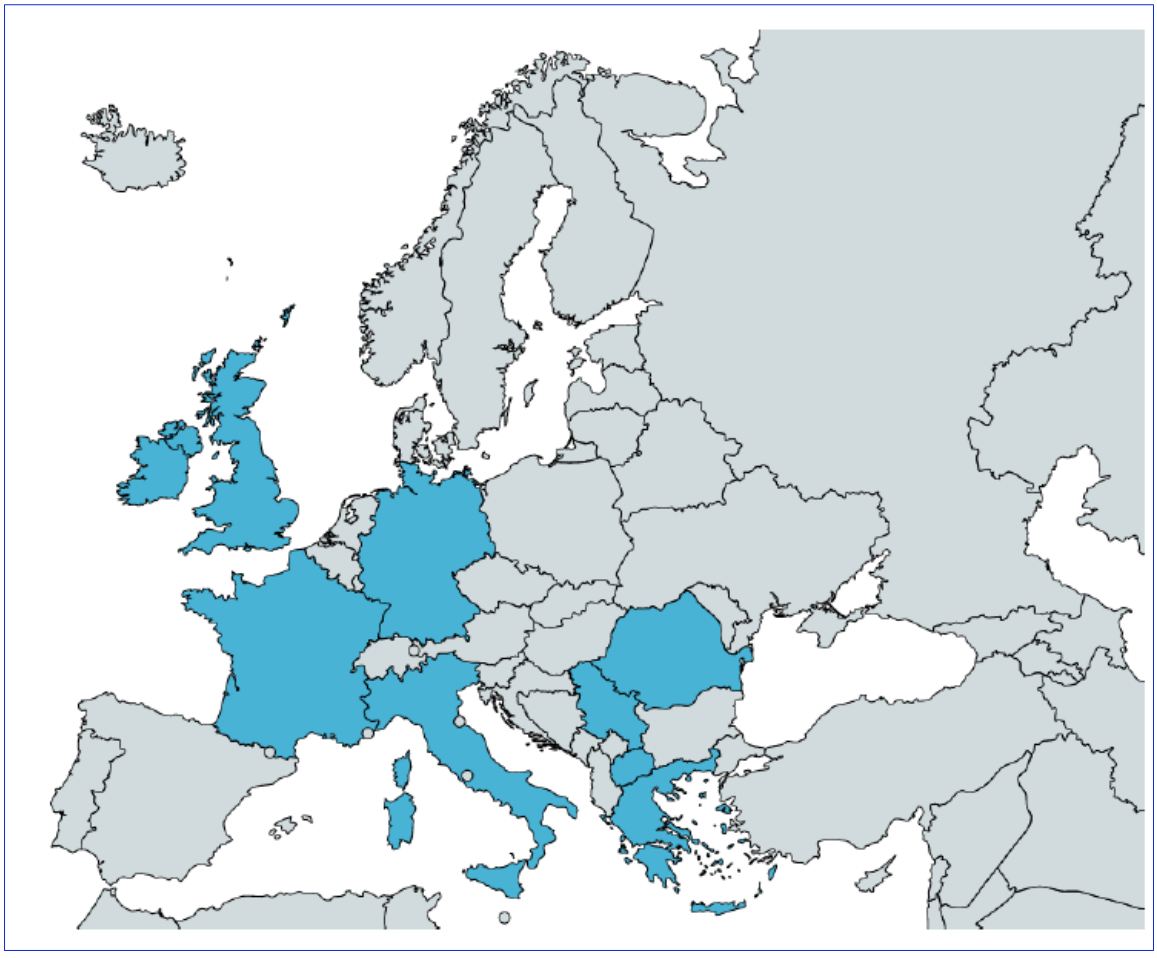

Figure 6.2: Geographical distribution of members of the Focus Group on enhanced/improved discovery

The first meeting of the focus group took place on the fourth of April 2022 and lasted seventy minutes. There were thirteen participants, most with an average knowledge of EOSC and its services related to search and ordering. The goal of the meeting was to gather ideas and inputs about the current status of discoverability in the EOSC Catalogue and Marketplace and to explore "how easy it is for a user to find, access and use components and features of the EOSC system". The participants were asked to pay particular attention to ways to improve the current discoverability in the EOSC Catalogue and Marketplace when it comes to User Experience, the presentation of content in terms of categorisation, labelling, wording and anything else that will make resource discovery faster and more accurate.

A questionnaire was used to structure the focus group discussion and consisted of five sections [see 14.2 Questionnaire].

Part 1: Basic information: Find out if the participants are familiar with a) EOSC Catalogue and Marketplace and/or b) any other type of service for browsing, searching and ordering resources.

Part 2: Using the EOSC Catalogue and Marketplace: The participants were asked to visit [3] and answer questions referring to the labels and the words used in the EOSC Catalogue and Marketplace.

Part 3: Discoverability and technical terms: The participants were asked for a definition of the most used category in the EOSC Catalogue and Marketplace, and the way they would define them.

Part 4: Search in the EOSC Catalogue and Marketplace: The participants were asked to find an open access Repository related to their scientific domain from a Provider in their region.

Part 5: Categories: The participants were asked to respond to questions about the resource categories and the items shown when browsing the categories.

The general conclusion of the focus group was that the EOSC Catalogue and Marketplace, in its present state, is almost unusable to the average researcher due to improper or ambiguous categorisation of services, lack of proper explanation of services in plain language (as the technical jargon is incomprehensible to researchers), the lack of proper filters and more besides. In addition, the criteria of the search algorithm are not described, so it is not clear to the User why the results are considered relevant to their search. At the same session we proposed a new method for organizing the categories. The feedback the EOSC Future team got on the new methods was positive and it will be used as a starting point for the new categories.

6.2 Exploratory analysis

The analysis related to discoverability explored the critical process of performing initial investigations to discover patterns, spot anomalies, test hypothesis and check assumptions. The work started with an internal brainstorming session that compared similar third-party services, followed by consultation with a focus group.

Equipped with the new framework that was developed as described in Section 6.1.1 **Internal Brainstorming** and having as a point of reference the progress made so far, the team participated in iterative internal brainstorming sessions trying to map ideas into distinct propositions/actions. The first brainstorming sessions produced an output of remarks, propositions and ideas after an initial thorough exploration of the EOSC Catalogue and Marketplace user interface. These ideas were used to identify several major proposition items and have them iteratively defined and described using the new framework.

The EOSC Catalogue and Marketplace user interface was used as a constant point of reference for exploration with team members, comparing implementations of the proposed features with the existing ones found in the EOSC Catalogue and Marketplace user interface (stating similarities, differences, pros and cons). Even though the systems explored operate in strictly commercial domains (content-consumption, shopping etc), the focus to maintain the discussion in the context of the EOSC Catalogue and Marketplace - which is a platform catering mainly for researchers – was preserved.

In subsequent sessions WP5 members gathered as much academic information available about topics behind each proposed action with references to state of the art papers. A rough cost of implementing each proposition (also identifying the affected components) was also defined. Inspired by the business proposition value canvas

framework there was a substantial effort trying to define for each proposition the customer (user) profile and to state user pains and gains.

With the support of the focus group, WP5 managed to validate and to augment the main points identified during the brainstorming. All the proposition items described in the following sections represent identified steps to be used to enhance the EOSC Catalogue and Marketplace.

6.3 Business analysis

6.3.1 Identified Business values

The main business values that were initiated by the internal brainstorming and were validated by the focus group are stated below. For each proposed item a value proposition canvas was created to show the Consumer's pains and gains (see Figure 6.3 to Figure 6.9).

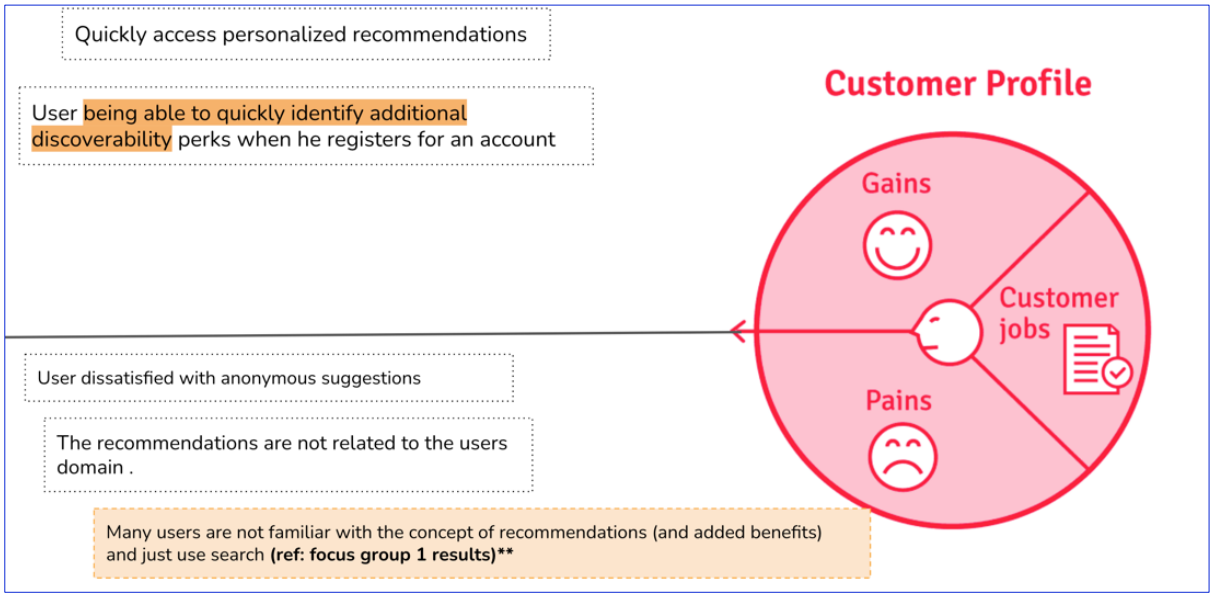

Figure 6.3: Value proposition canvas – notify unauthentic users that recommendations improve when logged in

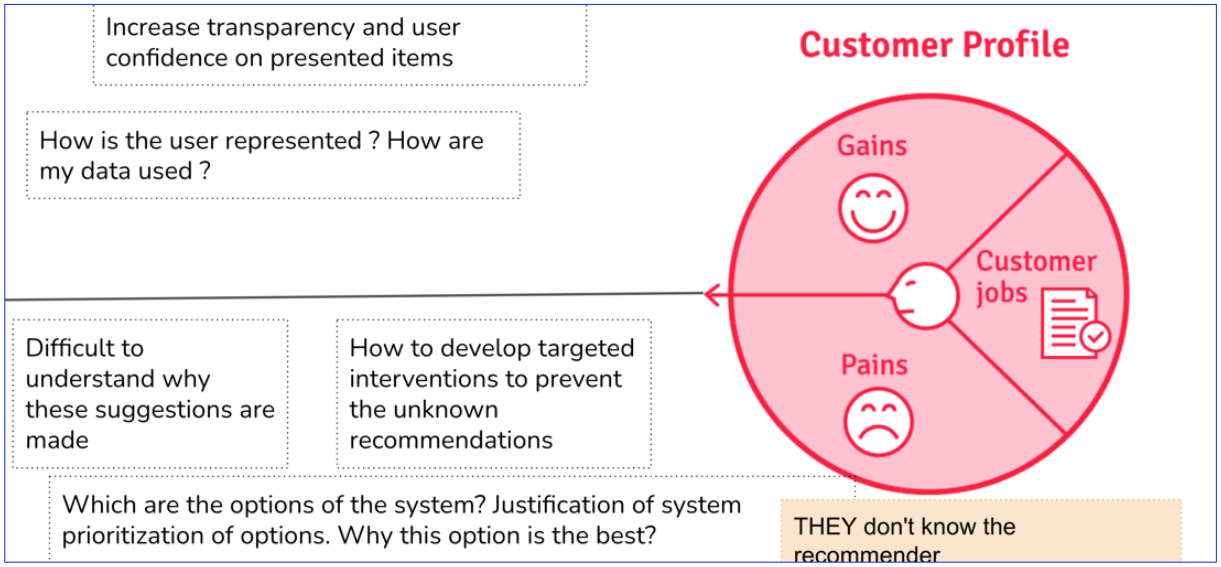

Figure 6.4: Value proposition canvas – explain why a recommendation was made

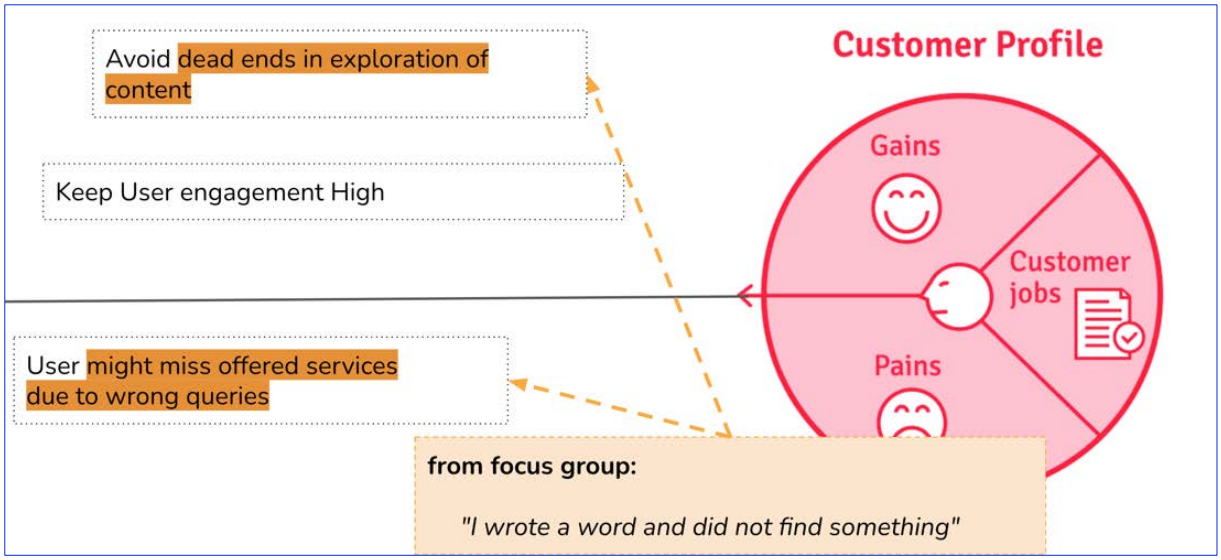

Figure 6.5: Value proposition canvas – optimise no-results page with suggestions

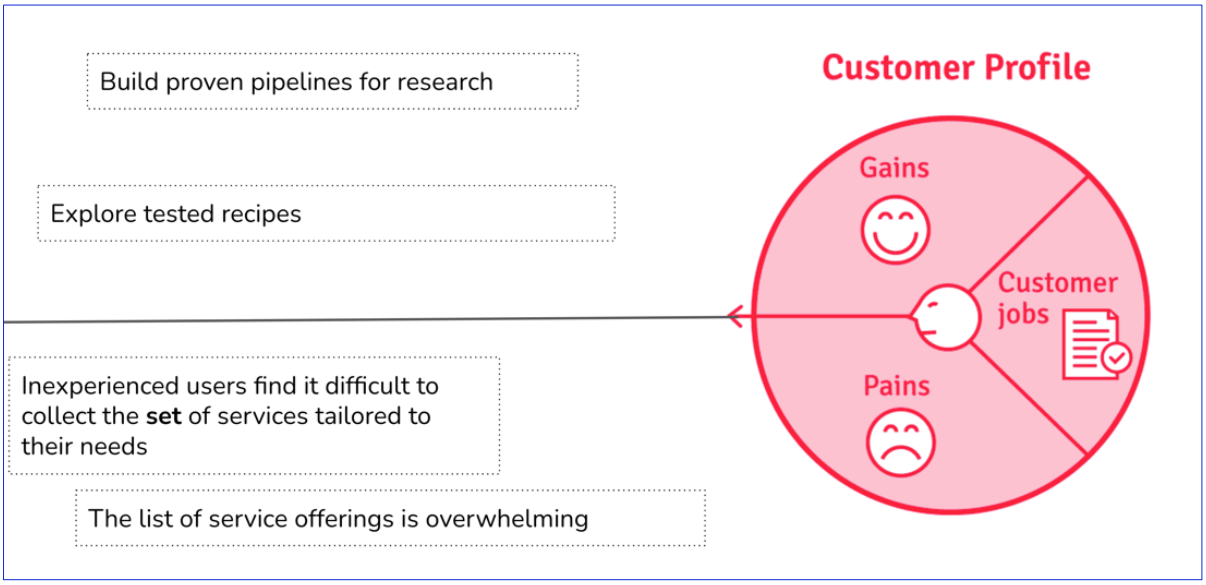

Figure 6.6: Value proposition canvas – support user-curated suggestions

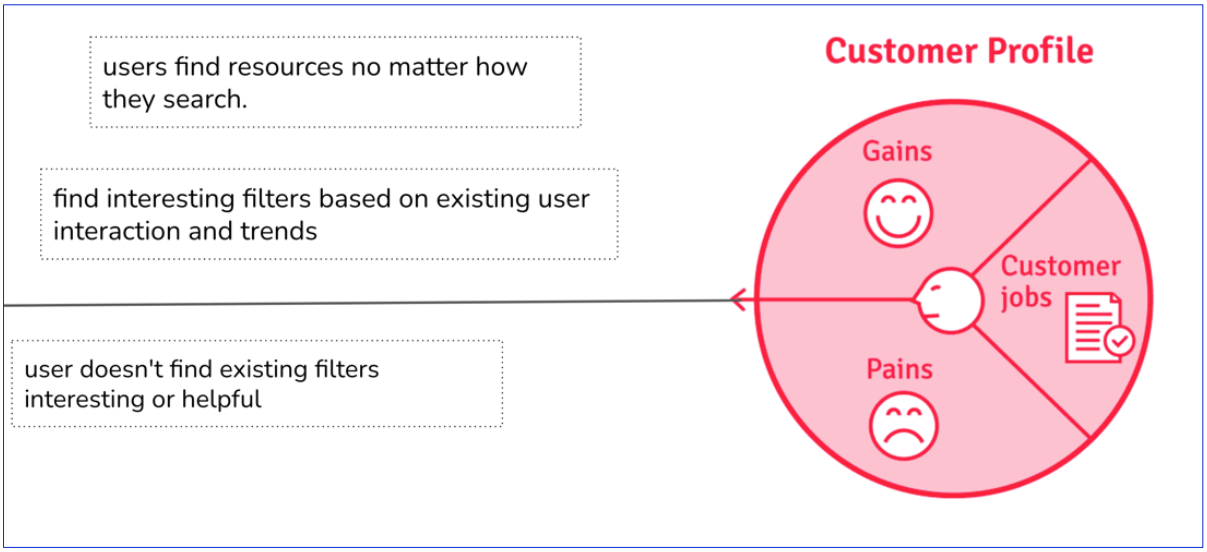

Figure 6.7: Value proposition canvas – enrich items with AI-generated tags

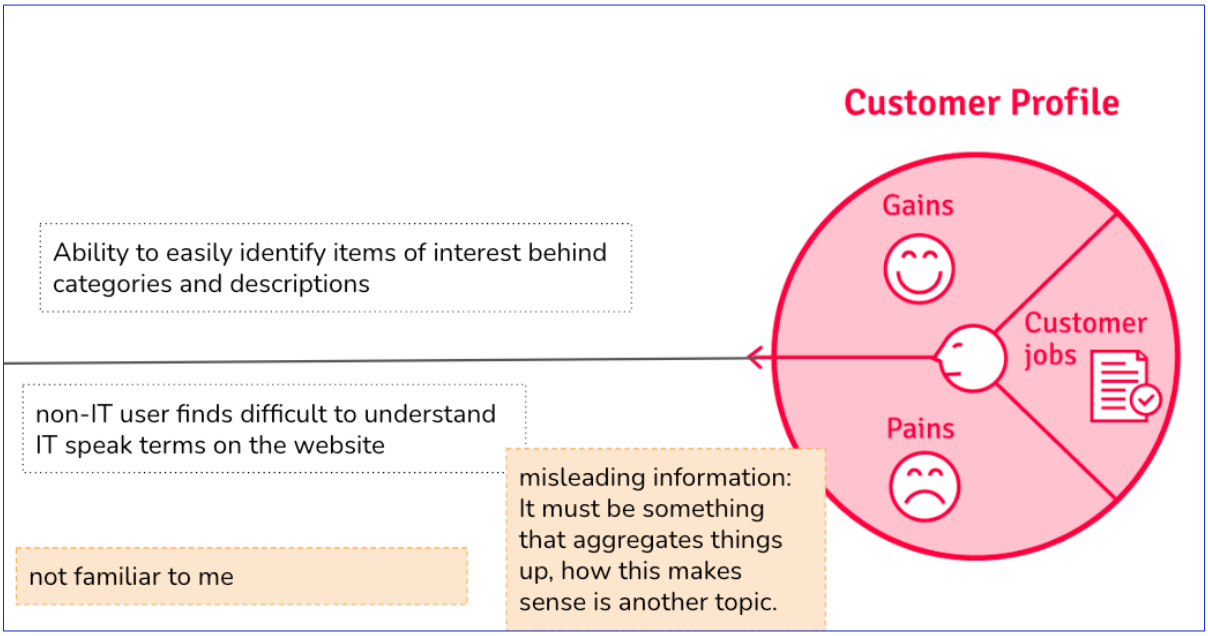

Figure 6.8: Value proposition canvas – avoid or explain technical jargon

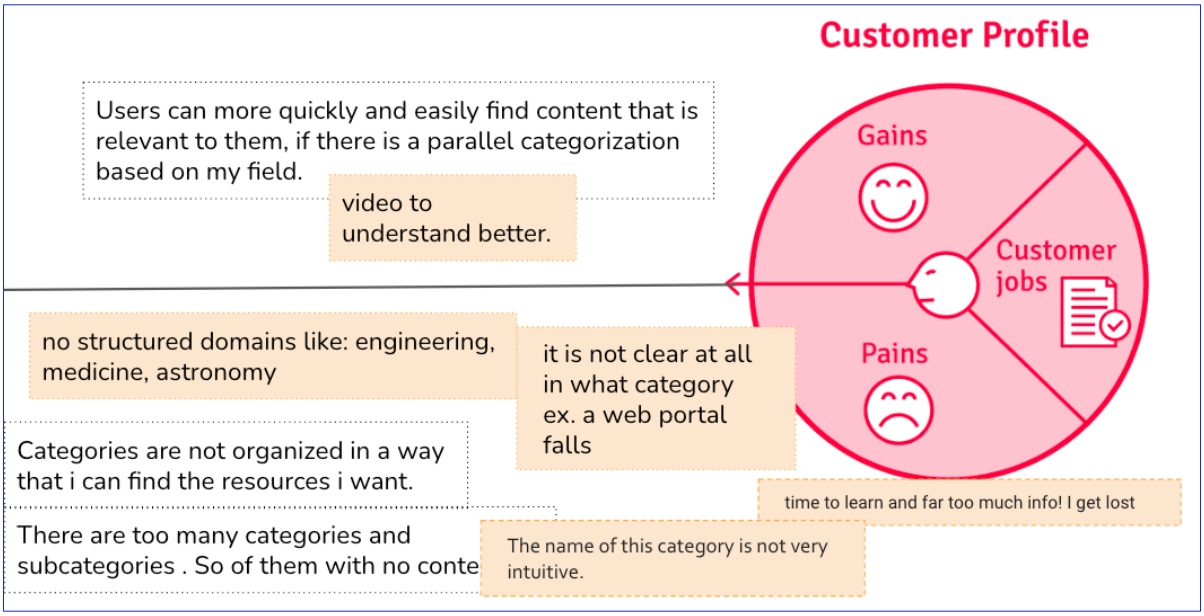

Figure 6.9: Value proposition canvas – provide additional categorisations of content

6.3.2 Identified steps for the design phase

The seven items identified for the design phase are listed below:

1. **Notify guest/unauthenticated users**. Notify guest/unlogged users that they should log in and create a profile to receive better recommendations and results.
2. **Support for User Curated Content**. Allow experienced users to optionally display their public profiles so other users with same interests can see a human curated list of service and resource recipes that can help them accomplish similar research goals.
3. **Explain to the user the criteria that the search algorithm used to select results**. Discovery requires a means of consistently communicating information (metadata) about the available resources. The EOSC Catalogue and Marketplace should present to the user the criteria used to select the results in every search. This can help users fine tune their subsequent queries and at the same time create a feeling of trust.
4. **Optimise no results pages with resources**. When researchers are looking for very specific resources on the EOSC Catalogue and Marketplace, they might get a "no results found" or similar message. This can be due to the unavailability of relevant resources or due to metatags that lack essential attributes and descriptions that enable better resource discovery. In such cases, similar or partial matches should be recommended, helping the researcher find something that is relevant to their search criteria.
5. **Use AI-generated tags for insights on trends**. The depth and granularity of extracted tags pave the way for the generation and collection of data regarding a catalogue and the way in which users interact with the EOSC Catalogue and Marketplace. Better decisions can be made by understanding the split between categories versus how they are performing. Tags can be used by analysing trends, styles and users' behaviour.
6. **Provide, in parallel, other ways to categorise resources**. Apart from the main categorisation, it can be useful to provide additional mappings of items to categories that reflect different approaches/perspectives (such as a data-oriented categorisation of resources or a more technical-oriented one etc). These can be provided as additional ways to explore the catalogue without disrupting the main existing categorisation.
7. **Explain technical terms to non-technical users**. This is a cloud and service-oriented world so some technical terms such as resource, service, app etc. have become more mainstream. However, to

support more traditional users, such cornerstone terms that appear in the User Interface should be thoroughly explained both by a dedicated page and a local aid, such as a tool tip.

7 Knowledge hub

The Knowledge Hub specification was prepared by WP9 and delivered in September 2021 [4]. It states that the Knowledge Hub consists of two services, the **Training Catalogue** and the **Learning Platform**.

The Training Catalogue holds a collection of training resources relating to EOSC, and consists of a database, an advanced search interface and a landing page for each of the training resources. Any relevant training resource that fulfils the onboarding procedures and rules of participation of training service providers may be included in the catalogue.

The Learning Platform is a learning management system of which the main components are an online learning environment with training courses, certification, a repository populated with openly available training materials, and a directory of trainers. It is an execution environment for interactive course materials and as such, any courses held in the Training Catalogue that are in the appropriate format can be run in it with minimal effort.

7.1 Process implementation

The beta version of the training catalogue [25] was implemented in the previous reporting period. This version has taken the specifications from D9.1 [4] and incorporated recommendations from WP5. While defining the metadata set to onboard a training resource, ten fields were considered for the beta version. These ten fields provide sufficient functionality to short-list desired training resources via filters and searching and allow for a less time-consuming onboarding procedure for the Providers.

The training resources were provided by WP9 from the Pilot Catalogues (ELIXIR TeSS [19], SSH Training Discovery Toolkit [20], DARIAH-Campus [21] and EOSC-Pillar [22]) and the filters use the values found in the metadata, which will need to be harmonized for future releases.

7.1.1 Focus group

This beta version was presented to the Training catalogue focus group to further optimise it and gather user requirements for the next version of the training catalogue. The focus group was assembled by WP10 (see Figure 7.1 and Figure 7.2 for the members' characteristics).

A focus group meeting took place on 21/3/2021 to learn about best practices from the users on other platforms or simply from their learning experiences. Five members of the focus group (out of some 10-15 persons invited) joined this event.

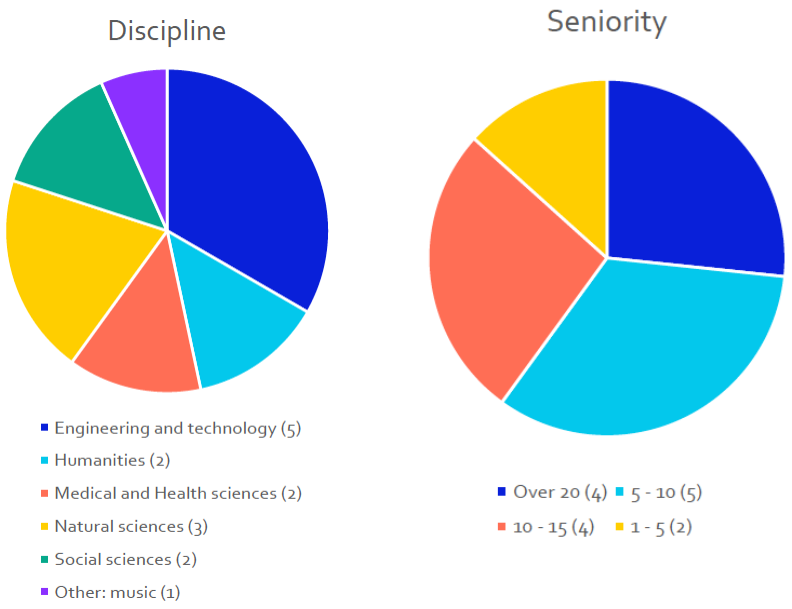

Figure 7.1: Characteristic of the members of the Focus Group on the Knowledge Hub

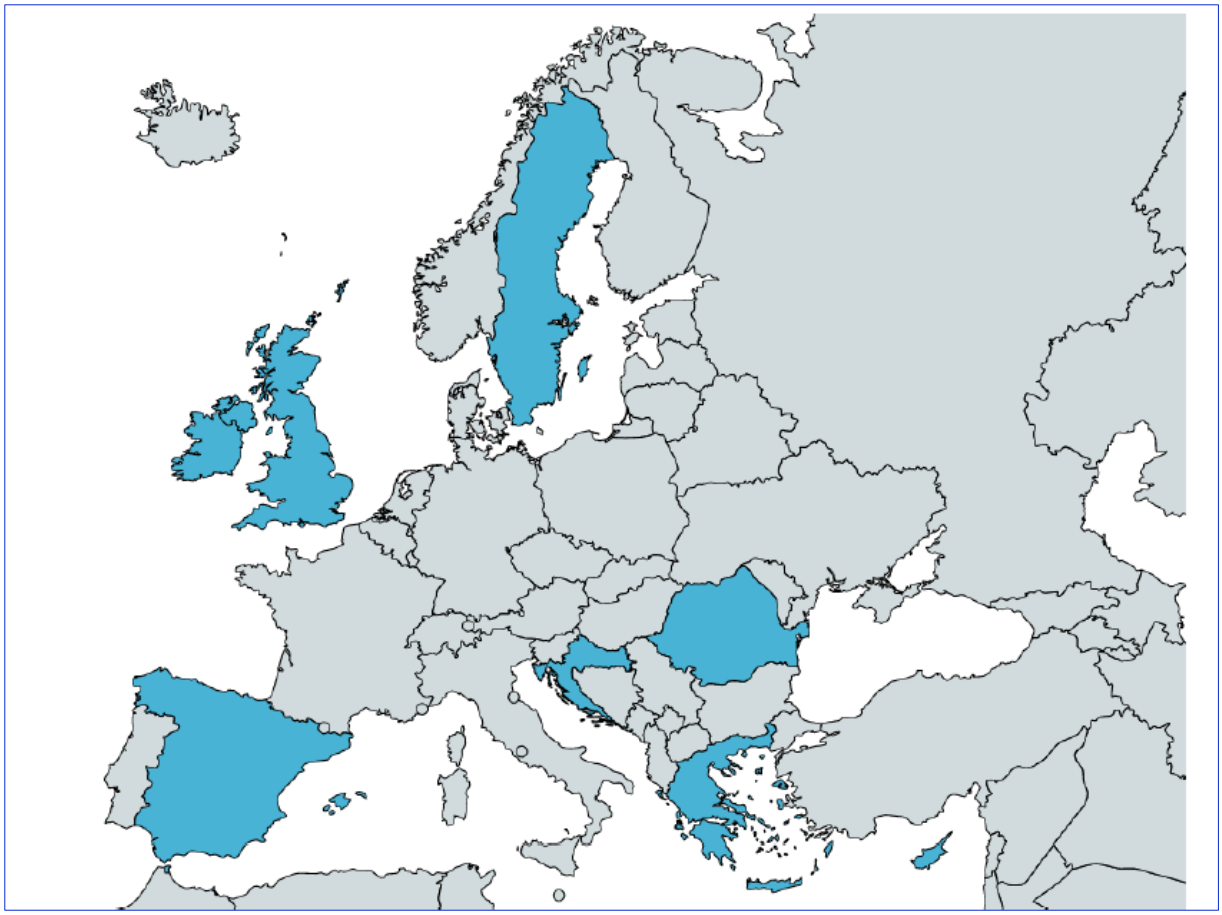

Figure 7.2: Geographical distribution of members of the Focus Group on the Knowledge Hub

The group started with two exploratory questions followed by an open discussion.

1. Q: What are your training needs and how do you find your training material? Answers:
    - Depends on the type of material. Need for specialized material, looking for papers. Online course last six months. Udemy, Coursera, Codecademy (for programming).
    - All characteristics of trainings should be searchable for users.
    - Showing the real subject (discipline and content). Filters important to select training. Consortia websites of the institution, NFDI, Helmholtz.
    - Discussion with peers.
    - Google and click for the first three.
2. Q: What are the functions you appreciate most on the training platforms you use? Answers:
    - Moodle, video tutorials for specific applications;
    - Open source;
    - Video tutorials.

This open discussion was followed by some interactive exercises (see Figure 7.3) using Google Jamboard to learn what are the main motives to pick a course from a relatively long list of results. Based on this, the group had a discussion on what metadata fields users find most useful.

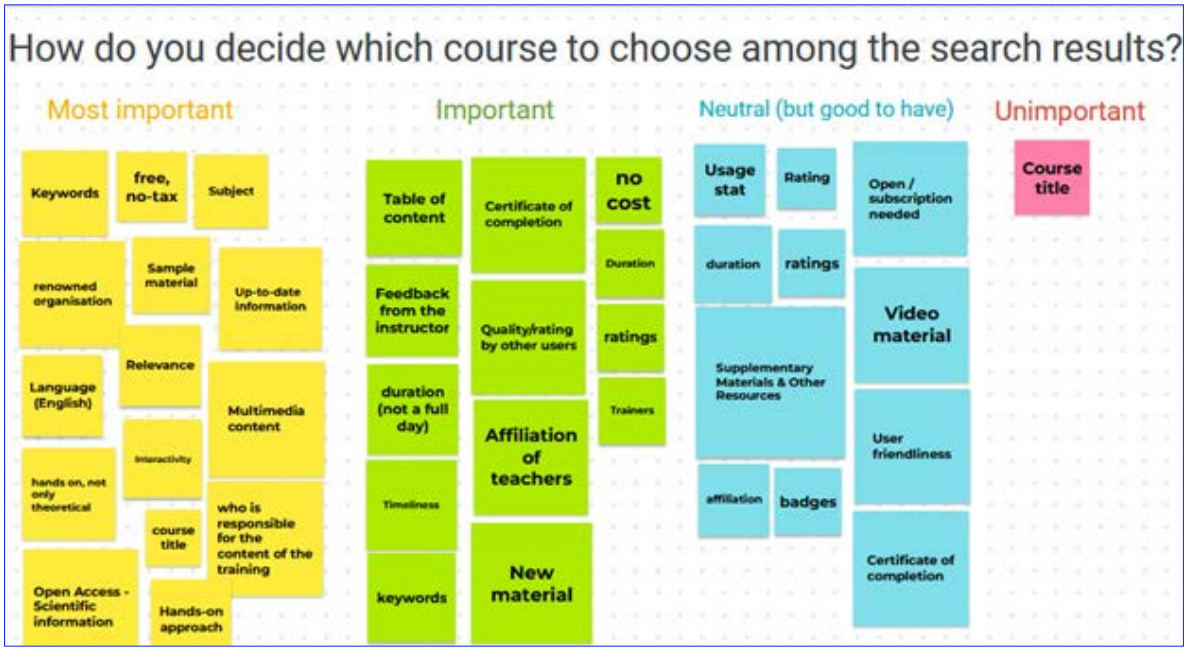

Figure 7.3: Interactive exercises for Knowledge Hub focus group

Emphasis was put on the relevance between the course title and the actual contents. Up-to-date information about the course material is also very important.

Sample material, such as a teaser, to judge the quality and content of the training material was mentioned as being helpful to decide whether training material is suitable. Relevant keywords, interactive material with an evaluation of the training outcome, feedback from an instructor, a community supporting the course, were the other elements mentioned by the User Group representatives.

Additional criteria to choose training material is whether it is hands-on or only passive material. The duration/length of the training course is another important criterion.

Access to data and compute resources is sometimes required and if so, seamless access to such resources is the basis for a successful training session.

The planned metadata set was also presented to the group and was judged overall to be complete. Some metadata could be moved from "mandatory" to "not mandatory". The format of the learning material should be covered under "Resource type". In the discussion which ensued some additional metadata tags where nevertheless identified.

Observations and Recommendations from the Focus Group session:

- The Focus Group was very small and as such was a non-representative sample of future EOSC users. The observations and recommendations that follow must be taken with a pinch of salt.
- Looking for training material is not a daily routine for researchers. An important aspect to them is to find training material when a new tool is needed for a project. This might underline the importance of the recommender system that could offer related courses when searching for other kinds of resources. The importance for signing up for course updates is also clear in this context.
- The lack of daily routine strengthens the importance of Google search and other simple search tools. Offering a "simple search" platform with access to advanced filtering options might be particularly useful. As researchers tend to use Google as their main search option, it makes it extra important to manage the SEO (Search Engine Optimization) issues of the training platform to ensure the materials are found.

- Researchers expect rich metadata fields to be able to judge if training material is relevant. However, some of the researchers would not use the possibilities offered by the metadata set and simply check the first hits of the search results.
- Availability of a clear description of the training content (including a table of contents) when searching for training resources. Filters are important to select training resources.
- The focus group agreed that the proposed metadata fields are complete, and this planned set should not create an extra burden when uploading training material.

7.2 Exploratory analysis

The Knowledge Hub landing page will consist of a simple static page with links to the Training Catalogue, Learning Platform and an FAQ section.

The Training Catalogue will work in a similar way to the EOSC Catalogue and Marketplace, whilst just containing training resources.

7.3 Business analysis

For the EOSC to be viable and provide value to its future users it is important that it supports the FAIR principles. Being the one-stop shop to find open data and data analysis is not enough as these need to be complemented with training resources that enable users to learn how to use the data and tools provided.

Given the vast domain that is science and the countless opportunities for cross-domain research, it is of the utmost importance that resources are provided to users to enable cross-domain research and data-analysis, thus widening the scope of users that can use each individual data set and data analysis tool.

The EOSC aims to implement a federated system to promote and enable Open Science and as explained in section 7.2 **Business analysis**, it is important to facilitate the usage of EOSC Portal data and tools and aggregating training resources will contribute to this.

The training catalogue will create a one-stop shop for all open science training resources, enabling the use and reuse of open data and tools available in the EOSC Portal. It will be useful for data scientists interested in cross-domain research as it will provide links to training resources for may scientific domains, allowing a better usage and understanding of other elements available in the EOSC ecosystem.

The Value Proposition Canvas (Figure 7.4) clearly displays what is the value offered by the Knowledge Hub through the key features, benefits it will provide and the experience that the users will have.

Users of the Knowledge Hub want to gain knowledge (e.g. via training materials) in an easy way, therefore the focus must be on providing an easy-to-use service that contains the resources required to gain knowledge (a catalogue of training materials, e-learning and also direct help).

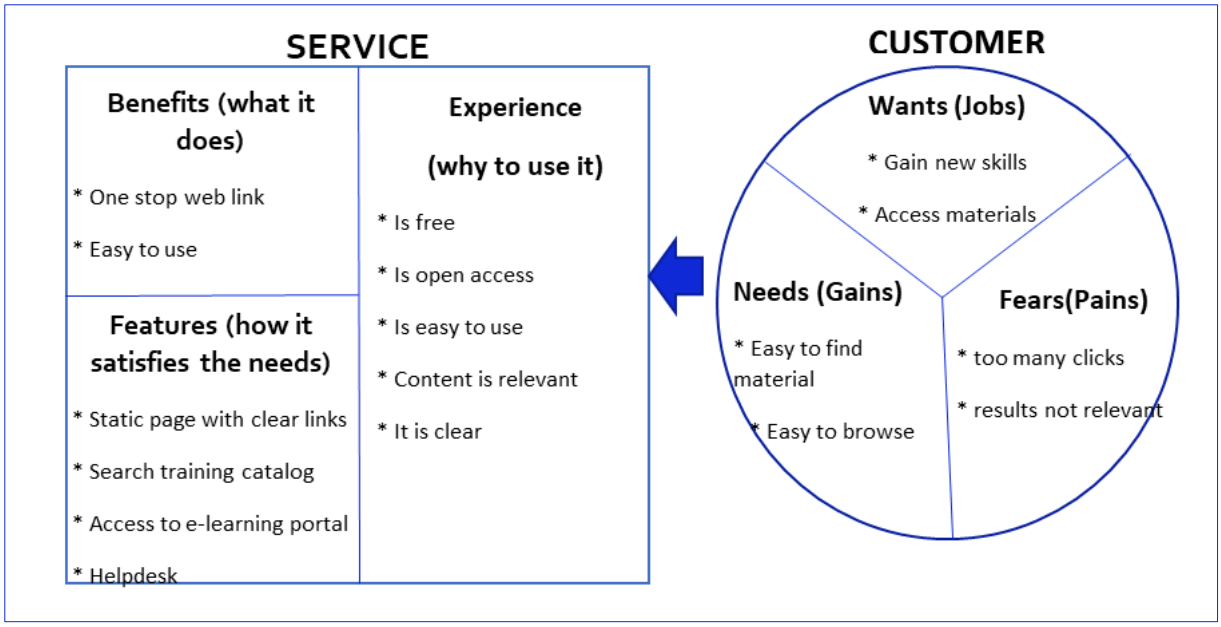

Figure 7.4: Value Proposition Canvas for the Knowledge Hub

The Knowledge Hub will be a success if it is used, that's why three main items have been listed as potential issues for the users.

8 User dashboard

The User Dashboard is a user-centric space which includes elements relevant to user activity in the Front-Office. The activities in EOSC can be scoped to:

- support the research activities of the user;
- support EOSC-related activities (projects, task forces, communities etc.);
- manage user settings.

8.1 Process implementation

8.1.1 Focus Group

In May 2022 the Focus Group was assembled by WP10 and a survey (User dashboard and user stories) has been sent (see Figure 8.1 and Figure 8.2 for the focus group members' characteristics). The main goal of the survey was to learn what features users expect from the User Dashboard, which elements need to be improved, and which errors need to be eliminated. The survey was divided into two sections, as can be seen in Section 15 **Appendix III: User Dashboard user stories**. The first section was intended to collect information about the profile of the users and get to know their opinion about what they think are the most important features to include in the User Dashboard. The second section contained mock-ups of the proposed designs of the User Dashboard and the participants were asked for opinions about specific visualisations to improve user satisfaction related to the use of the system.

Respondents were from all over Europe and most of them were in senior positions (scientists or lecturers), only one of them was a post-doctoral researcher and were from different fields of science. Half of them did not know the EOSC Portal at all, only one was an active user of the EOSC Portal, and the rest of them used the EOSC Portal occasionally.

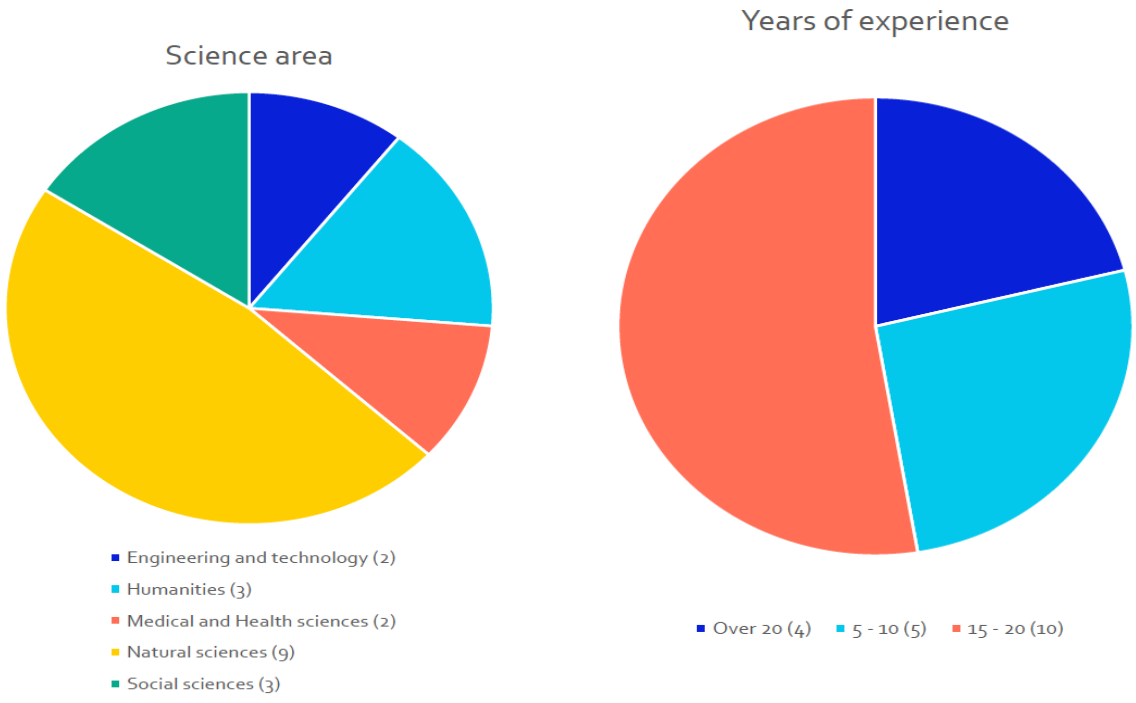

Figure 8.1: Characteristic of the members of the Focus Group on the User Dashboard

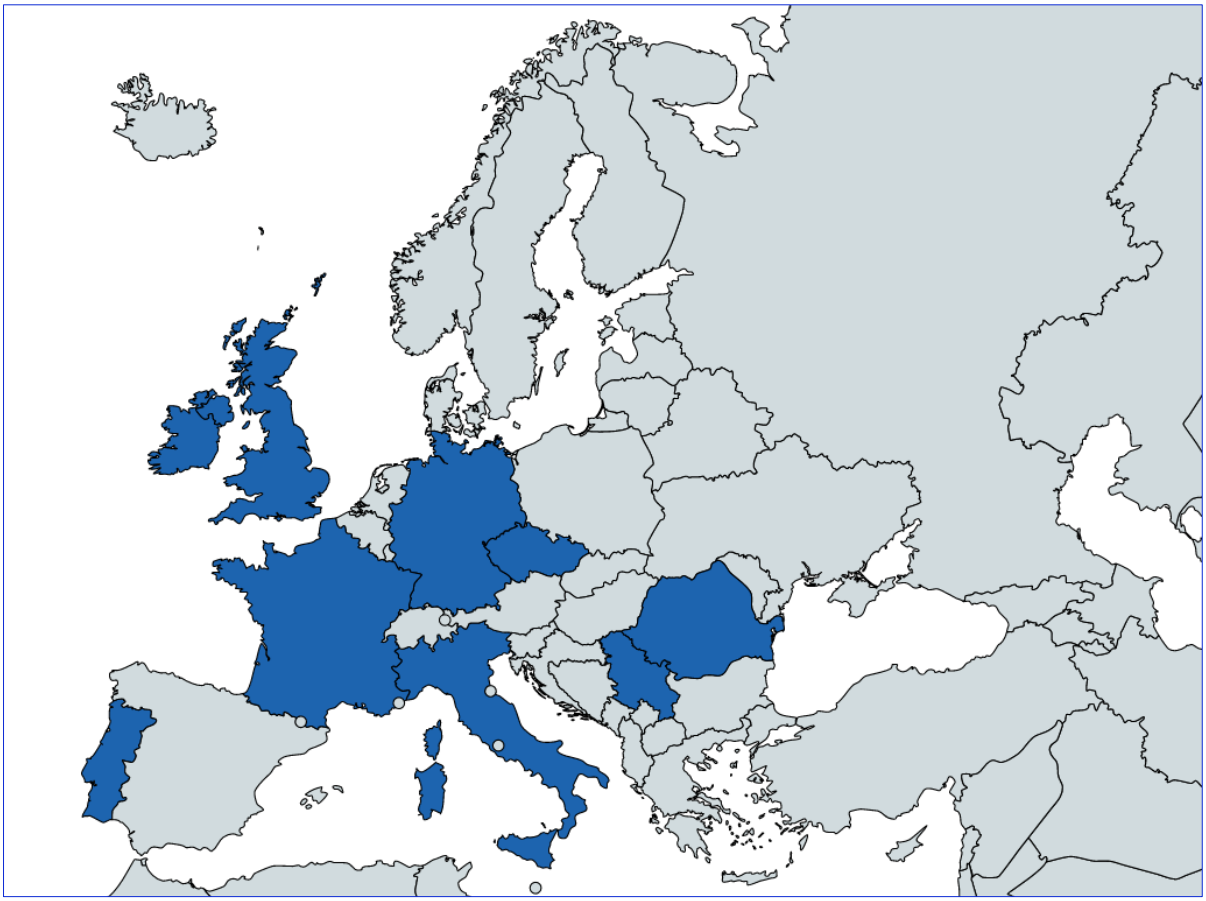

Figure 8.2: Geographical distribution of members of the Focus Group on the User Dashboard

The survey lasted two weeks and a group of seventeen people was invited to take part. After two weeks fourteen responses had been received, which were used to formulate observations that fed into the redefinition of the User Dashboard. The main observations from the survey are described in the **Business analysis** section.

8.2 Exploratory analysis

An exploratory analysis of the User Dashboard was made to define its functions and UX elements and for that requirements from different areas were collected. They were divided into functional categories and re-written in a form of User Stories to be taken into consideration during the development process.

There are many examples of the user dashboards in existing internet platforms and the main goal was to determine what goals the EOSC Front-Office User Dashboard should fulfil. The interviews with the focus group and the survey have shown that there are four main areas of interest in the scope of the User Dashboard for the European researchers:

- Ability to describe and manage the researcher's profile, possibly with the use of existing major research sites like Web of Science [5], PubMed [6], Mendeley [7], ORCID etc.) that provides the essential data to understand what information should be used to filter the EOSC resources (User settings)
- A dedicated space to discover EOSC information and resources available to the user based on the researcher profile (Availability)
- The possibility to express both user satisfaction of the consumed resources as well as its accuracy for a researcher. User satisfaction should be a significant input for the resource developers and providers when deciding on the resource development, but also a useful tool for other researchers regarding their choices of EOSC resources (Feedback)
- A collaborative area that allows the formation of user groups connected to the order management's Marketplace Projects and Resource Requests (Collaboration).

The list of the defined user stories is available in **Appendix III: User Dashboard user stories**.

8.3 Business analysis

To draw better conclusions which direction should be taken for the User Dashboard design a user survey has been conducted for which main results and observation are as follows:

1. The number of survey participants was sufficient, and their responses have been used to improve the initial design.
2. The most important aspects for users are information about favourite resources and projects from the EOSC Catalogue and Marketplace. People also considered it important to have information about available training. Respondents were strongly in favour of recommendations (for resources to use) being visible in the User Dashboard. The biggest contrast in terms of the results concerned information about a user's recent activities; some respondents think that it is very important, but others consider it unnecessary.
3. Most of the respondents liked version A (see Figure 8.3), but a lot of them are not satisfied with this version - version A is more controversial. Version B (Figure 8.4) was liked by fewer people but in general all respondents were satisfied with that version.

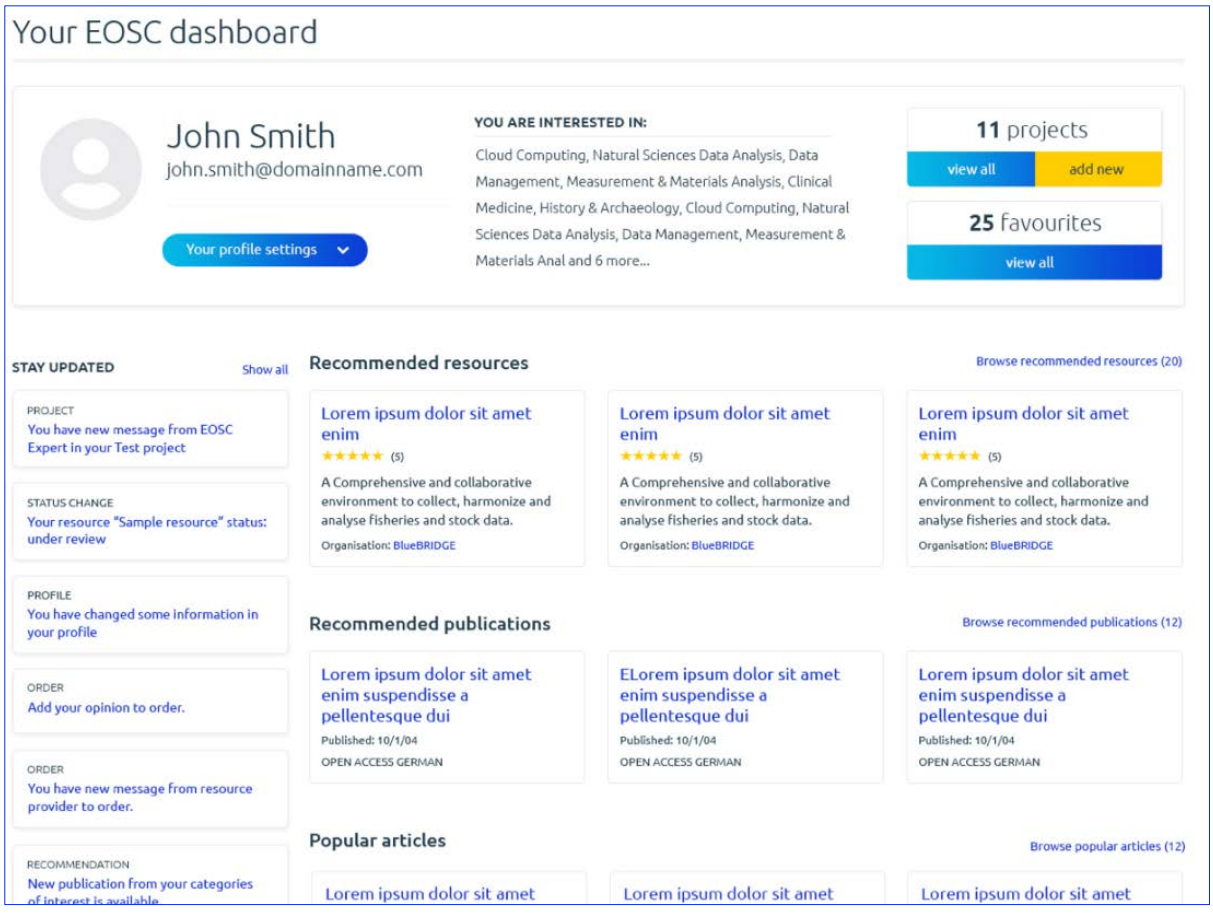

Figure 8.3: Version A of the User Dashboard

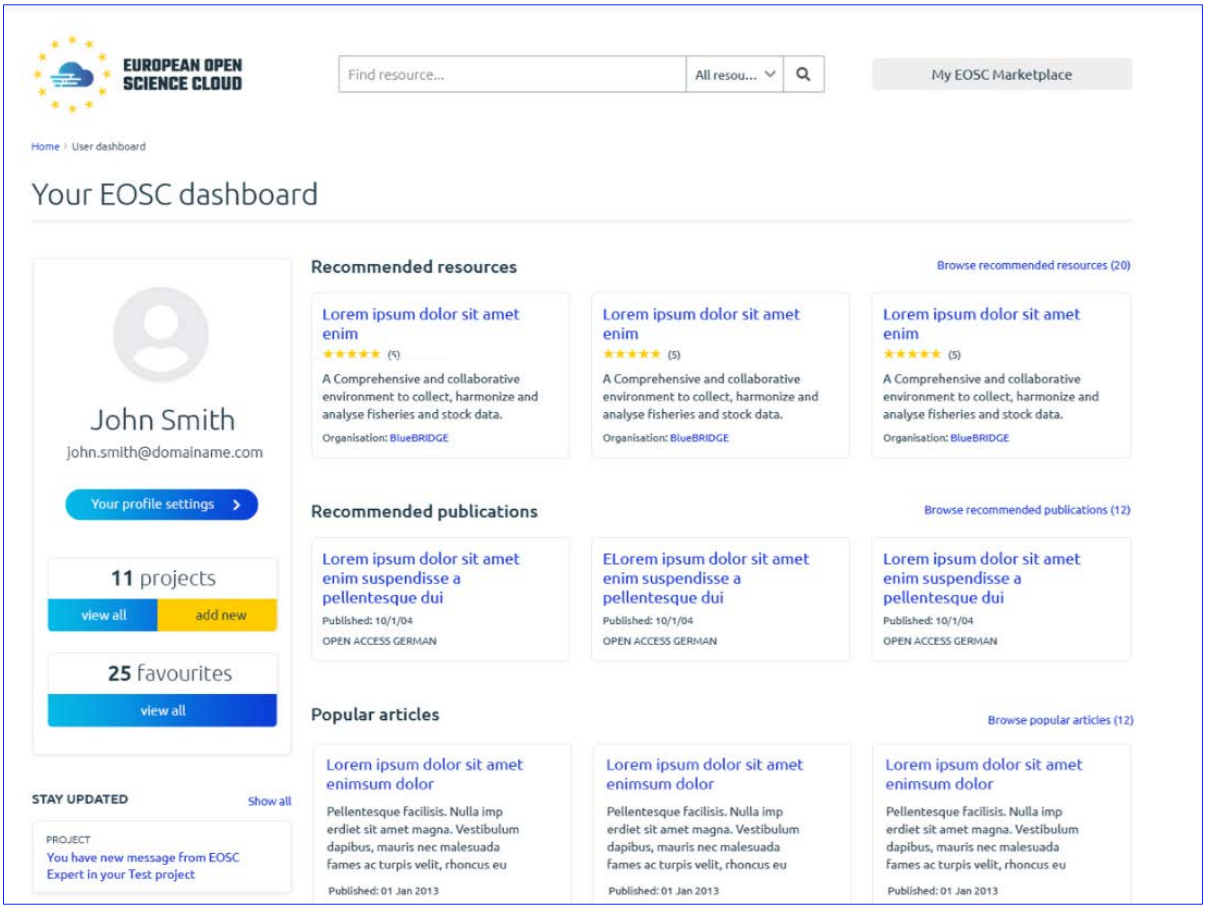

Figure 8.4: Version B of the User Dashboard

4. In general, people see "Stay updated" and "projects" (as shown in both Figure 8.3 and Figure 8.4) as the most important sections in the User Dashboard. They would like to have the possibility to adjust the sections shown in the dashboard to their own needs (personalisation of the appearance).
5. Most people thought that visualisations were very good but would be improved by decreasing the size of the buttons, text and icons.
6. The respondents did not know any similar solutions and they liked the idea of the User Dashboard as the hub of their activities in EOSC.

8.3.1 Next steps

Based on the result from the Focus Group, further analysis of the proposed designs took place to determine how to incorporate the feedback and prepared a development plan for improvements that cover the identified needs. The proposed design is described in detail in section 10 **Results and designs**.

9 Recommendation System for enhanced User Experience

The Recommender System is a novel component of the EOSC Portal. It will provide EOSC users with recommendations concerning the resources (data, services, training, projects and publications) that could be of interest to them, based on a multi-focal perspective. The Recommender System is intended to improve the user experience by guiding and supporting them by suggesting other resources they would likely use.

9.1 Process implementation

The Recommender System crosscuts several other existing functional modules or the way they are used by researchers. Additionally, the recommendations may substantially affect the users' experience and their interactions with the portal, by delivering new functions and providing them with additional information. For those reasons, the process of discovering and elaborating requirements included several phases of intertwining analysis and validation. Specifically, the process included short, feedback-based development cycles, in which individual functions were discussed and tested.

9.1.1.1 Focus group meeting

The first meeting of the focus group assembled by WP10 dedicated to the Recommender System took place on 17th of March 2022 (see Figure 9.1 and Figure 9.2 for the members' characteristics). The meeting was attended by fourteen members. All participants had initial knowledge concerning the EOSC project and its general objectives. In addition, all of them had some experience with recommender systems, mostly based on the existing commercial services available on the internet (in retail, content search or video streaming). The meeting lasted 75 minutes and was partitioned into three phases:

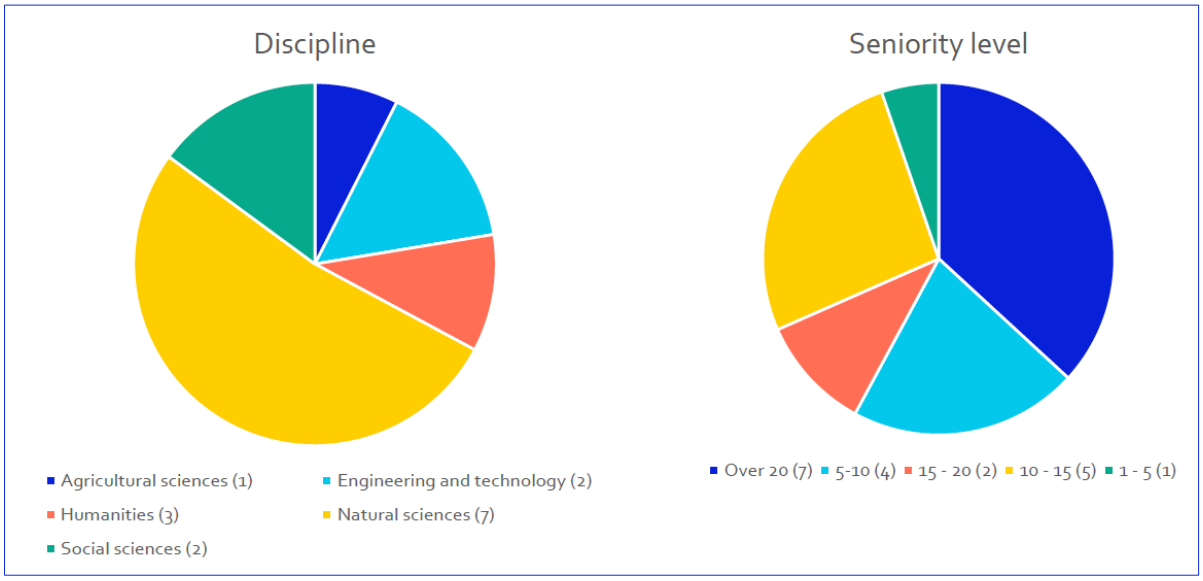

Figure 9.1: Characteristic of the members of the Focus Group on the Recommender System

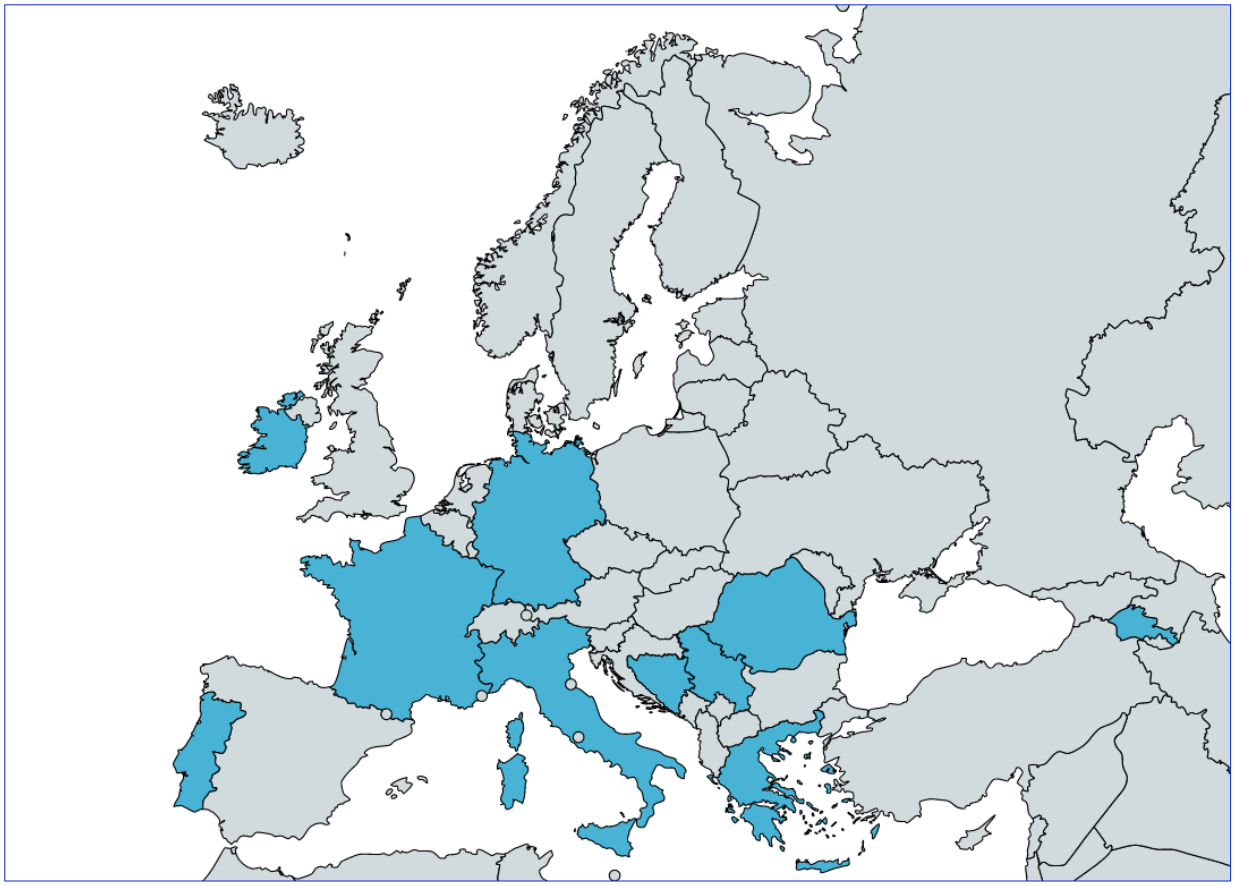

Figure 9.2: Geographical distribution of members of the Focus Group on the Recommender System

Phase I included warm-up and semi-structured discussion on the objectives assigned to recommendations in various systems, their perceived and actual usefulness, and the methods of measuring the effectiveness of recommendations. This phase introduced the participants to the topic and presented them with the preliminaries necessary to provide the context.

Phase II was a discussion focused on concepts related to recommendations. The meetings were held in smaller groups consisting of four or five participants. Each group was tasked with the same set of objectives:

- **to identify concepts that are relevant for the Recommender System;** the concepts may include, e.g., attributes of the recommendation, ways of presenting the recommendations, expected functions the recommendations should provide, possible metrics to measure the effectiveness etc.
- **to identify/name the topics,** around which the concepts could be placed; also, to identify possible overlaps of the topics or the concepts that could belong to various topics
- **to sort the concepts within topics,** to reflect their relative importance.

To facilitate the discussion and aid problem solving, groups worked with dedicated Miro boards, which are virtual whiteboards (see Figure 9.3), in which they could add, edit or delete elements describing the topics and concepts.

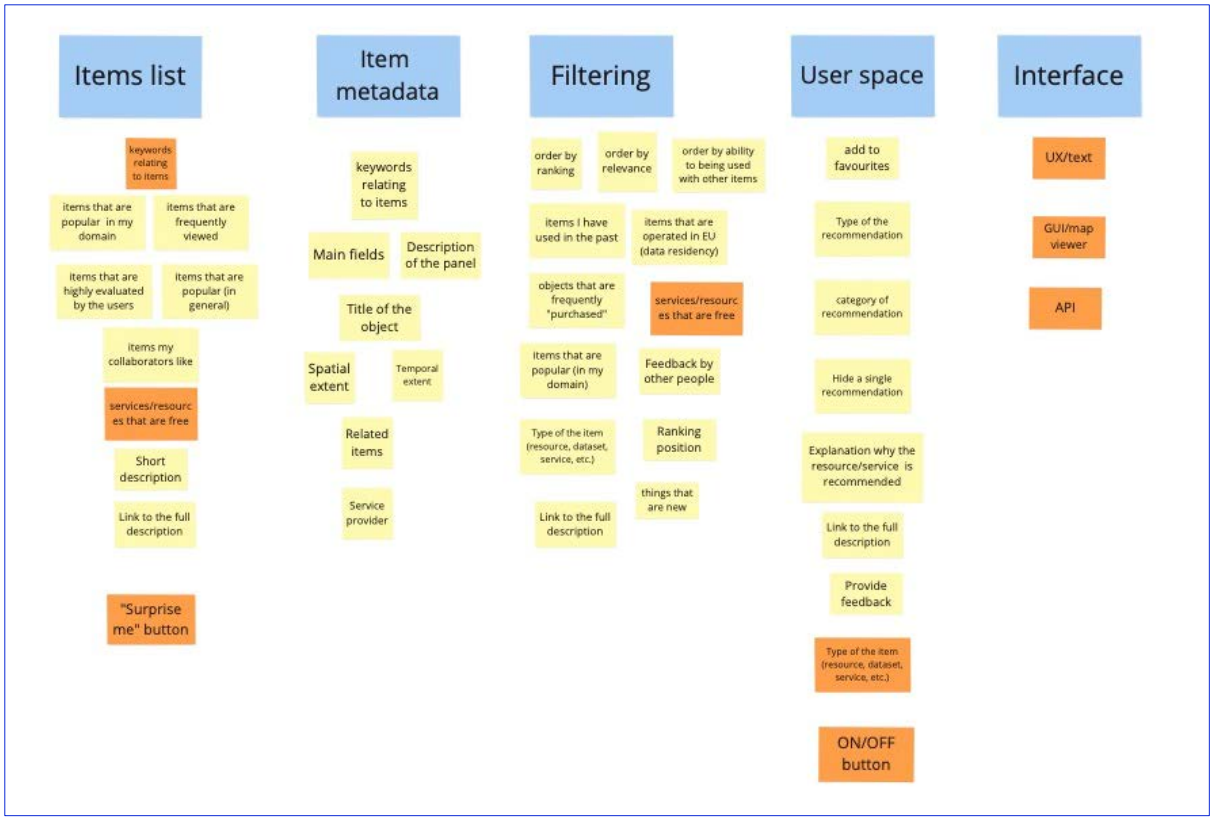

Figure 9.3: Miro board with results of the focus group meeting

All three groups delivered results of the discussion. They largely overlapped with the results of the initial brainstorming conducted internally by the task team, which validated the initial conjectures. An overview of the developed results of the focus groups, together with results of the analysis, are presented in the **Business analysis** section.

9.1.2 Individual meetings

Several key insights identified and discussed during the focus group meetings required further, a more thorough analysis and completion. Additionally, some of the reported findings were generic, and they relied on an aggregated perspective, which prevented the task team from understanding the specific points of view of individual researchers working in various research domains and using diverse methodologies, approaches and tools. For that purpose, a series of individual meetings with selected members of the user group were conducted.

All members were invited to participate in this activity. However, to ensure the required diversity of the sample, and due to timing and resource constraints, only six interviews were scheduled and conducted. The anonymised data of the researchers is shown in Table 9-1.

Table 9-1: Recommender System User Panel members' background information

Identifier	Occupation/role (domain)	Organisation
Researcher 1	Researcher/manager/CEO (geo sensing)	A start-up working on remote sensing for the environmental sciences
Researcher 2	Researcher (sociology, public health, public finances)	A public research institute for quality of life
Researcher 3	Researcher (linguistics)	A public university
Researcher 4	Researcher (metabolomics, signal processing, medical science)	A public university

Researcher 5	Senior lecturer (computer science, criminology)	A public university
Researcher 6	Researcher (physics, planetary geology, image processing and recognition)	A private university

Each of the interviews lasted approximately forty-five minutes and was recorded. The participants could not only answer the questions, but also start their own threads and present examples and metaphors to explain their point of view. The interactive form of the process allowed more data to be collected and provided more details.

9.2 Exploratory analysis

The interviews were semi-structured and focused on a few key issues. The data collected during the exploratory analysis has been aggregated and analysed to produce a more complete picture of the users' expectations. The findings are reported below:

9.2.1 Relevance/usefulness/importance of recommendations

- **When a recommendation is *good*? What are the features of a *good recommendation*?**
  - It is adequate to the user's expectations (expressed explicitly or implied).
  - It is understandable, so that the user can understand why it is relevant.
  - It matches user's preferences/constraints (e.g., related to language, price for access).
  - It is well-described.
  - It is not overwhelming for the user with excessive information; there are not many recommended items on the list.
  - It should help the user to understand the available options.
- **What a *relevant recommendation* means to you?**
  - It is potentially related to the objective of the user, so that the user is likely to use it.
  - it is commonly used in a given context/domain.
- **Useful recommendation**
  - It helps to quickly, easily and directly to achieve the user's goal.
- **Important recommendation**
  - It is a combination of relevance and usefulness.
  - It is useful beyond a specific context.
- **Other qualities that could be related to a *good* recommendation**
  - Flexibility, scalability, adjustability, opinion of other people (feedback), geographical/physical proximity, price of the resource, time that passed since the recent update/release of the item, easy access, if the tool is still available/operational/maintained/supported, accuracy with respect to expectations, speed of delivery, privacy, security, has good community feedback from people like the user, well-documented.

Alignment of recommendations with the search/exploration mode

- **How do you search for things? What are the different modes of searching?**
  - *Searching* is easiest but can be unsuitable when synonyms are used. It allows for a precise and accurate search based on keywords.
  - *Ontology/hierarchy-based*: most accurate, but usually requires manual curation. Filters are perfect in some contexts to narrow down the search space. They are particularly useful in humanities. Good categories are generic and portable across domains.
  - *Mixed*: the most flexible and attractive, as is allows switching modes if necessary, without losing the context.
- **Which data is necessary to effectively (and efficiently) find a resource/service?**
  - name, acronyms, concise description, keywords, relationships with other items.
- **Other notes**
  - The Recommender System could be a partner to the user, showing what other users consider trustworthy/useful.
  - The mode of searching depends on the objective (find/explore) and the context.

- Exploratory mode is preferred (to see the options/alternatives, understand the context).
- The Recommender System could help if the ontologies are poorly designed/maintained.

9.2.2 Presenting the recommendations

- **How the recommendations should be presented to the user?**
  - Essential data describing the recommended resource; informative, short, concise information that will encourage the user "to open a new tab with it"): title, author, brief description, photo, keywords.
  - Brief justification should explain *how* the recommendation was made.
  - Presentation of recommendations could be *expandable* (presenting different levels of detail) and *customisable* (users can decide which parts of the recommendation they want to see).
  - Other useful data: community that supports the resource (number of users, availability of documentation), feedback panel, so that the users can evaluate the quality of recommendations, geographic distance from the user, performance (for services and tools), the cost of use.

9.2.3 Feedback

- Users like reading feedback and want to rely on it. However, they are not so much interested in providing the feedback.
- Providing feedback should be non-intrusive and intuitive.
- It should combine both quantitative and qualitative data: quality expressed with a simple scale (like/dislike or 5 stars) + optional comment.
- Some feedback could be directed to the resource owner (applicable to services/tools/datasets), and not be publicly available.
- There are mixed opinions concerning the gamification used to promote feedback.

9.2.4 Validation of additional functions

- Saving and managing favourite recommended items:
  - Yes, it is a very useful function.
  - The number of favourites should be restricted.
- Saving results of the recommendation, so that they could be reviewed later
  - Yes, it is a very useful function.
  - The results should be manageable, to prevent excess of information
- Giving the user the ability to opt-out from seeing (and using) some types of recommendations.
  - Yes, it is a key function; although recommendations provide good value to the users, their privacy should be valued and protected as well.

9.3 Business analysis

The main results and observation based on the groups meeting and individual meetings are as follows:

1. The user group on the Recommender System is diverse and represents different research domains, positions and countries. That makes the observations and findings more representative and provides a good foundation for the analysis of requirements and further design and implementation activities.
2. Researchers have different knowledge about recommender systems, their role and objectives. Responses varied, from enthusiastic acceptance to reluctance or even rejection. The knowledge of Recommender System is mostly based on commercial services, and researchers would like the Recommender System to behave in a similar manner. However, some of them were more open to changes, extensions and adaptations in EOSC Recommender System than users of commercial services.
3. Users' background strongly affects the expectations towards the Recommender System, e.g., researchers working in humanities focused on access to publications/datasets and their discovery, whereas STEM-related researchers were more interested in services.
4. The interest in recommendations depends on both the researcher's domain and personal preferences.

5. Researchers usually expect that recommendations could be customisable to their needs (with respect to the type of recommendations, the presented data, ordering etc.), even though they declare not to be using that feature too often. However, some of them expected that the system would propose default settings that would be suitable for "typical users".
6. Understanding how a specific recommendation was issued in important (but not essential), as it helps to embrace how the Recommender System works.
7. Recommendations should be presented separately with respect to different data sources that have been used.
8. Privacy is highly valued. Users should be able to grant and withdraw consents to processing specific pieces of their personal data, or even opt-out from using recommendations.

10 Results and designs

10.1 Data inclusion in the Front-Office

The inclusion of research data in the Front-Office is achieved by providing the search engine behind the EOSC Portal with a dedicated view on the OpenAIRE Research Graph that enables searching, browsing and suggesting contents and research data related to EOSC. The future design will follow the look and feel of the rest of the EOSC Catalogue and Marketplace and will be made visible to researchers via the enhanced/improved discover User Interface.

Screenshots from the beta version of EOSC Explore [26] used in the testing exercise ("Treasure Hunt") performed with the Focus Group are shown below. Figure 10.1 shows the landing page, Figure 10.2 the type of research products exposed for data discovery, Figure 10.3 the advanced search functionality, Figure 10.4 the search filters and Figure 10.5 is an example of the page related to data information. As the screenshots used in the figures are from a pre-release version, it is likely that the appearance of some of them will change prior to the Month 18 release, based on usability testing and general feedback from the Focus Group.

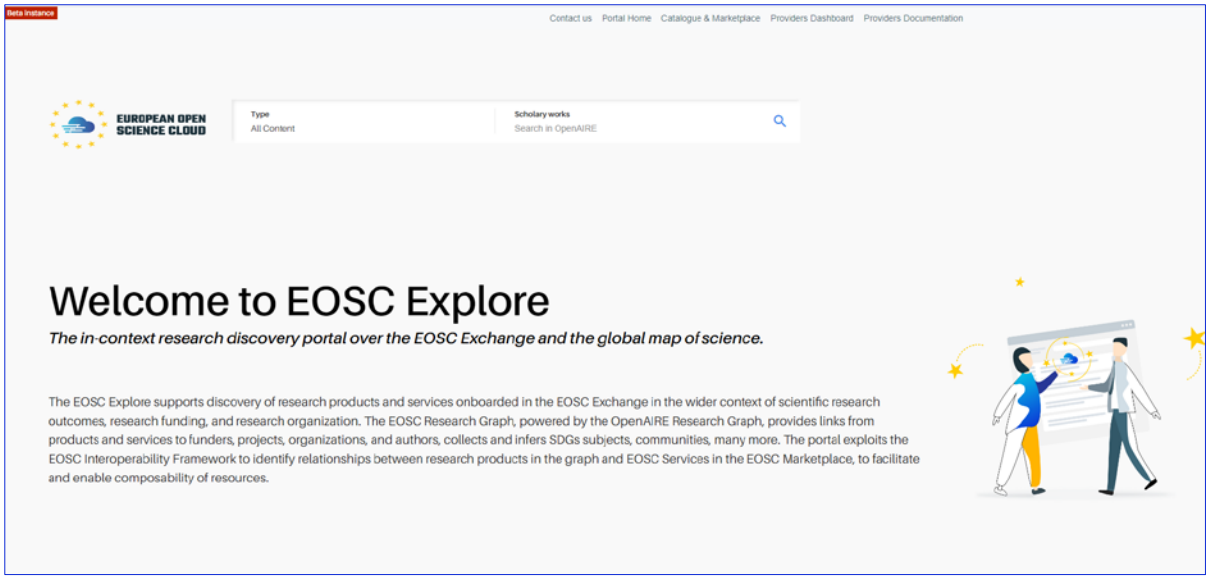

Figure 10.1: EOSC Explore landing page

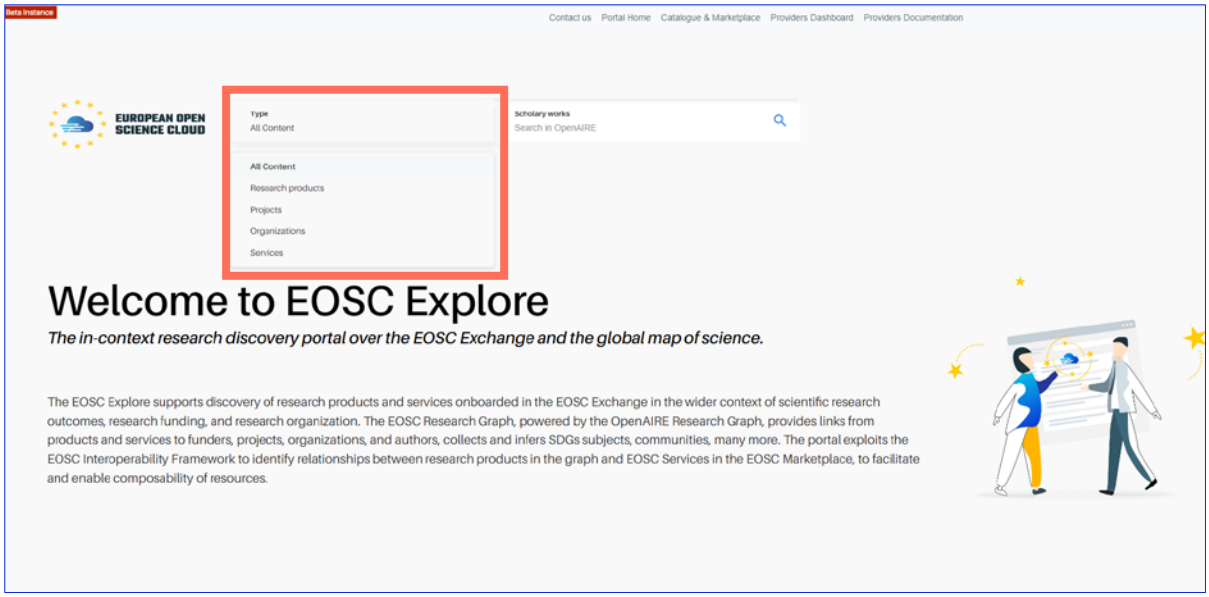

Figure 10.2: EOSC Explore research product types

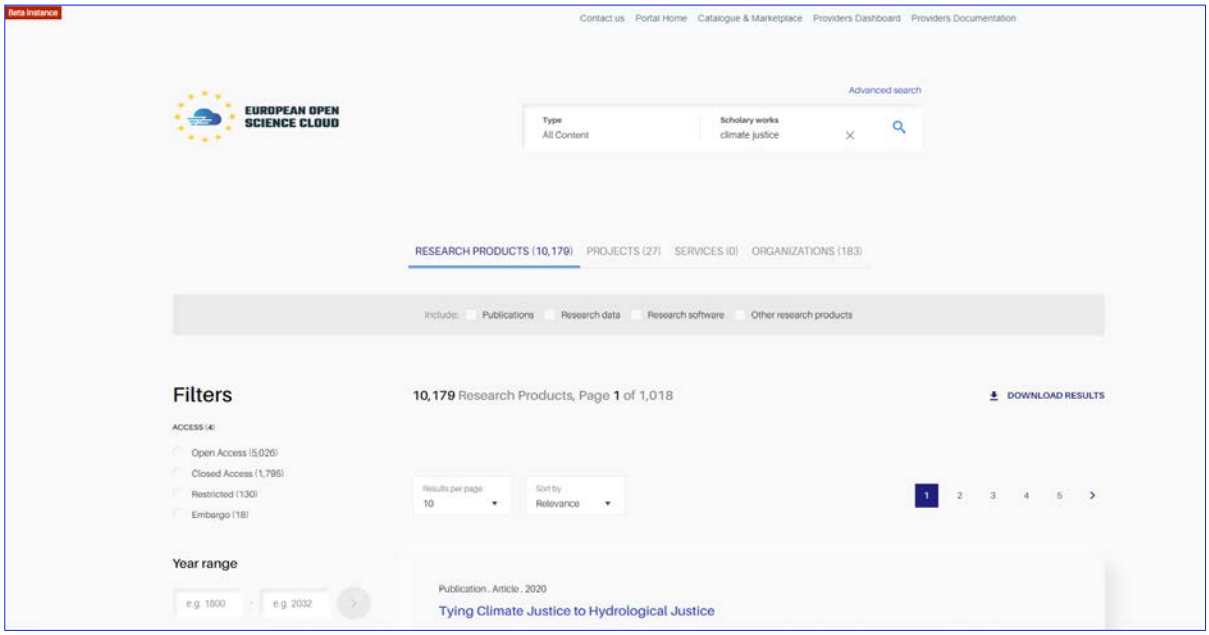

Figure 10.3: EOSC Explore search functionality

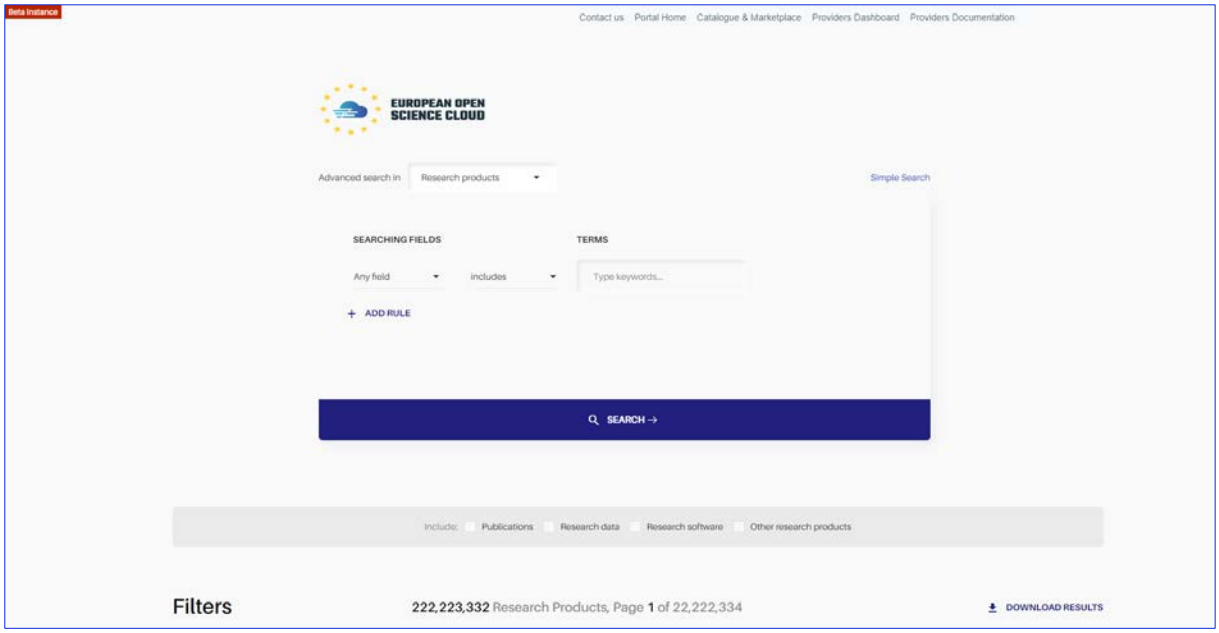

Figure 10.4: EOSC Explore search filters

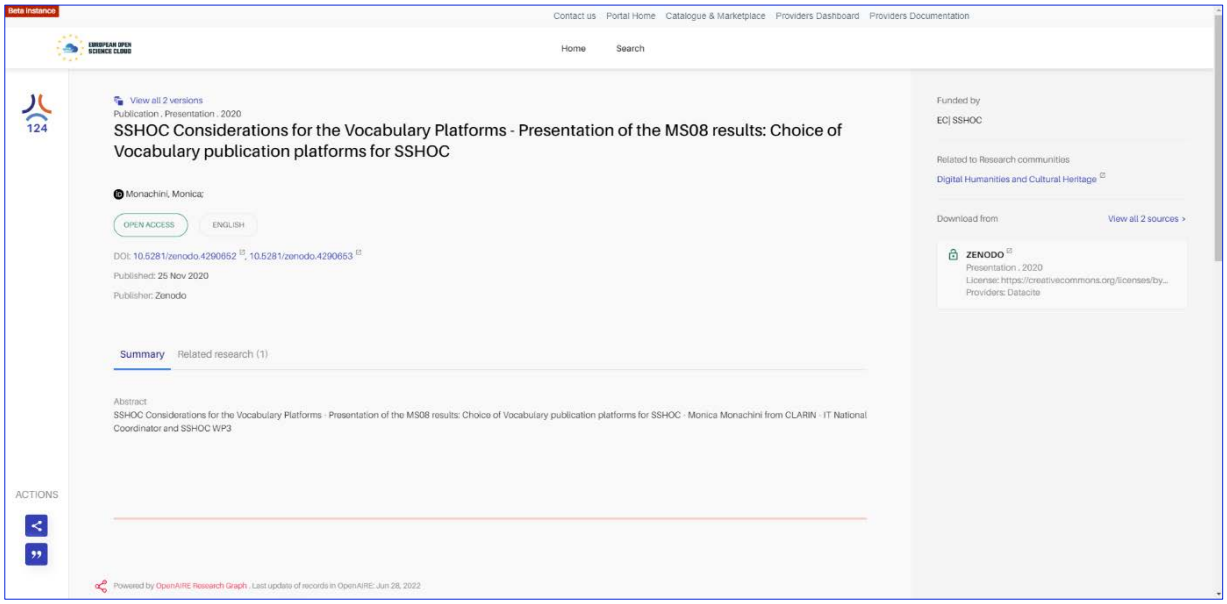

Figure 10.5: EOSC Explore search result details

10.2 Enhanced/improved discovery

In the reporting period, the first version of the Search Service was developed. Brainstorming was conducted internally in the group based on its collective professional experience. Consequently, the main page with the search bar was designed so that the user can search through many products: publications, data, software, services, and trainings. The User Interface contains many tabs where appropriate filters were applied to let users find the most suitable results. In addition, a lot of minor functionalities were added such as pagination, search suggestions, or displaying the number of search results (see Figure 10.6).

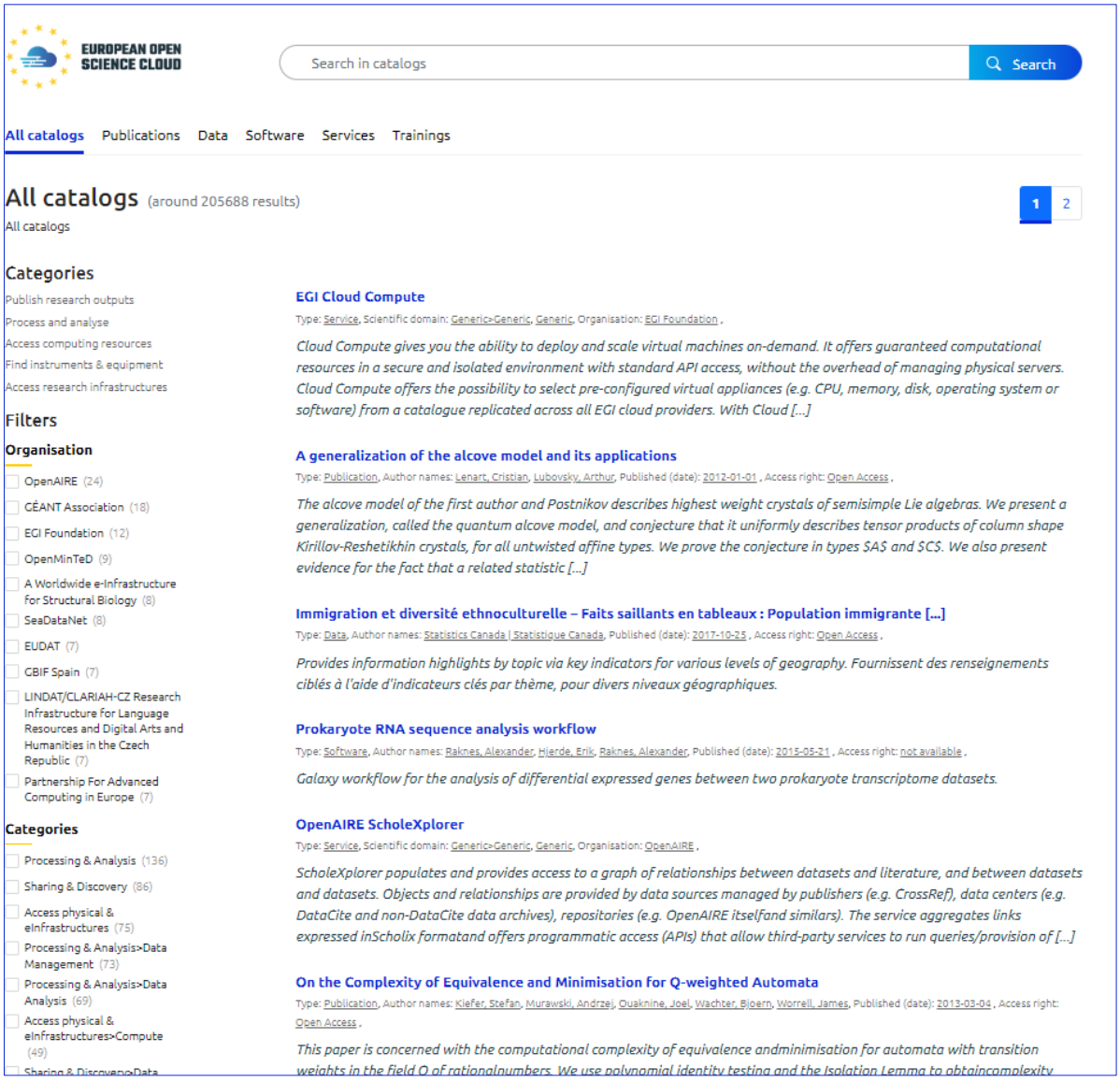

Figure 10.6: EOSC Catalogue and Marketplace User Interface

Another approach taken was to apply the new categorisation in the Search Service that will let user find items of interest in an easy way. The main advantage of this new categorisation (see Figure 10.7) is that it exposes the user to a more intuitive and effective grouping of services that follow the general research lifecycle model and provides direct access to the research activity that the users are interested in.

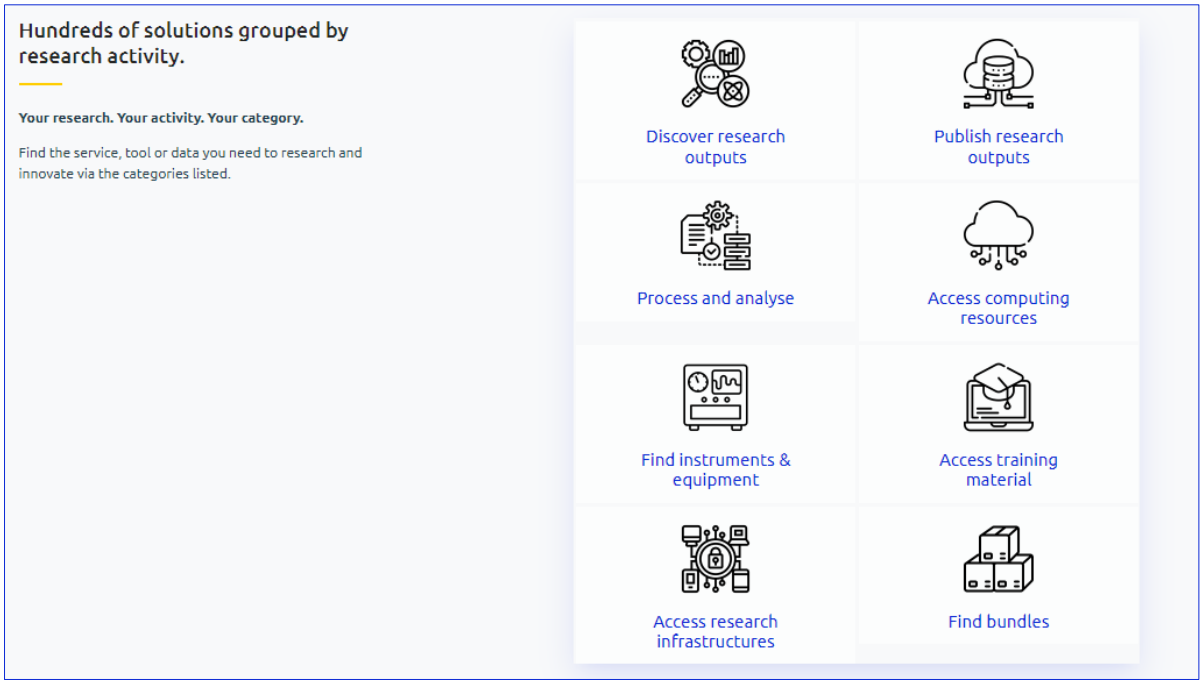

Figure 10.7: New categorisation of resources

In the remaining months of the project, the user interface of the Search Service will be improved to be more readable and simpler for the users. A well-organized space will be created that is intuitive and clean. Initial ideas were drawn up and development of them has begun. Resource descriptions will differ, according to the type of resource. Two examples are shown in Figure 10.8 and Figure 10.9.

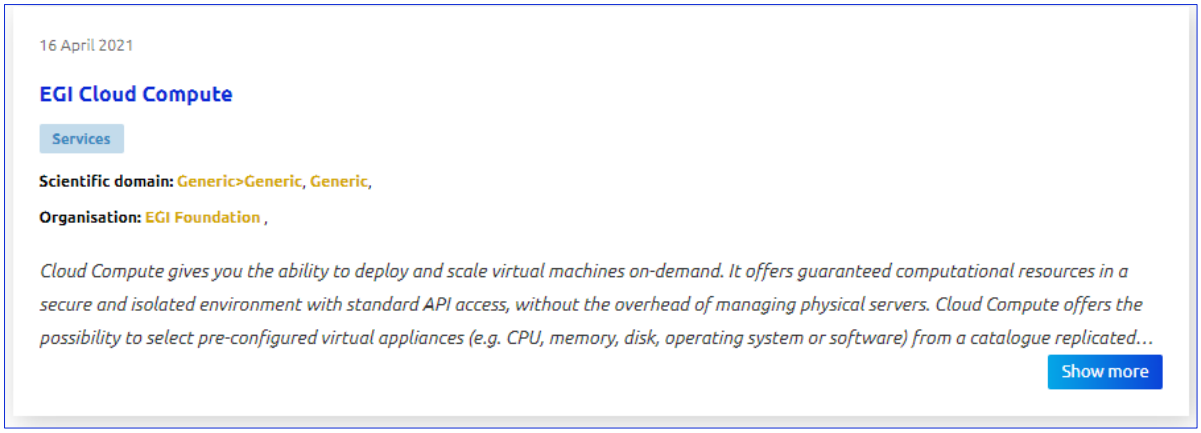

Figure 10.8: EOSC Catalogue and Marketplace service resource description

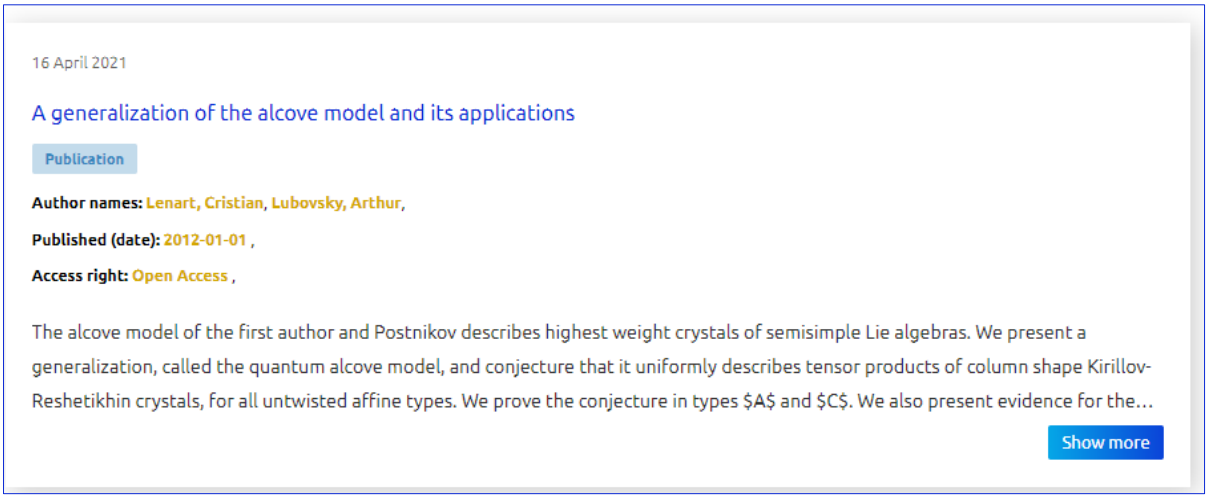

Figure 10.9: EOSC Catalogue and Marketplace publication resource description

The User Interface will be improved by adding more types of filters (date, Boolean etc.) as they were identified as very important by the end user. The proposition is shown in Figure 10.10.

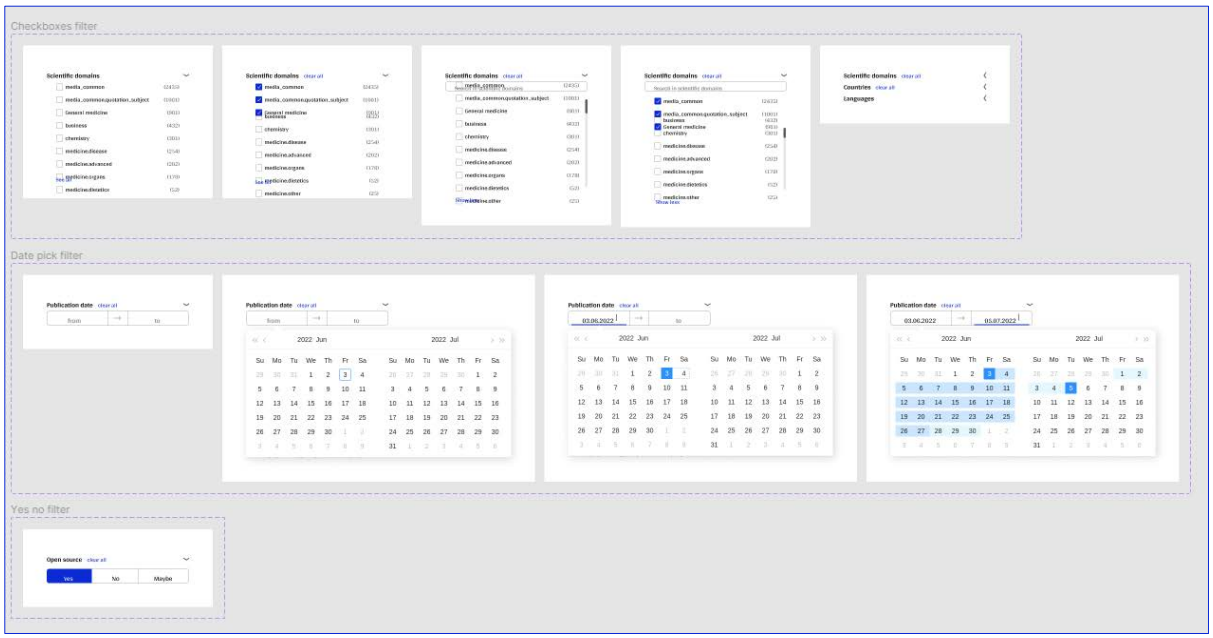

Figure 10.10: Proposed new search filters

In the remaining months of the project, the development of different features will be wide-ranging and will include extending the search service. The places where users take actions that could be relevant to future recommendations have been identified and relevant data will be collected and fed into the Recommender System. The most significant change will be the addition of the Favourites functionality. This functionality will be consistent in all dependent systems and will allow the user to save the result of a search and easily access it at any time.

10.3 Knowledge Hub

10.3.1 Training catalogue

The beta version of the training catalogue (see Figure 10.11) contains a small selection of resources that have been entered manually, to test its functionality and gather feedback elicited from the focus group. The simple metadata model [27] supports several filters (currently Resource type, Content type, Language, Organisation, Level of expertise, Target group, Qualification, Duration, Created on).

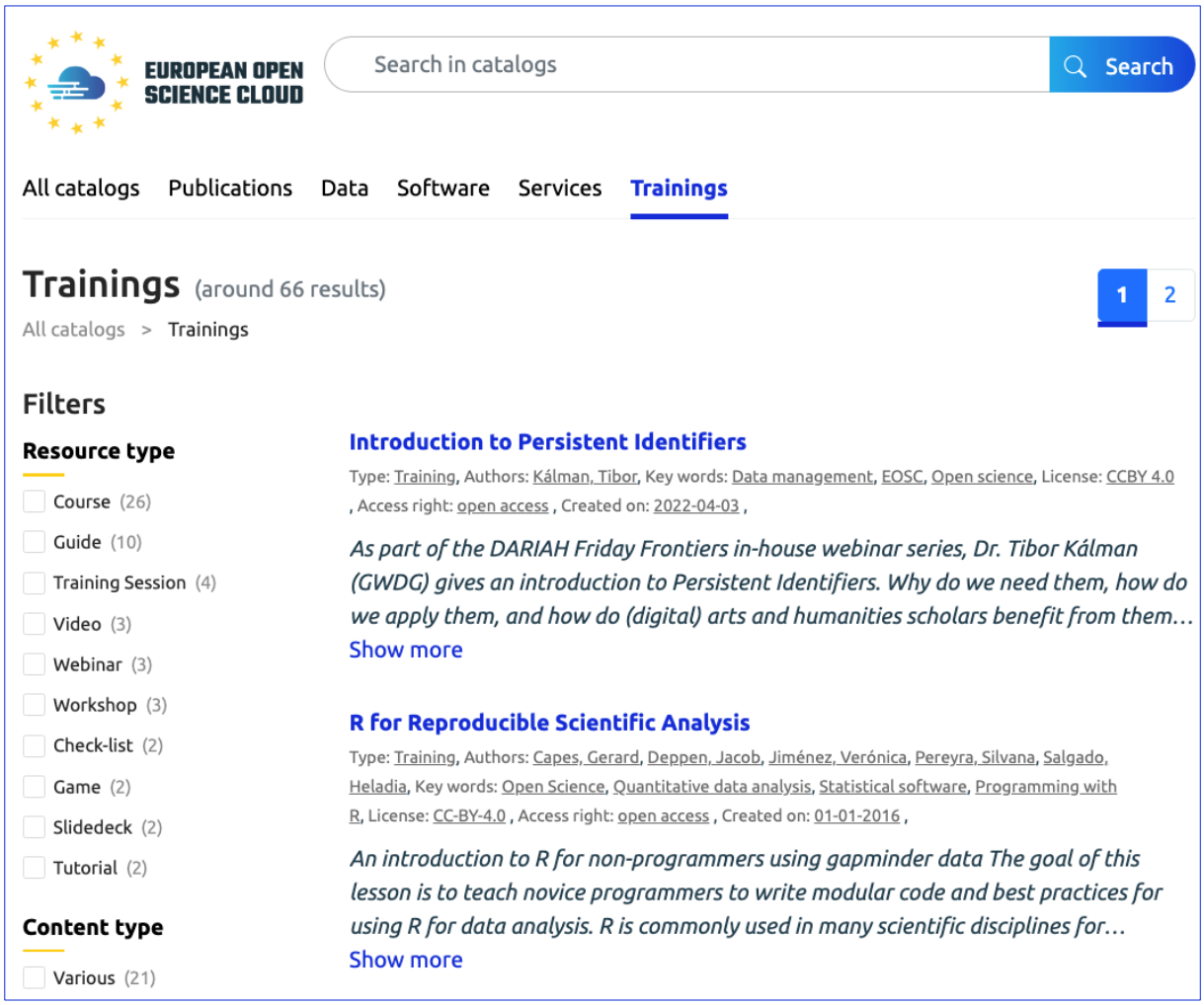

Figure 10.11: Partial view of beta version of Training catalogue

It is clear that some of the filter formats will be impractical when the amount of content is scaled up (e.g. duration), and that the source data needs to be harmonised in some cases (e.g. the language values).

10.3.2 Learning Platform

The Learning Platform reuses an existing service called OpenPlato [8] (built on the open-source product Moodle [9]) and displays EOSC branding. For the first release, the Learning Platform will use the existing look and feel/layout and feature set, then solicit user feedback for potential changes to future releases. Moodle provides tools for gathering User feedback – these will be evaluated and may be supplemented by/replaced with a custom feedback form that is linked to the EOSC Helpdesk.

In order to give an impression of the initial look and feel (branding excepted) of the Learning Platform, Figure 10.12 shows the OpenPlato course catalogue and Figure 10.13 shows the OpenPlato user dashboard.

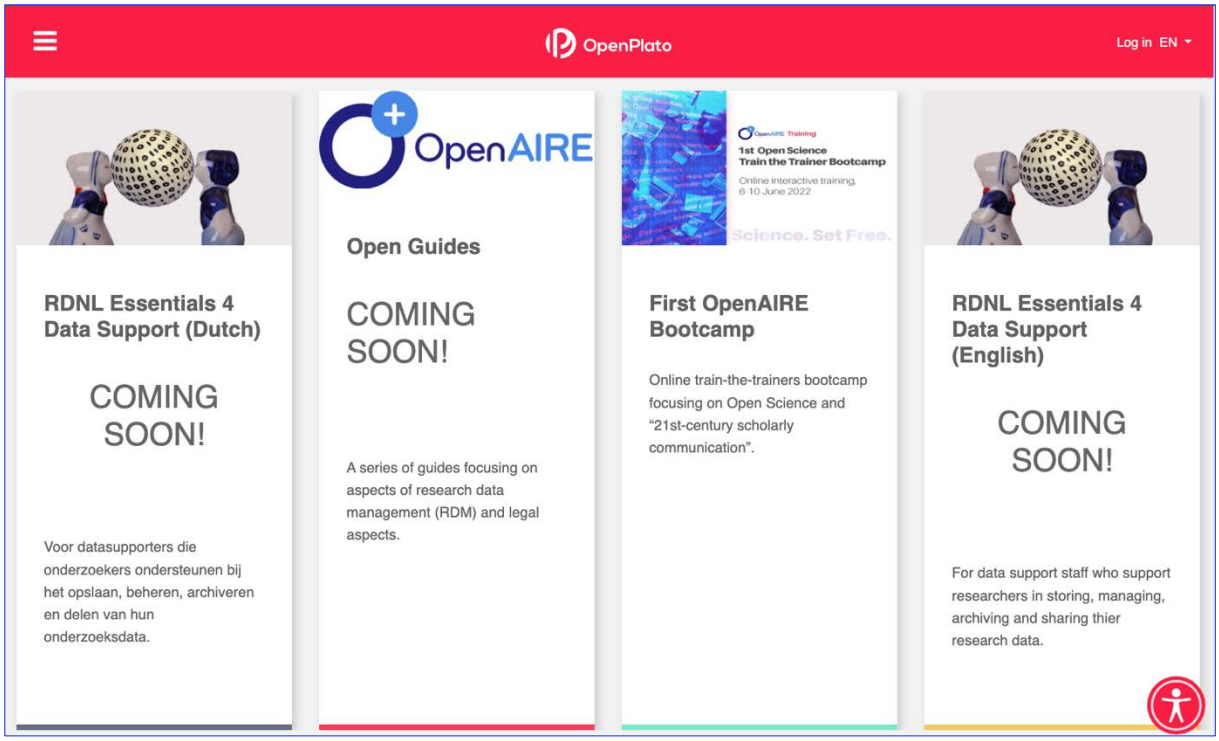

Figure 10.12: OpenPlato course catalogue

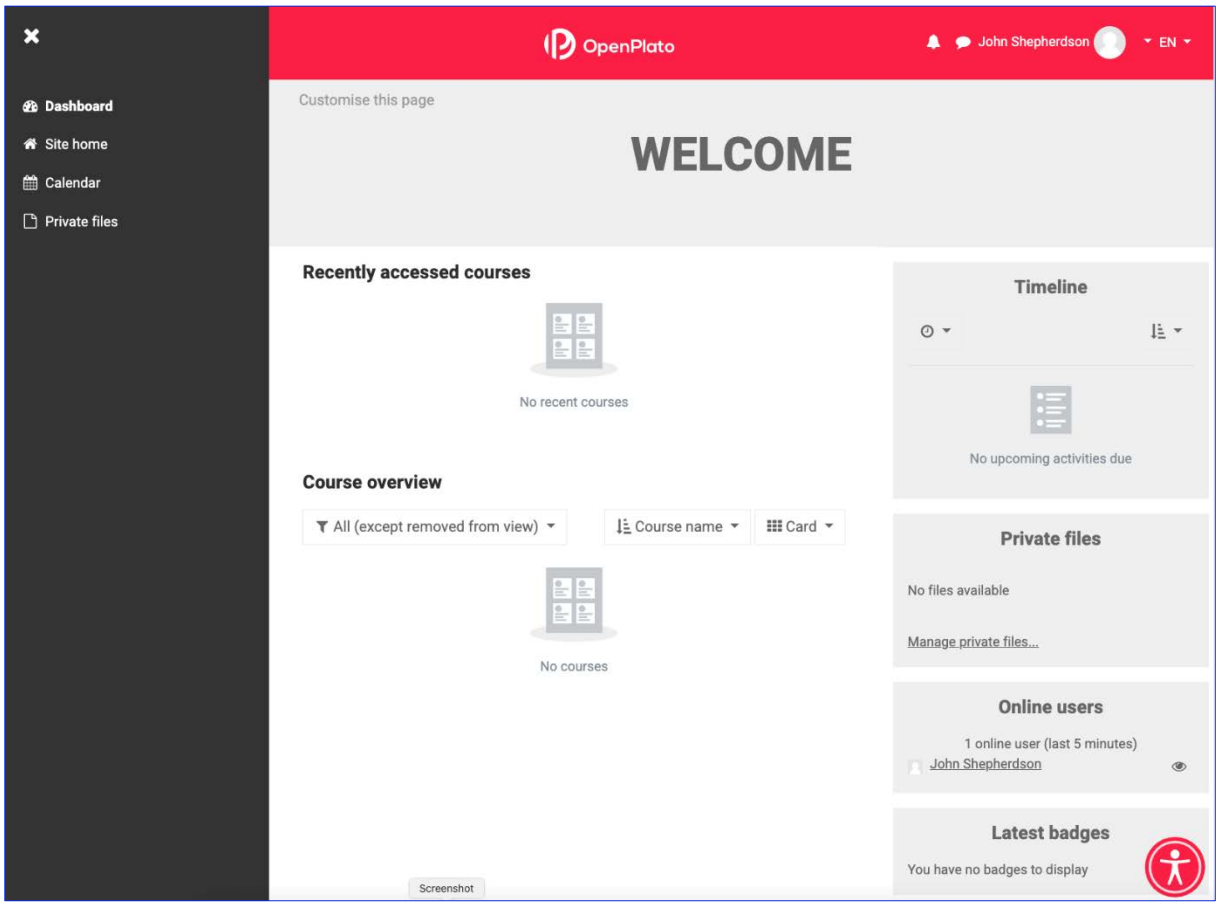

Figure 10.13: OpenPlato user dashboard

10.3.3 Knowledge Hub Helpdesk

The Knowledge Hub Helpdesk is based on an existing service, the EOSC Helpdesk [23] (which in turn is built on the open-source product Zammad [24]) and displays EOSC branding.

The EOSC Helpdesk consists of multiple queues which are dedicated to a particular product, service, type of problem, user community etc. Hence it was straightforward to add a queue for users of the Knowledge Hub, so they can ask questions about the contents and usage of the Training Catalogue and Learning Platform.

Figure 10.14 shows the EOSC Helpdesk dashboard, and Figure 10.15 shows the EOSC Helpdesk knowledge base, which can be extended to include a Knowledge Hub FAQ and/or Knowledge Hub knowledge base.

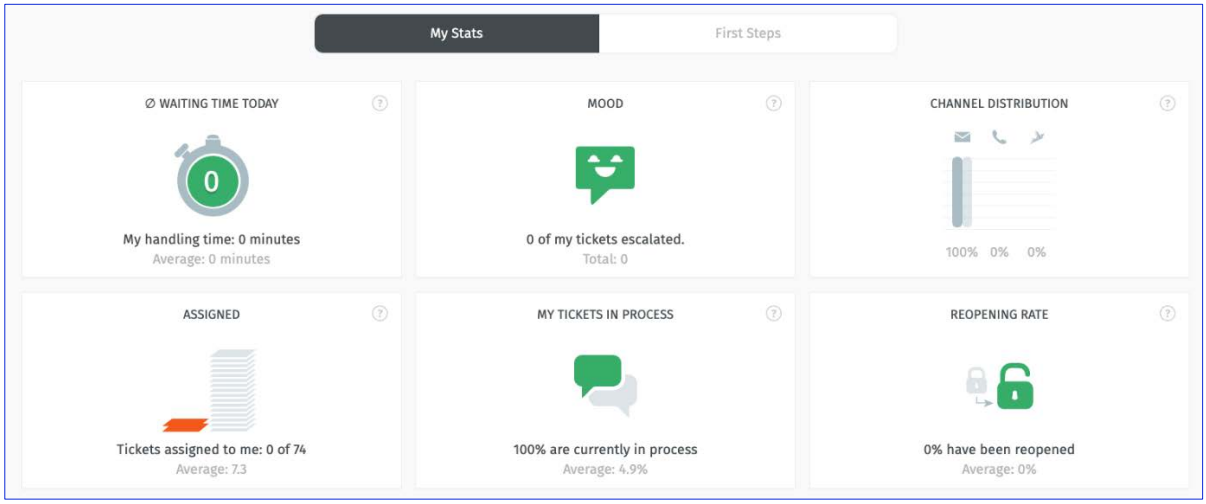

Figure 10.14: EOSC Helpdesk user dashboard

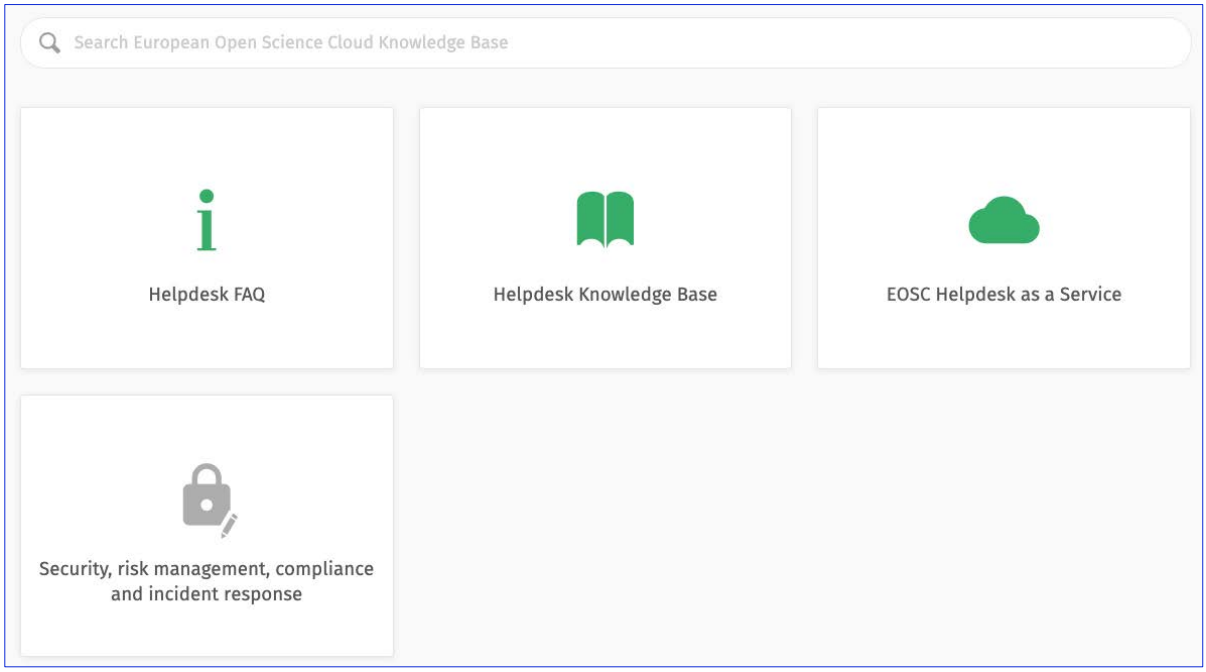

Figure 10.15: EOSC Helpdesk knowledge base

10.4 User dashboard

Taking into consideration the results from the User Survey, in this reporting period, we've prepared the updated proposition of the design of the User Dashboard. The important changes included the introduction of personalization which will allow the user to view only the information that is important to him personally. After

the user logs in for the first time (see picture), a panel is displayed from which to choose the preferred template. The user can decide to choose which widgets they consider to be important and customise the dashboard from the beginning or choose one of the two pre-prepared templates (see Figure 10.16).

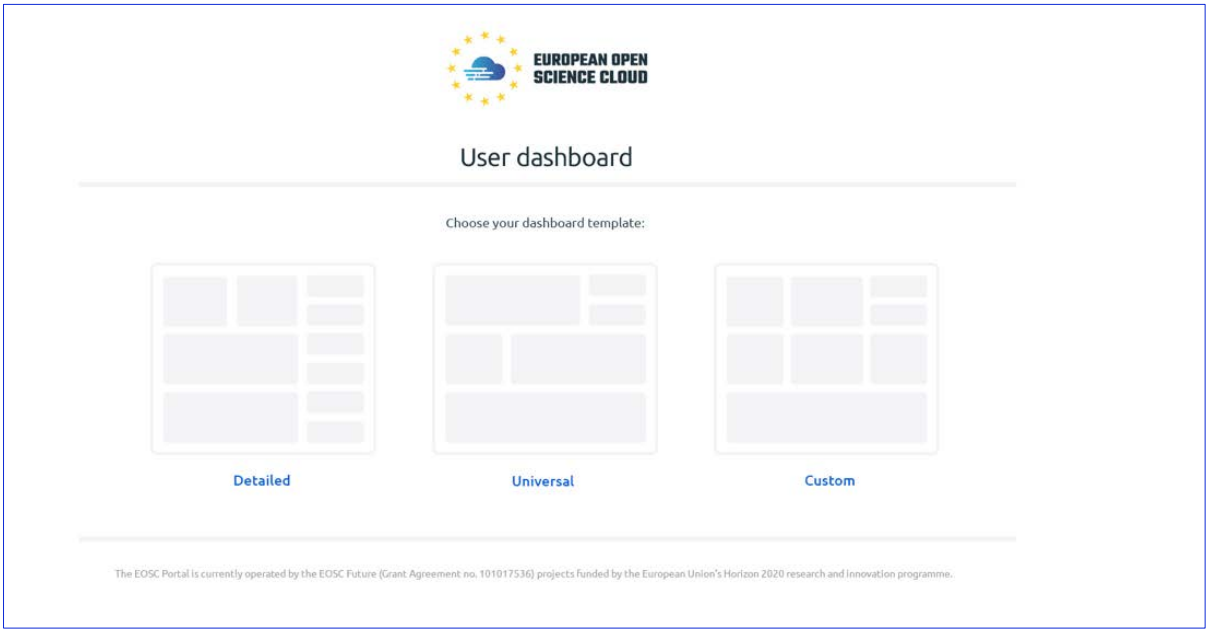

Figure 10.16: User dashboard layout templates

An example of the User Dashboard is shown in Figure 10.17. After consultations with the focus group, the User will be able to choose widgets from this list:

1. Favourite products (from OpenAIRE Explore, EOSC Catalogue and Marketplace, Search Service);
2. Recommended services;
3. Recommended training;
4. Recommended publications;
5. Recommended data sets;
6. Recommended software;
7. News from EOSC;
8. Ordered Services (services added to the project from EOSC Catalogue and Marketplace) with the possibility to request the services from the User Dashboard;
9. Projects (projects created in EOSC Catalogue and Marketplace with the possibility to add projects from MP);
10. Recommendation for data sources;
11. Top trending last week/month;
12. This list will be extended in the subsequent releases of the User Dashboard.

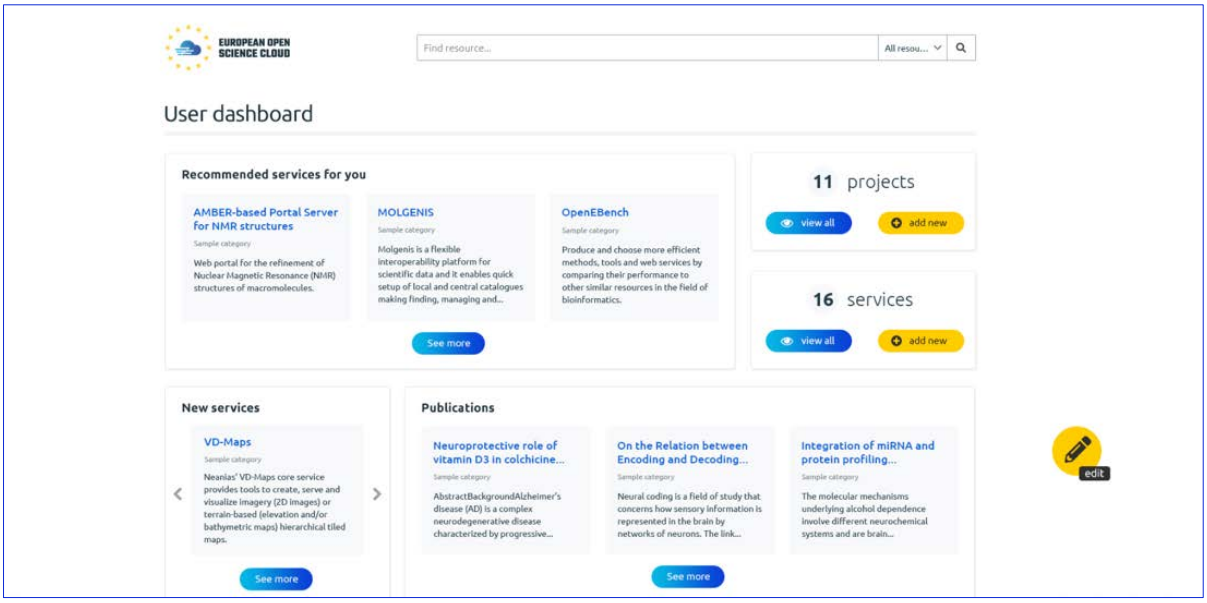

Figure 10.17: User dashboard (showing recommendations)

As mentioned before each widget will be fully configurable. Users will be able to change the size, position, and basic settings of each widget, as shown in Figure 10.18.

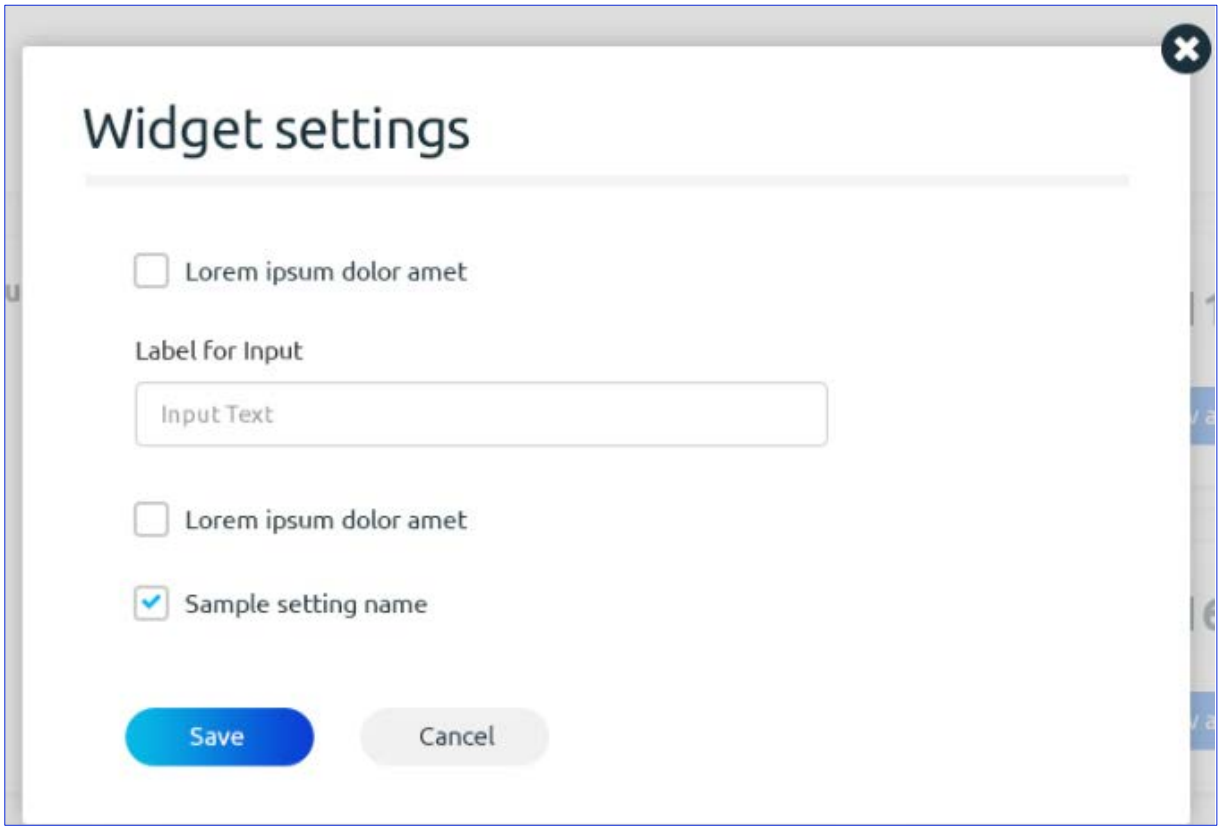

Figure 10.18: User dashboard widget setting

In the future, feeds from EOSC-content aggregators will be added and displayed in a wall-like layout. Users will be able to add feeds from EOSC Portal, EOSC Catalogue and Marketplace, Search Service, OpenAIRE Explore, and more besides (see Figure 10.19).

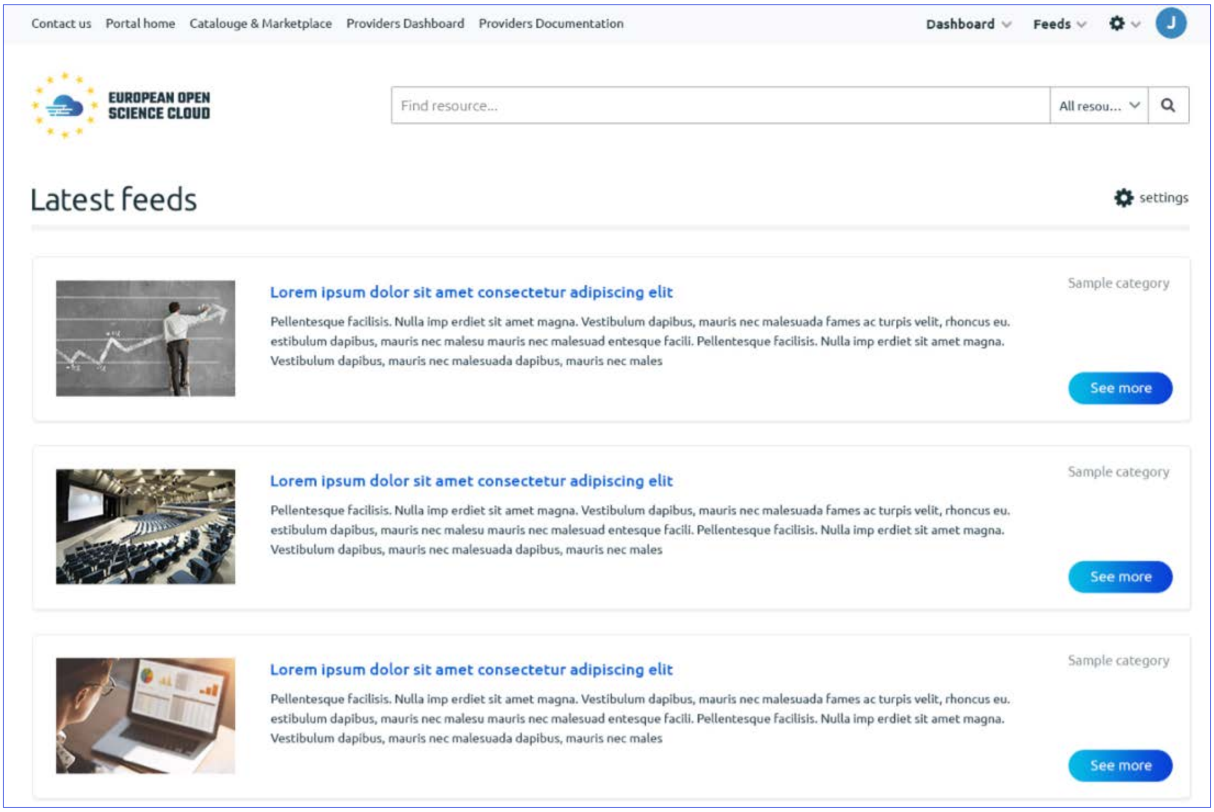

Figure 10.19: Information feeds

10.5 Recommender System for enhanced User Experience

The Recommender System has been designed and implemented as a service, so that multiple clients can benefit from it. So far, the Enhanced/Improved Discovery capabilities and the User Dashboard are the only clients, and the uses of recommendations are user preference settings are incorporated into their User Interfaces, as appropriate.

11 Conclusions

The ***EOSC Explore*** **data search** facility, when technically developed according to the user requirements, can only be as good as the data that stands behind it. Future tasks might need to look deeper into the interoperability and the interconnections of different data sets. Linkage must be developed via metadata and data infrastructures. The aim is that the user gets comprehensive search results out of this without being confused about the "mass of data". Here filters and smart surfaces are a good solution. The providers need to meet the requirements necessary to network all data sets. Therefore, this is a bottom-up process, their data needs to be incorporated into meaningfully elaborated networking structures. One future challenge is to connect and present all different levels which meet in EOSC in a way that profits the users most.

In many cases, **discoverability** is the difference between a successful product and one that fails to meet user needs. If users are unable to find what they're looking for, they will quickly become frustrated and may even abandon the product altogether. What discoverability does is to provide critical guidance for the design and development of services and the service interface. The iterative process that began with the internal brainstorming and continued by performing the focus group meeting and analysing the results helped identify issues with the current User Experience. A list of items that will remove the obstacles to allow users to focus on their task and can be implemented with relative low cost has been assembled.

Searching for **training** material is not a daily routine for researchers. This might underline the importance of the Recommender System that could offer related courses when searching for other kinds of resources. The lack of daily routine strengthens the importance of Google search and other simple search tools. Offering a "simple search" platform with access to advanced filtering options might be particularly useful. As researchers tend to use Google as their main search option, it makes it extra important to manage the SEO (Search Engine Optimization) issues of the training platform to ensure the materials are found. Researchers expect rich metadata fields to be able to judge if training material is relevant. Among these, most important is the availability of a clear description of the training content (including a table of content). The focus group agreed that the proposed metadata fields are complete, and this planned set would not create an extra burden when uploading training material.

As one of the important messages in EOSC states that it is built by and for the researchers, so the need for a user dedicated space in EOSC Front-Office was paramount. The **User Dashboard** as a place to gather researcher-related information and, based on that data, display the most accurate EOSC-related resources and information is intended to meet this need. It should be stressed that the researchers' working environment is complex and often depends on the scientific discipline or the level of collaboration complexity. For that reason, it was decided that one dimension of the User Dashboard, the recommendations, will be AI-based and automatic but it's 'shape' will be manageable by the user. It will be the researcher who decides which parts of EOSC should be presented in the Dashboard and which part of the researcher's profile should be more significant when it comes to the recommendation part. It was also decided that the UX solutions for the User Dashboard should be widely recognised and for that reason, the "EOSC areas and functions" will be displayed in the forms of the widgets. After the first release it will be verified if the number of recognised areas (widgets) is sufficient or if the Dashboard should be equipped with more.

The biggest challenge will be to meet all of the demands regarding collaboration in EOSC, remembering that there are already different types, levels and mechanisms of collaboration in place that should be included or mapped. It needs to be understood if the impact of such a development will exceed the resources needed to deliver it and if it will bring significant added value versus what is already in place. It is planned in the coming months to propose a solution that will acknowledge already existing scientific collaborations and connect them to the EOSC order management system via the User Dashboard.

The **Recommender System** is a functional module aimed at helping researchers to discover and use the content offered in the EOSC Portal. Recommendations are tailored to each specific user based on a variety of data about them. Successful implementations of commercial recommender services, e.g., at Google, Amazon or Facebook, demonstrate that there is a significant potential in employing AI to support users in exploring large ecosystems like EOSC.

A diverse user group of researchers have been involved in the validation of early insights and requirements. The process included semi-structured focus group meetings, as well as individual interviews addressing specific findings. The collected results show that in general the researchers have positive attitude to recommendations and believe they will help them in finding and using EOSC-provided services and resources more effectively. Although there are differences in the expected layout and User Experience of the system, researchers want to use and validate the items recommended by EOSC. Some of them expressed concerns related to privacy protection and sharing data with the system, but these concerns can be adequately addressed by technical solutions. Some of the most promising sources of data that could be used for recommendations include researcher-related data (research domain, previous publications and projects) and similarity to other researchers. Once the Recommendation System has been delivered, the quantity and quality of the recommendations will increase as the usage of the EOSC Portal, Catalogue and Marketplace grows.

Whilst the initial requirements for the various themes came from many sources (output from previous EOSC projects, internal brainstorming sessions, survey results etc.) the defining step in all cases has been the involvement of the focus groups, to validate and refine those requirements and in many cases raise new ones. This co-creation step will be repeated with each iteration of the various Front-Office components, so the User Experience moves ever closer to the needs of the EOSC consumers. The learning gained from the co-creation activities is being carried into the Portal redesign activities, as members of the teams investigating the various requirements themes take part in the latter. Any changes to the look and feel of the User Interface will be harmonised across the various Front-Office components, including the Portal.

12 References

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13 Appendix I: Data Inclusion in the Front-Office

13.1 Questionnaire to the Focus Group in Data Finding for the Webinar in April 2022

Webinar for EOSC User Group

HUMAN HABITS approach.

Intro on EOSC and expected outcome of the meeting

Roundtable introduction: name, discipline, what type of researcher (lab, supporting, …)

Narrative on the search strategy: What is the research strategy on searching resources? Can you describe the path for searching?

How do you search for data that are not in your specific research domain if you need to work in interdisciplinary research?

What is currently the search engine of your choice?

From 1-5, how much are you satisfied with it?

What is missing?

Name 1-2 most important functions you would like it to have.

Define your strategy in searching for data. For example, are you searching for keywords; or for advanced information related to dates, authors, licensing, downloads, etc.; or what is most important when refining and navigating.

Hands-on task specific to EOSC:

Search for a dataset that you know exists out there and would help you in your research. (e.g., search for something like *Cloud radiative forcing data*).

Have you found the answer?

yes

no

not sure

What website have you found?

EOSC association

EOSC portal

EOSC marketplace

other

Have you refined the task by using:

scientific domain

categories

other

How did you filter the research? (open)

Are you interested in contextual information (who, where, by whom, etc.) (open). If yes, did you find it?

How intuitive was the overall experience (score)

Your feedback for next time we meet.

13.2 Treasure Hunt and data discovery performed in June 2022

Welcome to our WP5 Treasure Hunt in EOSC Explore

Dear users,

Thank you for being part of this amazing group! We accomplish a lot and the spirits are high!

Today we would like to invite you to our treasure hunt.

Aim: We want to know better, how the EOSC Explore works for you. By making you hunt known and unknown data you can let us know how helpful the EOSC Explore is recently.

Three tasks are to be accomplished by you

Treasure hunt

The idea here is that specific results/data should be searched for. Like in real life when a colleague says "you should look for this and that, it will help you. That is the treasure we are looking for in this task.

Data Journey

Look for Data you are interested in, data from your domain you need to work with. Can the Explore meet expectations and wishes here?

Play!

Now that you searched for the treasures and your own data of interest, please use the advanced search and filters more to see how this works for you.

ATTENTION!!! We will give you a test page in beta version, please do not share the link: https://explore.eosc-portal.eu/

Treasure hunt in EOSC Explore: please find in https://explore.eosc-portal.eu/

a) a publication from 2021 that addresses the question "what characteristics decisively influence human elite athletic performance". How many brains and what kind of sports activity do you find on the cover of this publication?

b) a Data set for "spiritual leadership". Please tell us, what the data set is offering.

c) a Software for mapping digital humanities and let us know about related publications.

d) How did it go? Any difficulties? Any thoughts or wishes? Please let us know:

Your data journey in EOSC Explore: please find in https://explore.eosc-portal.eu/

a) Search for one of the latest publications from your domain. Which one do you have?

b) Search for one of the most used data sets from your domain

c) Search for any software related to your domain

d) How did you do it, what were your steps?

e) Any frustrations with the process? Anything you loved? Please let us know:

NOW, let's play a little bit with the "advanced search" and let us apply the filters!!

Look for anything that is of interest for you and try to use the filters to refine the query.

a) What are your feelings, experiences, and challenges regarding the advanced search/filters here?

b) Anything you can suggest, or you would prefer?

13.3 Interview performed in July 2022

The results of the above questionnaire had been further discussed in a live interview on July 2022 when it was asked about their user experience with *EOSC Explore*:

- How would you rate your overall experience in using EOSC Explore?
- On a scale of 1 to 10, how would you rate your experience in terms of "ease of use"? (1= very difficult, 10 = very easy)
- On a scale of 1 to 10, how satisfied are you with the terminology used in the service? (1= not at all satisfied, 10 = extremely satisfied)
- On a scale of 1 to 10, how satisfied are you with the data you found as a search result? (1 = not at all satisfied, 10 = extremely satisfied)
- On a scale of 1 to 10, how likely is that you will use the service again? (1 = not at all likely, 10 = very likely)

14 Appendix II: Enhanced/improved discovery

14.1 Screenshots

Equipped with the new UI framework and having as a point of reference the progress made so far, the team participated in iterative internal brainstorming sessions trying to map ideas into distinct propositions/actions. The first brainstorming sessions produced an output of remarks, propositions and ideas after an initial thorough exploration of the User Interface of the EOSC Catalogue and Marketplace. They were used to organise the effort into identifying some major proposition items / ideas and have them iteratively defined and described using the employed framework.

Framework - Actions / Business Values

For each action we have to describe:

- general idea
- best practices / similar solutions 📚
- references 📚
- implementation cost 💰
- user pains(alleviated) / gains 🙋

The iterative process: start with assumptions. Multiple steps are required to validate them through users.

The following figures show the actions followed for each point.

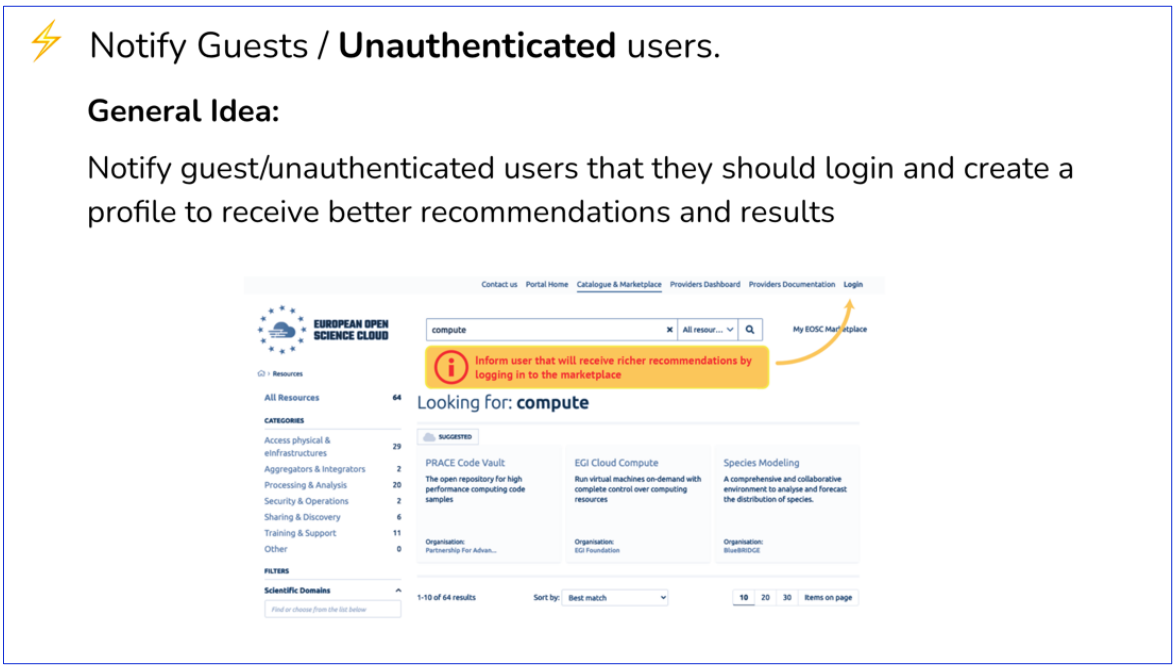


Figure 14.1: Notify guests / Unauthenticated users: General Idea, concept.

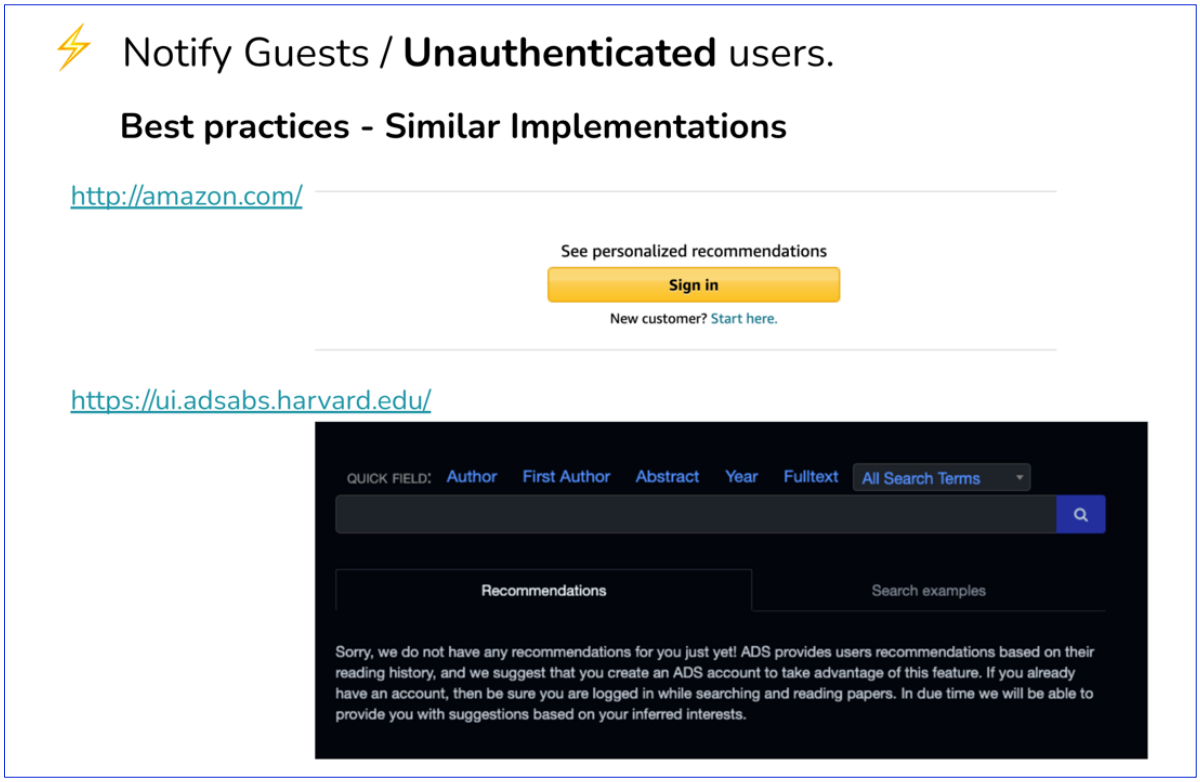


Figure 14.2: Notify guests / Unauthenticated users: best practices, similar implementations (Amazon, Adsabs)

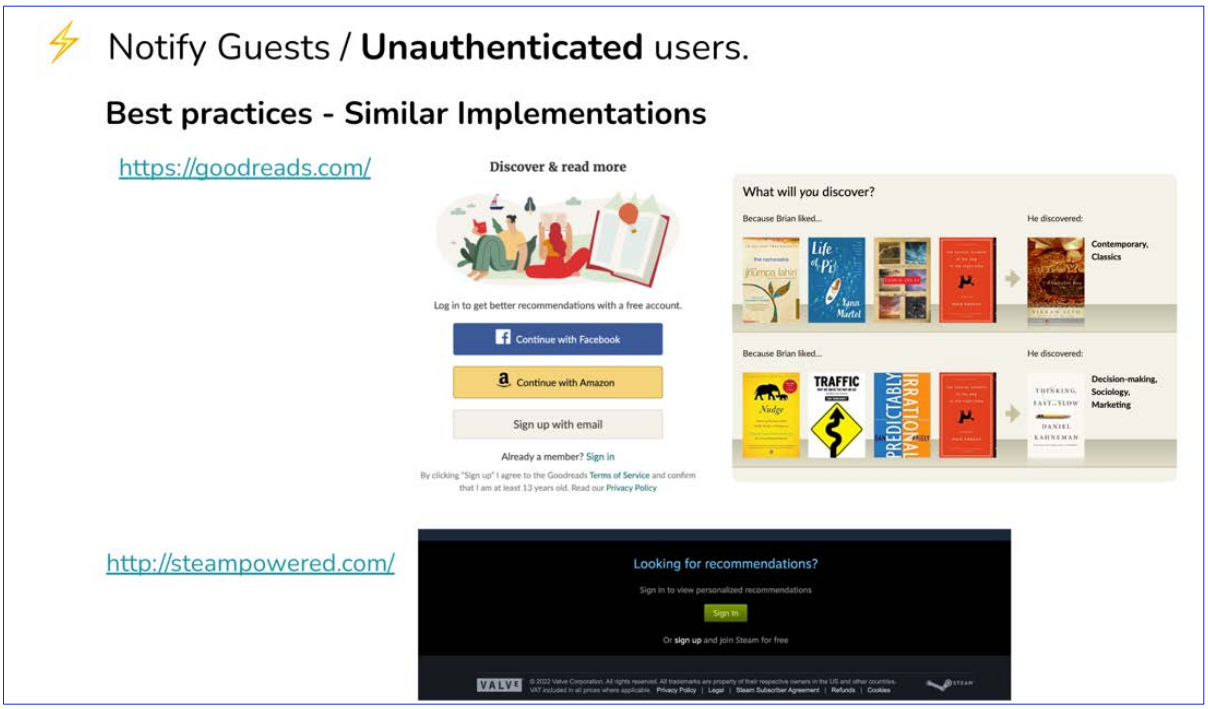


Figure 14.3: Notify guests / Unauthenticated users: best practices, similar implementations (Goodreads, Steampowered).

⚡ Notify Guests / **Unauthenticated** users.

Implementation cost 💰:

- small
- affects:

Notes/References:

- Another common issue you'll soon run into when creating a real production-ready recommender is what to do with users that aren't registered users yet. What can be done, for instance, for the new user browsing products in an e-commerce website?
- This anonymous user has no browsing or purchase history, let alone an ID, as far as the site is concerned. The problem of making recommendations to such users, starting from no data, is called the cold start problem. It concerns the issue that the system cannot draw any inferences for users or items about which it has not yet gathered sufficient information.

Figure 14.4: Notify guests / Unauthenticated users: Implementation costs and components it affects

⚡ Explain **why** something is recommended

General Idea:

Discovery requires a means of consistently communicating information about resources (meta information) that are made available for discovery. The marketplace should present to the user the criteria used to display the results in every search.

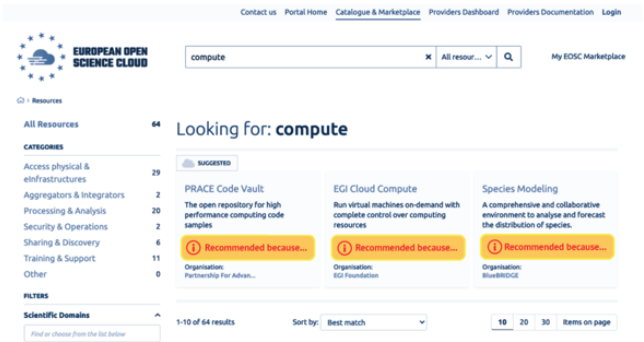


Figure 14.5: Explain why something is recommended: General Idea, concept

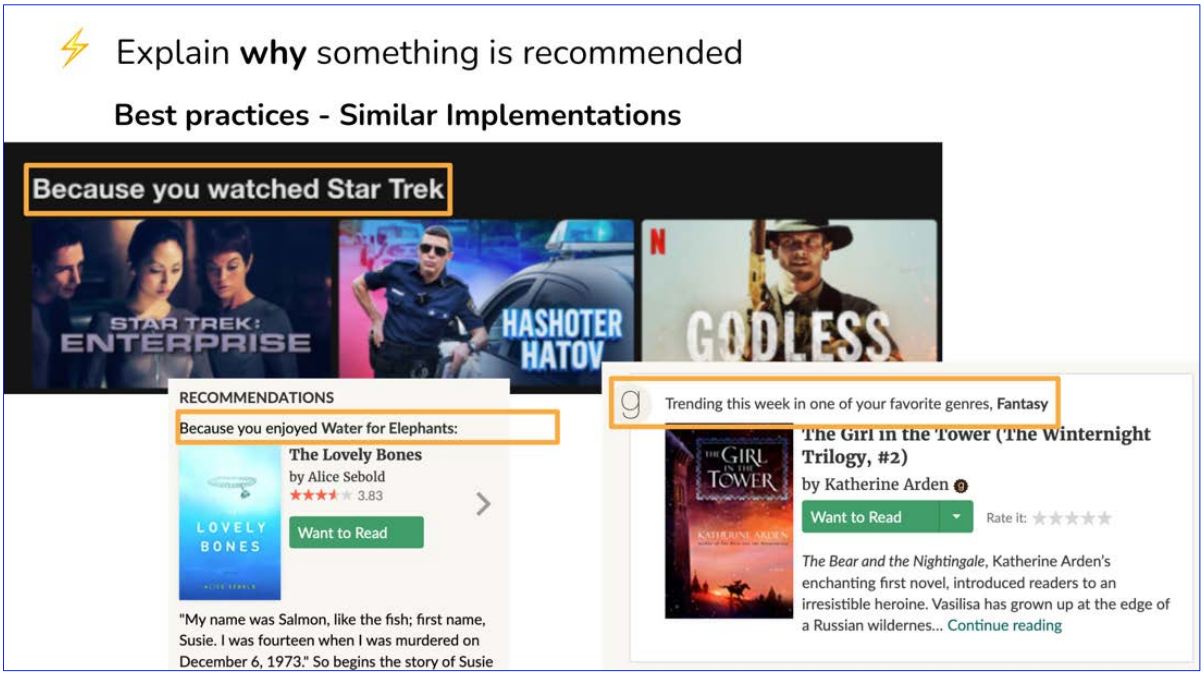


Figure 14.6: Explain why something is recommended: Best practices , similar implementations "Because you watched" by Netflix

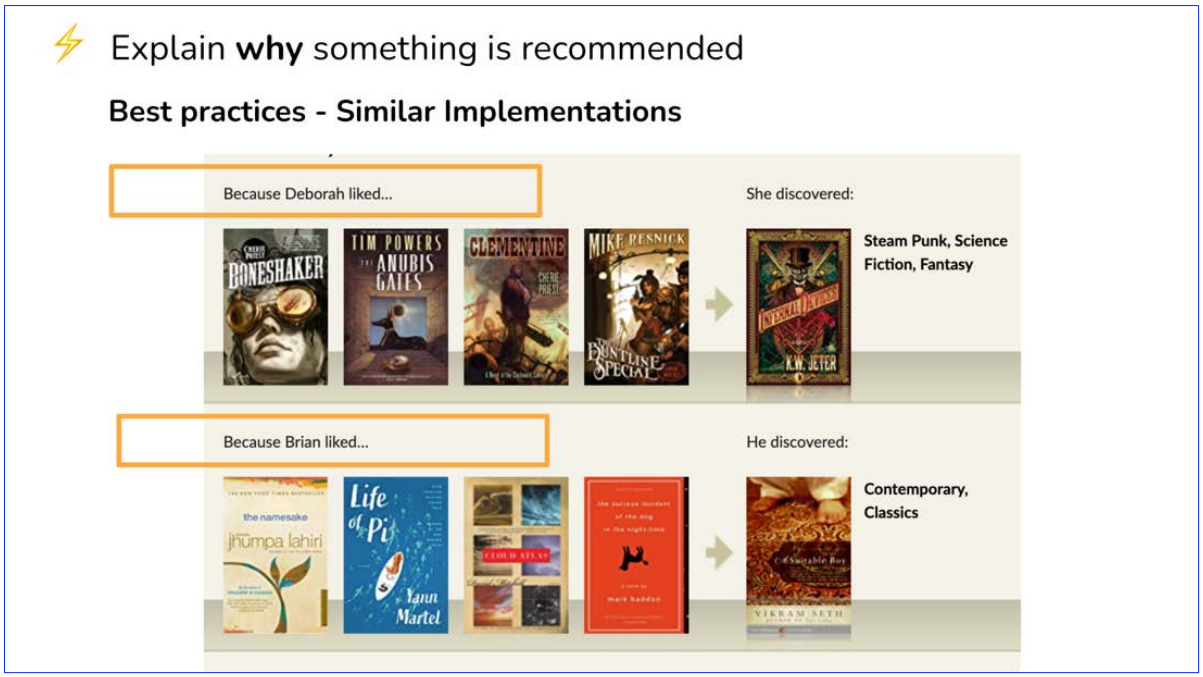


Figure 14.7: Explain why something is recommended: Best practices , similar implementations by Goodreads

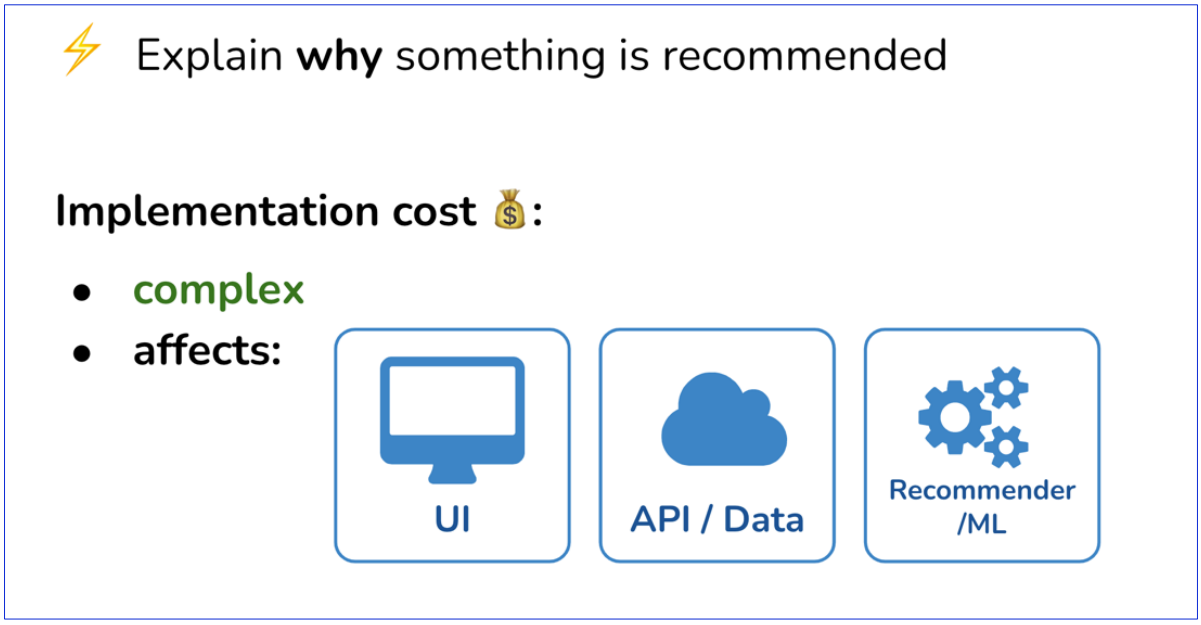


Figure 14.8: Explain why something is recommended: Implementation costs and components it affects

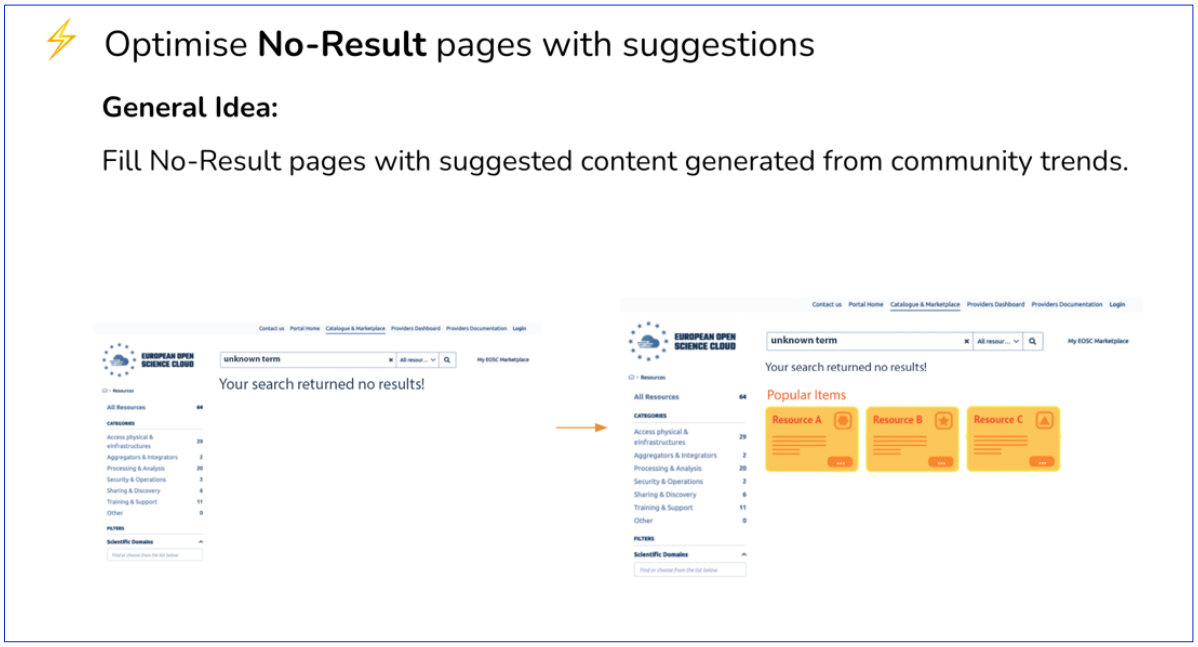
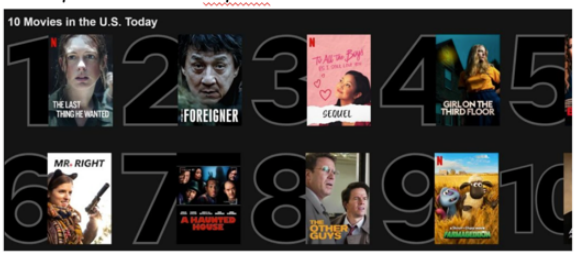


Figure 14.9: Optimise No-Result pages with suggestions: The proposal - idea

Optimise **No-Result** pages with suggestions

One approach is to have some understanding of what's popular and engaging for most users. In these cases, the result can be a fallback set of outputs based solely on features we know and can infer from the request. These can include data from the users' profile (ex, science field, geographical position)

example: netflix's top10 list



ref: https://canvatechblog.com/recommender-systems-when-they-fail-who-are-you-gonna-call-3377d21534ee

Figure 14.10: Optimise No-Result pages with suggestions: Similar implementation by Netflix

Optimise **No-Result** pages with suggestions

Implementation cost 💰:

- **medium**
- **affects:**

Figure 14.11: Optimise No-Result pages with suggestions: Implementation costs and components it affects

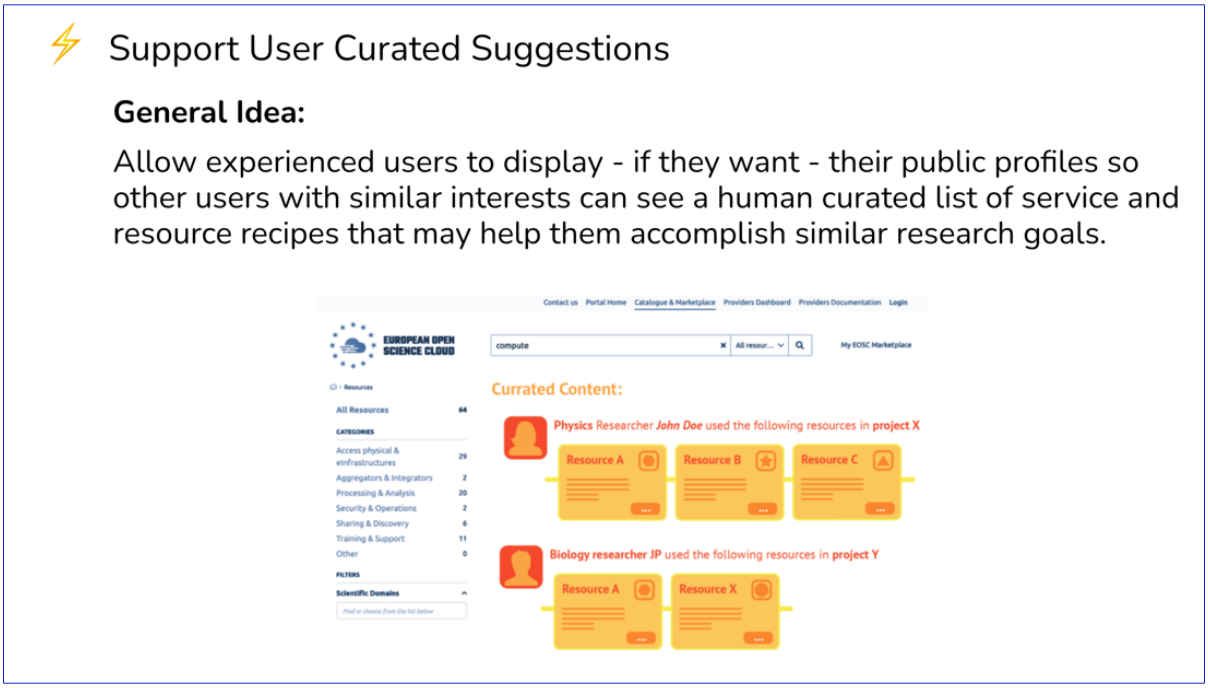


Figure 14.12: Support User Curated Suggestions: The proposal - idea

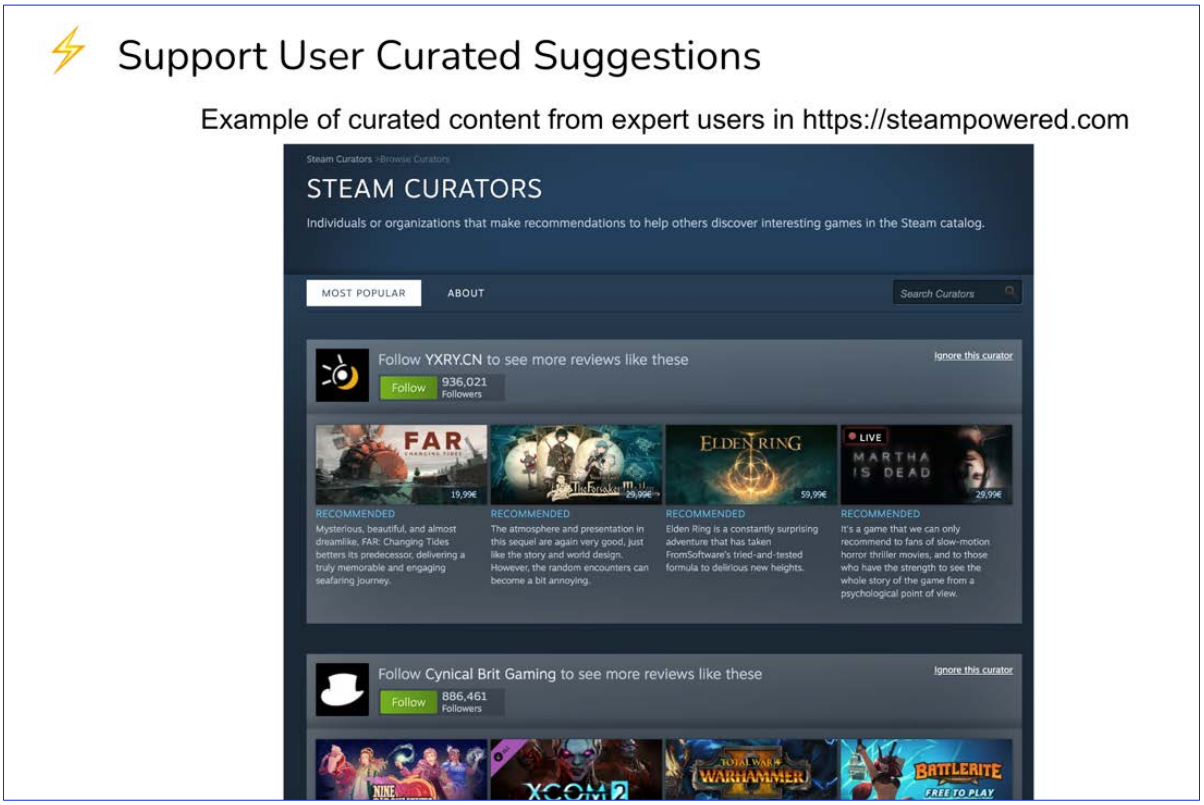


Figure 14.13: Support User Curated Suggestions: Similar implementation by Steampowered

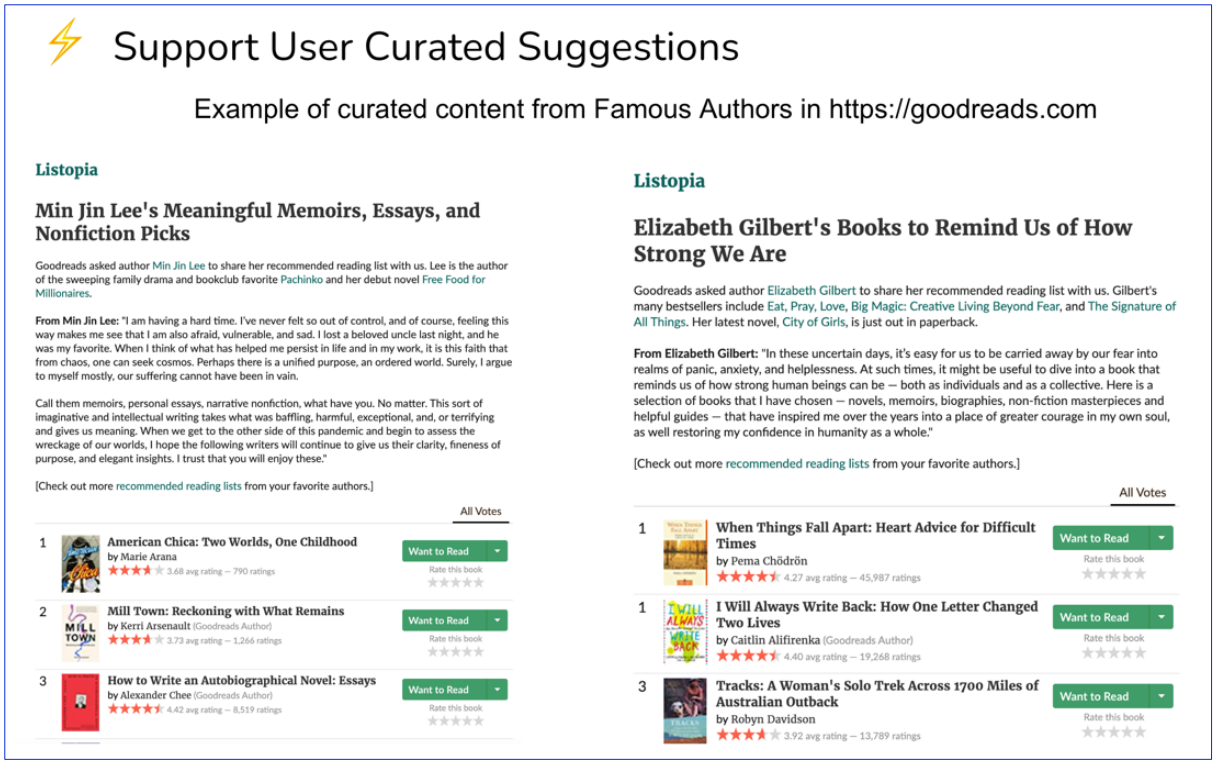


Figure 14.14: Support User Curated Suggestions: Similar implementation by Goodreads.

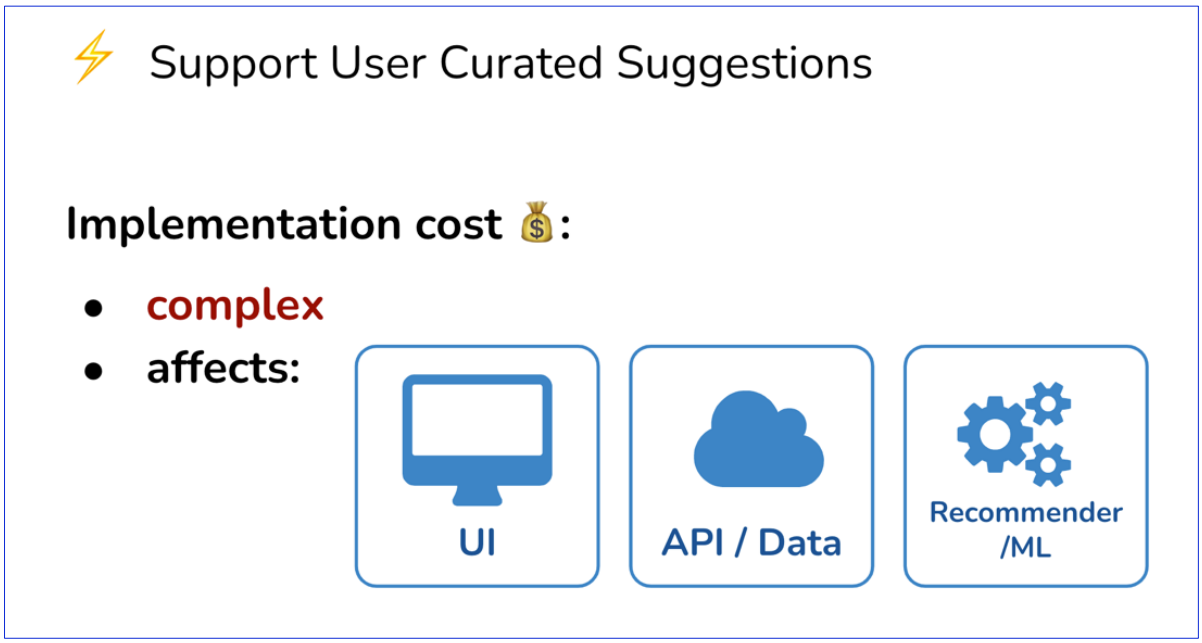


Figure 14.15: Support User Curated Suggestions: Implementation cost and components it affects

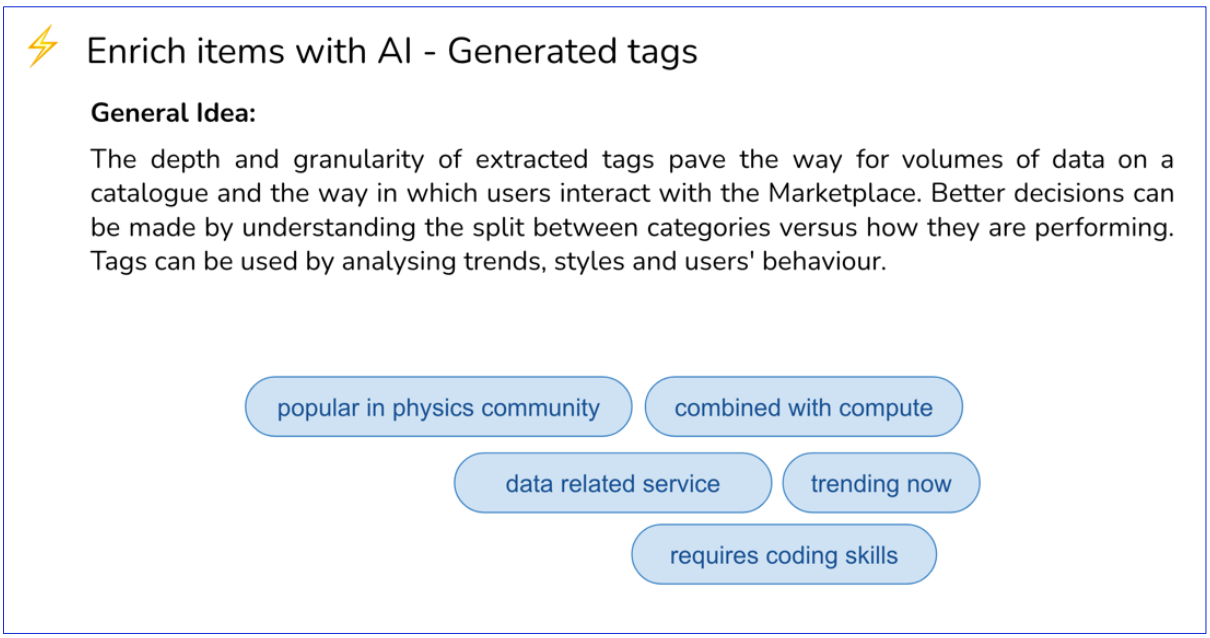


Figure 14.16: Enrich items with AI – Generated tags: The proposal - idea

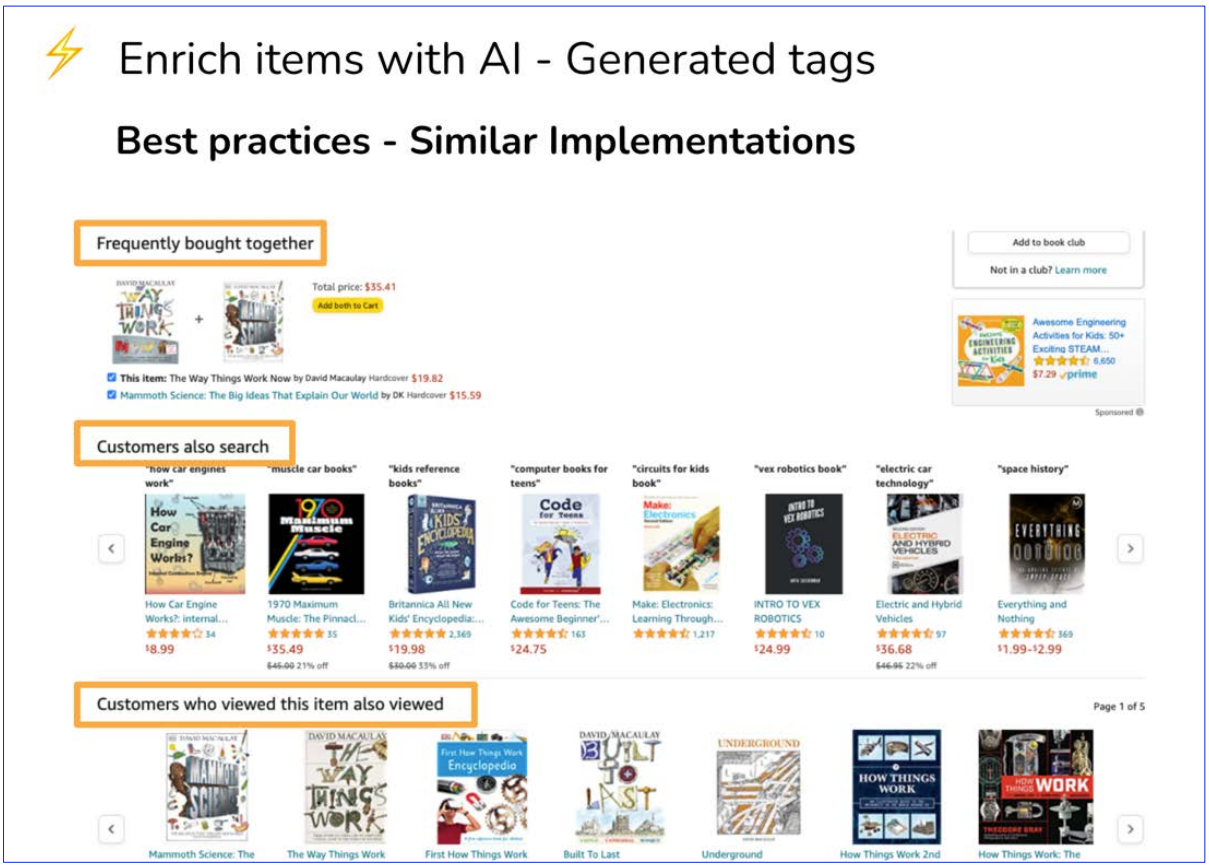


Figure 14.17: Enrich items with AI – Generated tags: Best practices, similar implementations by Amazon, Goodreads etc.

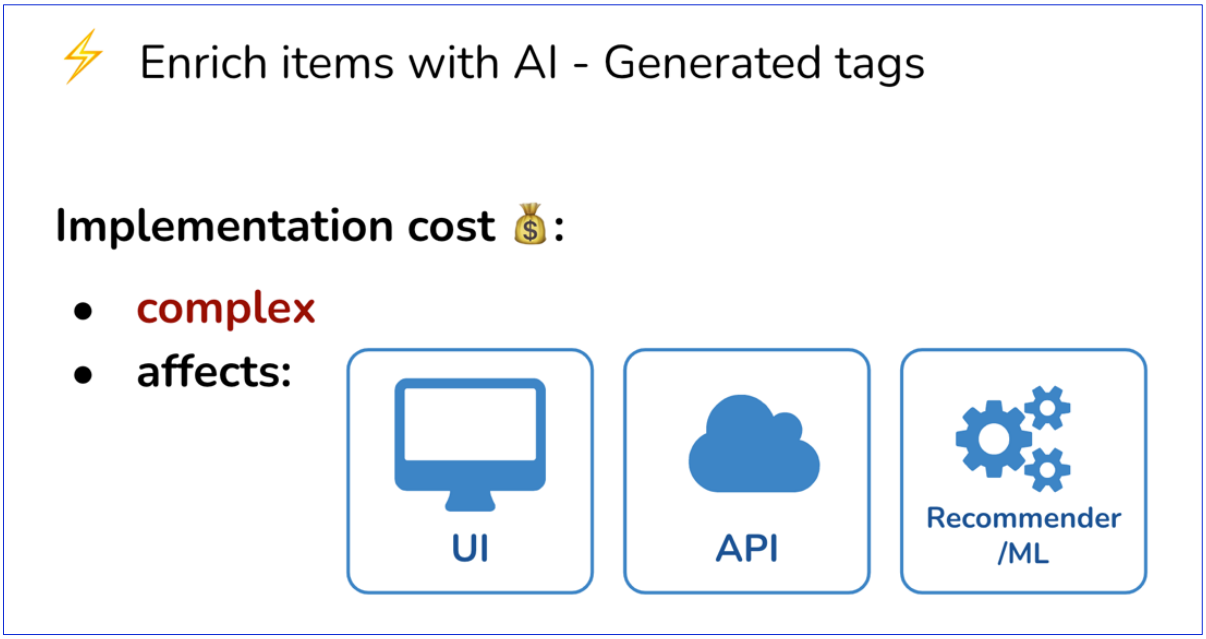


Figure 14.18: Enrich items with AI – Generated tags: Implementation cost and components it affects

14.2 Questionnaire

Section 1: Focus group; Discoverability in EOSC

Product discovery is the process of enabling "users" to find the items they're looking for and exposing them to new items they may want

1. First, have you ever used a website or app that lets you search and order resources?
    - Yes
    - No

2. Are you familiar with EOSC?
    - Yes
    - No

Section 2: Visit the EOSC Portal Catalogue and Marketplace

VIsit https://marketplace.eosc-portal.eu/ and answer the following questions

Welcome to the EOSC Portal Catalogue and Marketplace

3. At a first glance is it easy to understand what the marketplace is about and what kind of items are offered to you?
    - Yes
    - No
4. Write down 5 words that look weird to you or seem difficult to understand
5. Name down 3 things (technical terms, features) that make it difficult for you to understand what they are actually there for.

Section 3: Discoverability and technical terms

In this step you will be asked to explain 5 words commonly used in the marketplace. Explain in your own words what is the meaning of the following words

6. What is your preferable way of finding items? BY:

- using the search box
- browsing the categories
- getting recommendations

7. Are you familiar with the following word (yes, no , I think so)
    - Resource
    - Provider
    - Aggregator
    - Integrator
    - Virtual Machine
    - Container
    - Service
    - eInfrastructure
8. Could you please tell us what is a Resource for you?
9. Could you please tell us what is an Aggregator for you?

Section 4: Search in the Marketplace

Visit the link https://marketplace.eosc-portal.eu/services and then try to find an open access Repository related to your Scientific domain from a provider in your region.

10. Name the 1st action you did to follow the task. What steps did you follow in general?
11. Name the repository you found.
12. Based on the task that you followed. (yes, no, so and so)
    - Was it successful?
    - Did you find what you needed?
    - Did it take more time than expected?
13. Please explain the problem you faced when you tried to find the resource requested. *

14. What's missing from what you've already tried? *
15. How was your overall experience? (0 Very unintuitive, 10 Very intuitive)

Section 5: Categories in the Marketplace

Marketplace follows a unified view of the Providers and their Resources under a common model, called EOSC Profiles. The profiles have created a first version of the categories used in the Marketplace. Main categories in the marketplace*

16. Could you please describe what type of resources do you expect to find under Aggregators & Integrators.
17. Could you please describe what type of resources do you expect to find under Sharing & Discovery.
18. Find a web portal for Medical Sciences by browsing through the categories. Describe the steps you followed.
19. What's missing from what you've already tried?
20. How was your overall experience? (0 Very unintuitive, 10 Very intuitive)

15 Appendix III: User Dashboard user stories

User stories from the User Settings area:

1. As a Researcher, I want to define my scientific profile and interests to be offered services and scientific products that might support my research activities.

2. As a Researcher, I want to define my interests so I am exposed to relevant scientific content that might apply to my research or interests.

User stories from the Availability area:

1. As a Researcher, I want to see news and articles that are related to my interests and activities (User settings) As a Researcher, I want to define my technical needs to be offered resources that might support my research activities.

2. As a Consumer, I want to define my EOSC activities (projects, communities, working groups, task forces) so I can reach all relevant websites from one place. If this is to be accepted, think about the distinction of EOSC-related Front-Office user in the typology.

3. As a Consumer, I want to have a dedicated and intuitive space to reach the services and scientific products of my interest.

4. As a Consumer, I want to have a dedicated and intuitive space to reach the services I'm using (workflows I've defined).

5. As a Consumer, I want to have a dedicated and intuitive space to reach the Marketplace projects I have defined.

6. As a Consumer, I want to have a dedicated and intuitive space to locate funding opportunities (Users can set up alerts, share opportunities and search or browse through the funding database)

User stories from the Feedback area:

1. As a Consumer, I want to provide feedback on the (suggested) resources available

2. As a Consumer, I want to be able to rate services in the EOSC (user satisfaction)

3. As a Consumer, I want to be able to remove all data related to my account (GDPR compliance)

User stories from the Collaboration area:

1. As a Consumer, I want to have a dedicated and intuitive space where I can find my EOSC-related messages

2. As a Consumer, I want to be able to form user groups in the Portal

3. As a Consumer, I want to relate a user group to a Marketplace research project

4. As a Consumer, I want to be able to join a discussion of my interest (forum functionality)