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Deliverable 5.4

Service Registry

Mike Bryant
King's College London / NIOD

Emmanuelle Moscovitz
Yad Vashem

Nurit Davidson
Yad Vashem

Anna Ullrich
IfZ

René van Horik
DANS

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Contact Person	Mike Bryant, michael.bryant@kcl.ac.uk, +44 (0)20 7848 4616
Abstract (for dissemination)	This deliverable covers the development of an EHRI Service Registry, or catalogue of services offered by the Research Infrastructure (RI). The rationale for development of a Service Registry (SR) is to assist in the discovery of end-user services by members of EHRI's target user groups. Rather than developing a custom SR administration backend, EHRI has opted to register services with the EOSC (European Open Science Cloud) Marketplace and use the Marketplace's API to provide an EHRI-specific SR frontend. In addition to reducing development time by taking advantage of a mature and well-developed pre-existing system, this approach has the benefit of providing additional exposure and discoverability for EHRI's services by introducing them into the wider EOSC ecosystem.
Management Summary	N/A

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Glossary

API	Application Programming Interface
CH	Central Hub
DARIAH	Digital Research Infrastructure for the Arts and Humanities
DASISH	Data Service Infrastructure for the Social Sciences and Humanities
DESIR	DARIAH ERIC Sustainability Refined
EHRI	European Holocaust Research Infrastructure
EOSC	European Open Science Cloud
JSON	JavaScript Object Notation
NN	National Nodes
REST	Representational State Transfer
RI	Research Infrastructure
SR	Service Registry
SIF	Service Integration Framework
SOA	Service Oriented Architecture
SSH	Social Science and the Humanities
SSHOC	Social Science and Humanities Open Cloud
TERESAH	Tools E-Registry for E-Social science, Arts and Humanities
VI-SEEM	VRE in Southeastern Europe and the Eastern Mediterranean
VRE	Virtual Research Environment
XML	eXtensible Markup Language

1. Introduction

To improve access to its infrastructure the EHRI-RI will incorporate a catalogue of services to assist users in finding and accessing its full range of offerings. Effective cataloguing of services was a requirement identified by the User Needs Survey presented in deliverable 5.1[1], and as the infrastructure transitions through the implementation phase into a distributed RI, the requirements for effective cataloguing of outputs and activities — which will in the future be more linguistically and geographically diverse — will become more important.

This catalogue, henceforth referred to as the EHRI-RI Service Registry (SR), will be developed with EHRI's user community in mind, encompassing academic researchers, collection holders, digital humanists, media professionals, educators and the general public. It is therefore distinct from a catalogue of *technical* services, or the means to facilitate automated service discovery, for which the term "Service Registry" is often used in technical contexts. Due to EHRI's humanities-based and subject-specific character, an EHRI-RI Service Registry will also require a somewhat distinct approach to those developed by infrastructures with considerably broader remits or intended to service a community of primarily technical stakeholders.

This deliverable discusses our approach to prototyping a registry for EHRI services that can be expanded and further developed in the EHRI-RI implementation phase and beyond. We discuss in section 2 how some other infrastructures have approached this problem, based on their specific requirements. In section 3 we describe our draft implementation, which leverages existing infrastructure in the EU research community, specifically the European Open Science Cloud (EOSC) Portal, as a "backend" powering our own EHRI-specific "frontend."

2. Review of existing tool & service registries

As previously mentioned, the term "Service Registry" has a range of different interpretations depending on the context. In the context of a Service Oriented Architecture (SOA), a style of software engineering in which systems are composed of numerous discrete, networked services as opposed to monolithic multifunctional components, it commonly refers to a discovery mechanism whereby individual services can dynamically look up binding information (such as IP address and port) of other services on which they depend, without this information being statically configured. At the other end of the scale the term can refer to something more like an app store or "marketplace": a catalogue of tools equipped with discovery mechanisms such as faceted search, reviews and ratings, and keyword indexing. For an excellent overview and comparison of various RI marketplace-style SRs see part 2 of the DESIR's D5.4 on the future DARIAH Marketplace (later to become the SSHOC Marketplace.)[2]

We have undertaken to review here two SRs developed by RIs which to some extent illustrate this variation without differing greatly in scope and scale: VI-SEEM and DASISH.

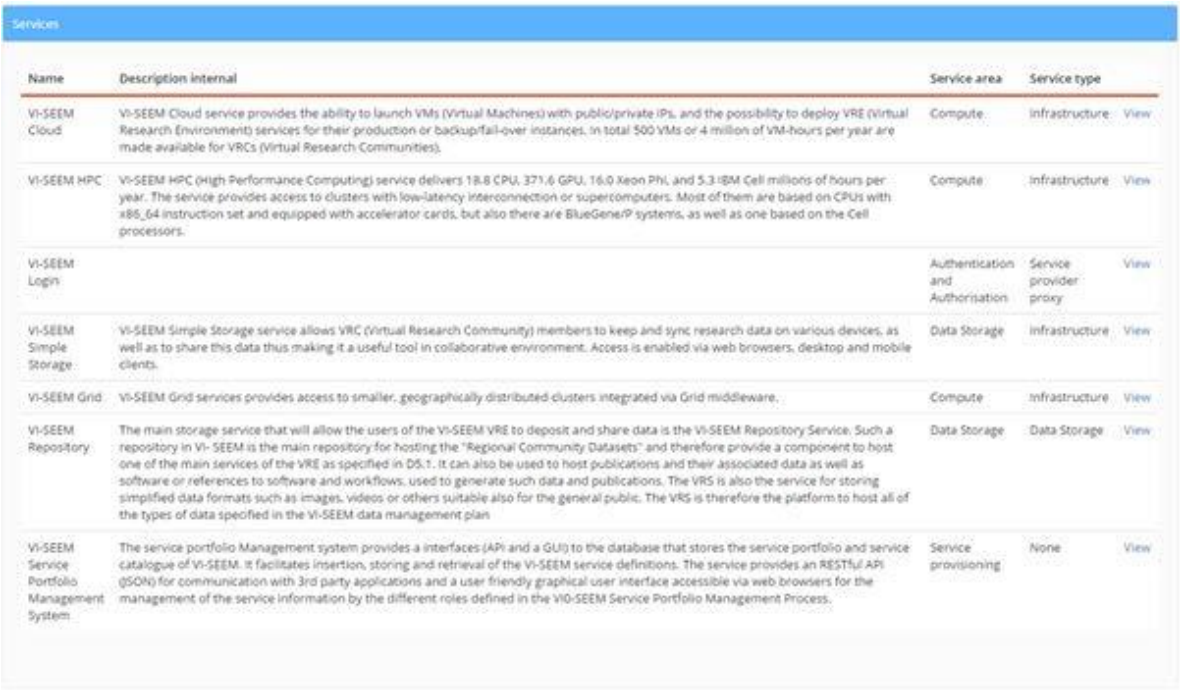
2.1. VI-SEEM

The VI-SEEM project is intended to facilitate regional interdisciplinary collaboration by building a Virtual Research Environment (VRE) targeted at Life Sciences, Climatology and Digital Cultural Heritage in Southern Europe and the Southeastern Mediterranean.

[1] D5.1 - User Needs Analysis.pdf (ehri-project.eu)

[2] https://dariah.openaire.eu/search/publication?articleId=r3c4b2081b22::28d0dbe3a811f13110e27bb6bb282cf2

In their deliverable 3.2 they describe their approach to building a Service Registry and monitoring infrastructure, with a focus on internal coordination and building-block services for technical stakeholders (e.g. storage and identity management.)[3]



Services

Name	Description internal	Service area	Service type	
VI-SEEM Cloud	VI-SEEM Cloud service provides the ability to launch VMs (Virtual Machines) with public/private IPs, and the possibility to deploy VRE (Virtual Research Environment) services for their production or backup/fail-over instances. In total 500 VMs or 4 million of VM-hours per year are made available for VRCs (Virtual Research Communities).	Compute	Infrastructure	View
VI-SEEM HPC	VI-SEEM HPC (High Performance Computing) service delivers 18.8 CPU, 371.6 GPU, 16.0 Xeon Phi, and 5.3 IBM Cell millions of hours per year. The service provides access to clusters with low-latency interconnection or supercomputers. Most of them are based on CPUs with x86_64 instruction set and equipped with accelerator cards, but also there are BlueGene/P systems, as well as one based on the Cell processors.	Compute	Infrastructure	View
VI-SEEM Login		Authentication and Authorisation	Service provider proxy	View
VI-SEEM Simple Storage	VI-SEEM Simple Storage service allows VRC (Virtual Research Community) members to keep and sync research data on various devices, as well as to share this data thus making it a useful tool in collaborative environment. Access is enabled via web browsers, desktop and mobile clients.	Data Storage	Infrastructure	View
VI-SEEM Grid	VI-SEEM Grid services provides access to smaller, geographically distributed clusters integrated via Grid middleware.	Compute	Infrastructure	View
VI-SEEM Repository	The main storage service that will allow the users of the VI-SEEM VRE to deposit and share data is the VI-SEEM Repository Service. Such a repository in VI- SEEM is the main repository for hosting the "Regional Community Datasets" and therefore provide a component to host one of the main services of the VRE as specified in D5.1. It can also be used to host publications and their associated data as well as software or references to software and workflows, used to generate such data and publications. The VRS is also the service for storing simplified data formats such as images, videos or others suitable also for the general public. The VRS is therefore the platform to host all of the types of data specified in the VI-SEEM data management plan	Data Storage	Data Storage	View
VI-SEEM Service Portfolio Management System	The service portfolio Management system provides a interfaces (API and a GUI) to the database that stores the service portfolio and service catalogue of VI-SEEM. It facilitates insertion, storing and retrieval of the VI-SEEM service definitions. The service provides an RESTful API (JSON) for communication with 3rd party applications and a user friendly graphical user interface accessible via web browsers for the management of the service information by the different roles defined in the VI0-SEEM Service Portfolio Management Process.	Service provisioning	None	View

Figure 1*: the VI-SEEM service catalogue application.*

VI-SEEM's prototype service catalogue (see Figure 1) is described as a web application written using the Django framework and backed by a MySQL database. Service metadata includes internal and external descriptions, a list of intended users, contact information, and links to various external documentation concerning usage and operation. The catalogue provides both a default web interface and an API, where services can be created or enumerated via JSON data in a REST-like manner. While VI-SEEM's catalogue incorporates information about service status, their approach to service monitoring builds on a distinct and separate set of technologies from the registry itself, including the open source monitoring application Nagios.[4]

2.2. DASISH

The DASISH project developed a tool registry called TERESAH (Tools E-Registry for E-Social science, Arts and Humanities) for cataloguing tools and services used by researchers in Social Science and Humanities (SSH) domains. It is now hosted by DARIAH EU[5] and currently lists 113 tools and 3 services encompassing a wide range of methods and applications (see Figure 2.)

[3] https://vi-seem.eu/wp-content/uploads/sites/10/2016/02/VI-SEEM-D3.2-Service-registry-operational-and-service-level-monitoring.pdf

[4] https://www.nagios.org/

[5] http://teresah.dariah.eu/

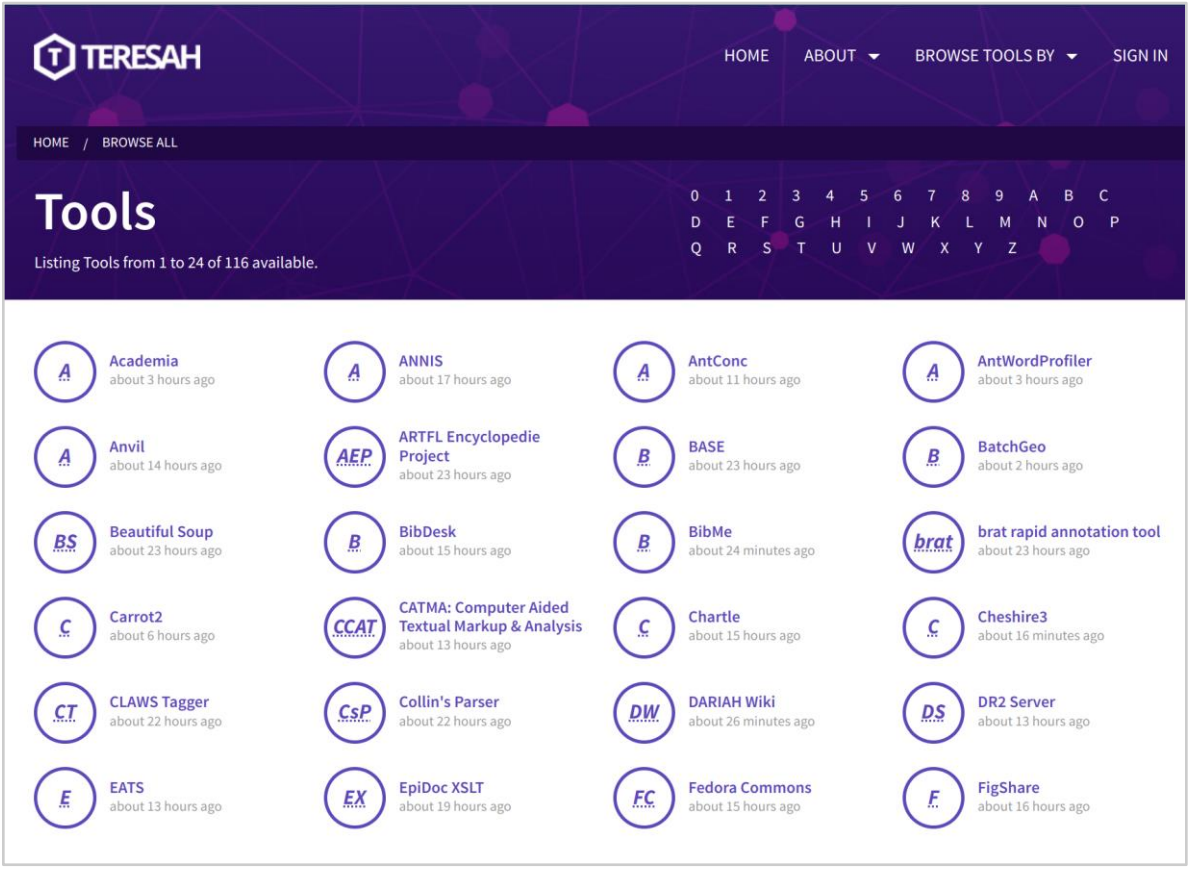


Figure 2*: TERESAH the tool (and service) registry developed for the DASISH project.*

TERESAH was designed and built specifically for DASISH and is available to download and run from source code via Github, licensed under the EUPL 1.1.[6] It is built on the Laravel PHP framework and requires a MySQL, PostgreSQL or SQL Server database.

Once installed, TERESAH offers an administrative interface for cataloguing tools and services, offering metadata such as the tool's creator, its licence, a general description and a URL for online access or download. The public user interface offers faceted search and browse functionality and the ability to discover tools via a similarity metric.

TERESAH also offers structured data access to its catalogue, with a REST-style API returning data in JSON format in addition to RDF support. RDF export is available for the catalogue as a whole or individual tools, and uses schema.org[7] as the descriptive ontology.

3. Approach and description

With its humanities orientation, subject-specific focus, and the particular scale which follows from these factors, EHRI's service registry requirements are necessarily quite distinct from infrastructures with wider, more generic remits or a basis in the physical sciences. While the EHRI-RI Central Hub will consist of a relatively broad range of technical services (APIs; see D7.4 for details[8]) the primary objective of the Service Registry prototype discussed here is to

[6] https://github.com/DASISH/TERESAH
[7] https://schema.org/
[8] https://www.ehri-project.eu/sites/default/files/downloads/Deliverables/D7.4%20-%20Technical%20Report.pdf

enhance discovery for EHRI's offerings for its primary user groups: academic researchers, educators, collection holders, and the general public.[9]

Because EHRI's focus has historically been, and is likely to remain as it transitions to the EHRI-ERIC, on a smaller number of high-quality resources, keeping track of these offerings is not immediately a problem of scale. There has been, however, a need to ensure that new offerings can be made visible and disseminated efficiently once they are ready for publication, and a need to ensure that they are integrated with appropriate monitoring and analytics systems in a timely manner.

Publicising the availability of new EHRI resources has hitherto been done through social media channels (Twitter and Facebook), via the EHRI Project website, and through dissemination by relevant partner institutions. While this approach has been sufficient for EHRI's offerings to date, the website content management system (CMS) is not ideally suited to serve as a catalogue, and restricted access to the CMS limits the manner in which updates can be made in a timely manner. As the EHRI-RI becomes more geographically distributed and National Nodes begin to publish their own resources, access to the Project website will be harder to coordinate and scale.

This same logic mitigated against the creation of a bespoke "static" website to serve as a resource catalogue. While this simple and straightforward approach would suffice for enumerating resources offered by EHRI in its project guise or later the Central Hub, it would become a burden to maintain with a more distributed infrastructure offering wider and more linguistically diverse resources.

A database-powered catalogue, that could be administered by multiple individuals in a distributed manner, was therefore considered to be the most future-proof approach to the creation of an EHRI Service Registry, even if the eventual number of resources to be managed would ultimately be relatively modest. As shown in section 2, other infrastructures have developed their own database-powered SR solutions tailored to their specific requirements, and these vary quite widely in characteristics and approach.

For EHRI-PP, however, either developing its own database-backed SR (or modifying an existing system for our own purposes), presented a considerable investment of staff and development resources that was difficult to justify when these resources would be diverted from EHRI's primary content-creation and cataloguing objectives. Moreover, managing and monitoring an additional system would require an ongoing commitment in IT resources into the future.

It is also worth noting that the SR prototyping described in this deliverable exists alongside other parallel efforts to make EHRI's services more discoverable and accessible, in addition to ongoing updates to the project website and social media channels. In EHRI-PP's sister project, EHRI-3, a task in WP10 (Thematic Layers) is exploring various methods of aggregating and visualising data from multiple EHRI services in a unified and coherent manner, and will, when finalised, serve as a "dashboard" providing additional entry points into the EHRI-RI data ecosystem. The dashboard, however, is not intended to encompass every EHRI-RI resource, and necessarily depends on a degree of API orchestration and integration that is only viable from a subset of services.[10]

3.1. EOSC Marketplace

Instead of building our own service database administration system, therefore, EHRI-PP has opted to instead leverage the existing infrastructure of the European Open Science Cloud (EOSC), specifically their Catalogue and Marketplace, with its accompanying APIs. EOSC is

[9] See D5.1: User Needs Analysis: https://www.ehri-project.eu/sites/default/files/downloads/D5.1%20-%20User%20Needs%20Analysis.pdf

[10] See EHRI-3 D10.2: Thematic Dashboards: https://www.ehri-project.eu/sites/default/files/downloads/Deliverables/D10.2%20-%20EHRI%20Thematic%20Dashboards.pdf

an environment for hosting and processing EU research data being run from 2021 under the Horizon Europe programme, and the Catalogue and Marketplace a component of the EOSC Portal, a platform for integration of information about research *resources* and resource *providers*. The EOSC Portal encompasses natural and social sciences as well as the humanities.

Within the EOSC Marketplace, providers can have hierarchical relationships and must either be, or belong to, a legal entity. At the time of writing, EHRI is therefore a provider in its own right, but has a relationship to KNAW NIOD, the controlling legal entity. This structure will likely be maintained as the EHRI project transitions to EHRI-ERIC, though it is anticipated that the EHRI EOSC provider will in future be denoted as a legal entity in its own right.

Figure 3 shows EHRI and NIOD registered as providers in the EOSC Marketplace dashboard.

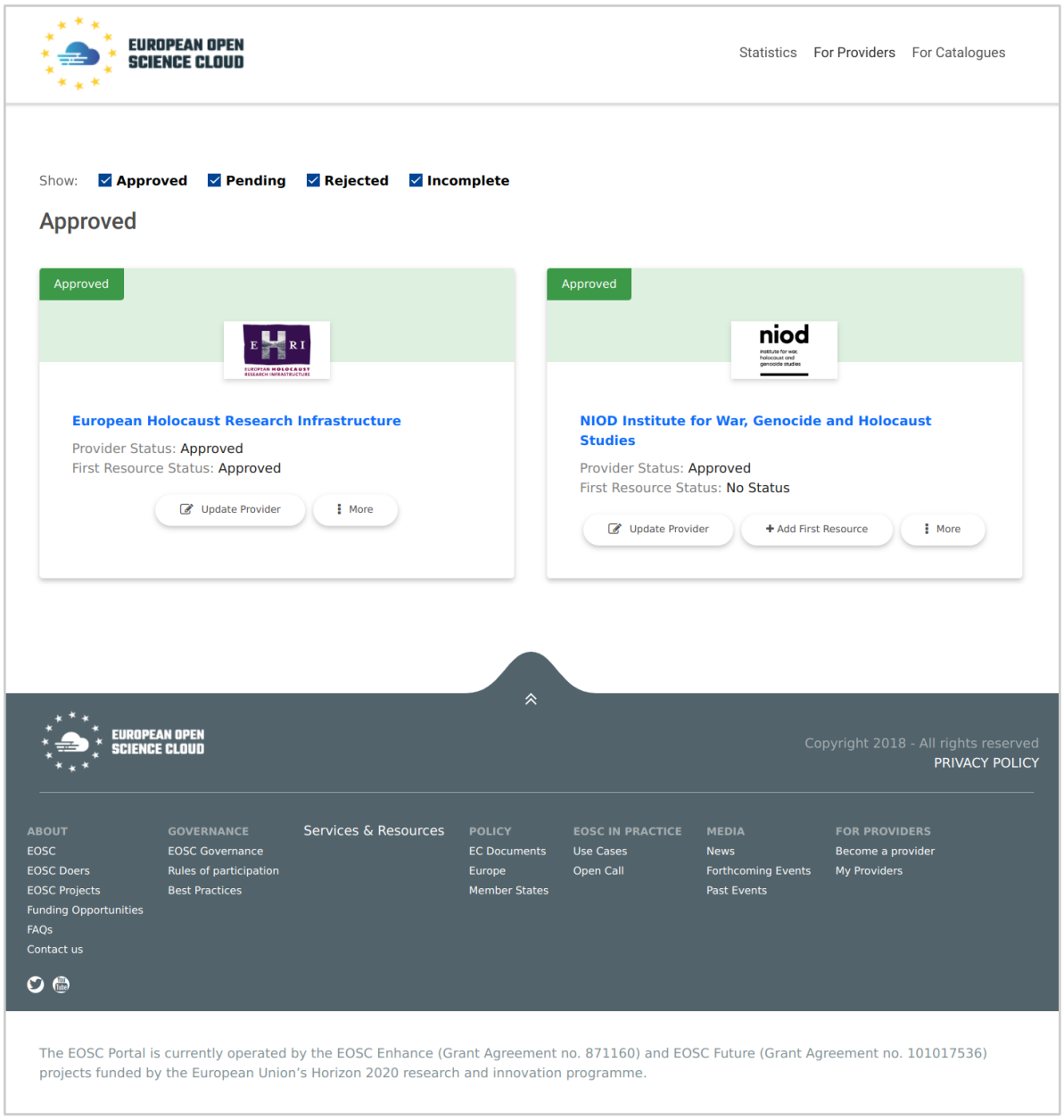


Figure 3 *EHRI and NIOD as providers registered in the EOSC Marketplace.*

3.2. Resource cataloguing

Once providers have been registered in the EOSC Marketplace, a process that requires an approval step by EOSC staff, resource records can be created. The resource creation process has 12 sections where information is requested:

Basic information

Identifying information for a resource, including its name, abbreviation (e.g. an acronym), and its web page URL. There is also the facility for listing additional providers, for cases where more than one may be relevant.

Marketing information

This section allows a textual description of the resource to be provided in Markdown format, which allows text formatting, links to external sites, embedded images and other formatting. A tagline, provides a short summary of the resource, and a link to a logo image are also required. Optionally, the provider may link to video resources and use-cases here as well.

Classification

This section provides a number of fields intended to facilitate resource discovery via index terms. These include:

- The scientific categorisation and sub-categorisation of the resource, which for EHRI we have used “Humanities” and “History and Archeology” respectively.
- The general category and subcategory, which varies for EHRI’s resources. For the EHRI Document Blog, as an example, we have used “Scholarly Communication” and “Writing” respectively.
- The target audience. As per D5.1, here we have entered EHRI’s intended user community, namely researchers, educators, media professionals and the general public.
- Access type and access mode: as discussed in D5.2 User Strategy and Access Policy these are, for the relevant online services, virtual (online) and free.[11] EHRI’s Conny Kristel Fellowship Programme is catalogued as in-person and free with conditions, since there are a limited number of places and acceptance criteria.
- Tags: an area where the provider can enter a set of keywords to facilitate search and discovery. These keywords are not restricted to any specific vocabulary or set of vocabularies and therefore are effectively free text. As described below, we have used them to provide an EHRI-specific categorisation of resources.

Availability

Lets the provider specify where, in a geographical sense, the resource is available — worldwide in EHRI’s case — and the languages in which it is offered. EHRI’s resources include content and descriptions in a very wide variety of languages, but we have restricted this field to the language or languages in which the resource’s user interface (where applicable) is available.

Location

An optional field where the provider can list the geographical locations where data resides. In EHRI’s case this would be Amsterdam and Frankfurt where its Data Centres are located, but we have omitted the field for resources currently catalogued.

[11] https://www.ehri-project.eu/sites/default/files/downloads/Deliverables/D5.2%20-%20User%20Stategy%20and%20Access%20Policies.pdf

Contact

Provides fields for the main contact (the resource administrator), public contacts, the provider Helpdesk, and a contact for security issues. For EHRI, the primary public contact listed here is the feedback address managed by the EHRI Helpdesk.

Maturity

The maturity section provides a mandatory field for selecting the ISO 16290:2013 Technological Readiness Level (TRL), a scale from 1 to 9 with 1 being the least technological maturity ("basic principals observed") and 9 being the most ("proven in operation").[12] In EHRI's case, many services are indeed proven in operation and thus granted TRL-9, but several others are prototypes (TRL-7) or demonstrators (TRL-6).

Other (optional) fields in the maturity section include the life cycle status (for e.g. if a system has been retired or is due for retirement), and fields for listing relevant certifications, standards, open-source technologies. Finally, there are fields for the current version of the service, its most recent update and for providing the URL to a change log. Since most EHRI services are continuously integrated, i.e. changes are deployed on a rolling basis rather than following granular versions, these fields have been omitted, since they would otherwise be quickly outdated (though in some cases the change log could direct the user to a Github commit log.)

Attribution

Provides three optional fields for the funding body, funding programme, and the grant or project name.

Management

The management section provides fields related to the resource usage, including links to the helpdesk, manual, terms of use, privacy policy and access policy. There is also a field for directing the user to a service status page, which as discussed in section 4 is a possible addition to the EHRI SR frontend. All management fields are optional.

Order

The order section is primarily relevant for detailing the process by which the resource can be obtained. As discussed previously, all EHRI resources are at present Fully Open Access, with the exception of the selective EHRI Fellowship programme.

Financial

Finally, the financial section details the payment and pricing models for the resource, and thus is not relevant for current EHRI services.

3.3. Tagging

One consequence of building on the EOSC Marketplace infrastructure is that EHRI's services are catalogued in a very broad context, spanning numerous domains across science, social science, and the humanities. A pertinent question was therefore how EHRI-RI internal service categorisations would map onto those of EOSC.

The EHRI-RI Central Hub will have a variety of different types of resources, including:

- Data portals (the EHRI Portal and Geospatial repository)
- Online scholarly editions (Begrenzte Flucht, Early Holocaust Testimony, Diplomatic Reports)

[12] https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

- APIs (OAI-PMH, GraphQL, Search)
- Special purpose websites (the Document Blog and project website)

To achieve this we have made use of the EOSC Marketplace's tags feature, which allows entry of any number of single word or multi-word tags per provider resource. Currently a small number of tags designates an EHRI-RI service as belonging to a particular category in the EHRI context, consisting of:

- Data Portal
- Blog
- Project
- Training
- Digital Edition
- Tool
- Prototype

These tags are subject to change if new types of EHRI services become available.

3.4. EOSC Provider Dashboard

Figure 4 shows a screenshot of EHRI's services as presented on the EOSC Portal providers dashboard. The dashboard grants providers administrative access to a range of additional information about their resources, including the number of visits it has had from users of the EOSC Portal, the number of ratings, and the number of times users have added it to a project (a feature that allows for user-specific resource collections.) Providers also have access to the change history of a resource's description in the portal.

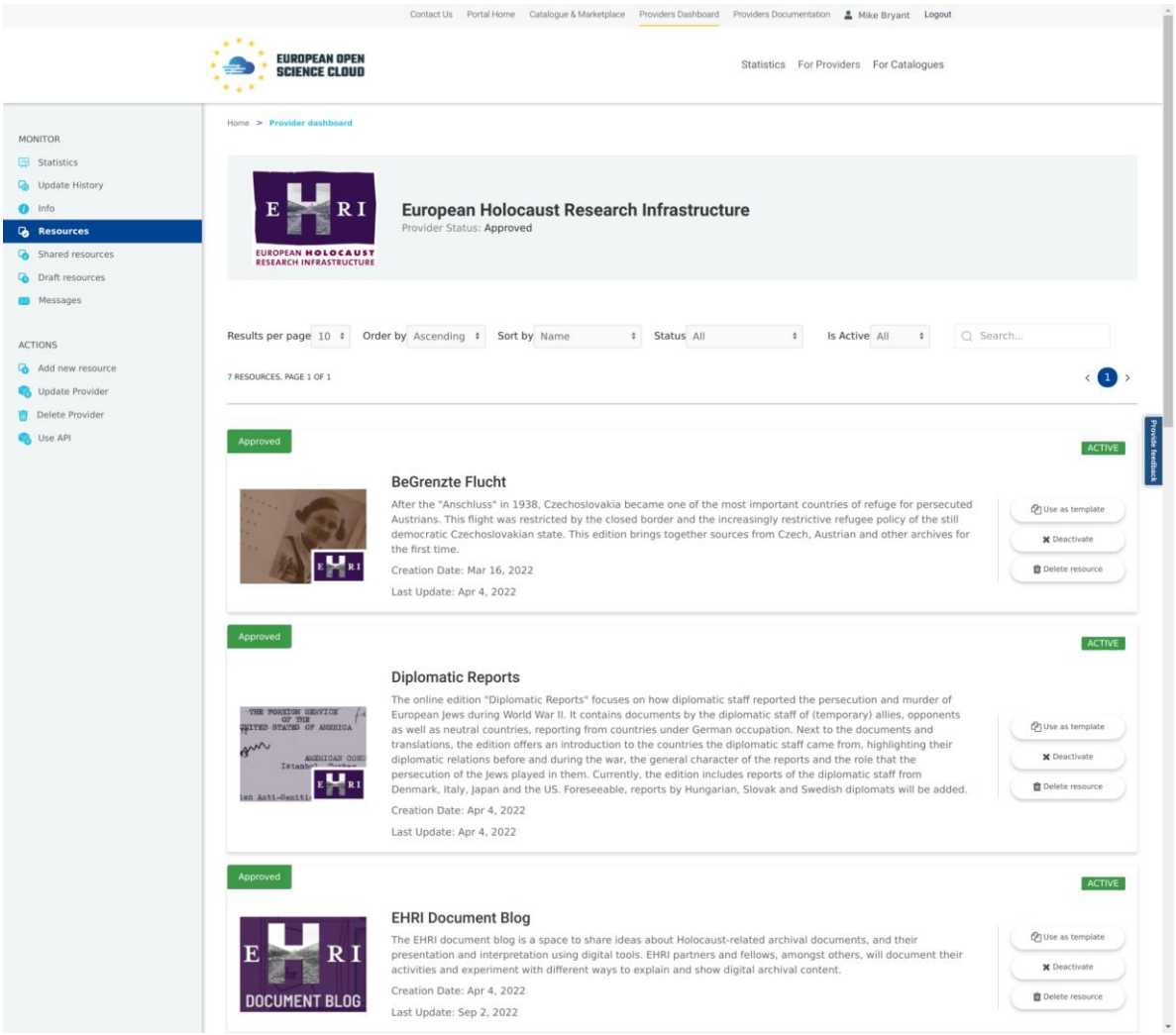


Figure 4*: the EHRI's services on the EOSC Marketplace.*

The EHRI services currently catalogued in the EOSC Portal are available to users at https://marketplace.eosc-portal.eu/services?providers=306.

3.5. EOSC Portal API

The EOSC Portal includes a REST-style API which facilitates programmatic access to a provider's resources as either XML or JSON data. The abbreviated example in Figure 5 shows the data retrieved when accessing the URL https://api.eosc-portal.eu/provider/services/ehri with the "Accept" header set to application/json:


```
[
  {
    "id": "ehri.the_ehri_portal",
    "abbreviation": "The EHRI Portal",
    "name": "The EHRI Portal",
    "resourceOrganisation": "ehri",
    "resourceProviders": [
      "ehri"
    ],
    "webpage": "https://portal.ehri-project.eu/",
    "description": "The EHRI portal offers access to information on Holocaust-
```

```
related archival material held in institutions across Europe and beyond. For more information on the EHRI project visit [https://www.ehri-project.eu](https://www.ehri-project.eu).",
    "tagline": "The EHRI portal offers access to information on Holocaust-related archival material held in institutions across Europe and beyond.",
    "logo": "https://www.ehri-project.eu/sites/all/themes/zenehri/images/logo.png",
    "multimedia": [
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        "multimediaName": "Multimedia 1"
      }
    ],
    "useCases": [],
    "scientificDomains": [
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        "scientificSubdomain": "scientific_subdomain-humanities-history_and_archaeology"
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        "subcategory": "subcategory-aggregators_and_integrators-aggregators_and_integrators-data"
      }
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      "Portal",
      "Holocaust",
      "Research",
      "Shoah",
      "Archives",
      "History",
      "Deportations",
      "Camps",
      "Ghettos"
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      "de",
      "pl"
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    "trl": "trl-9",
    "lifeCycleStatus": "life_cycle_status-operation",
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    ],
    "catalogueId": "eosc",
    "helpdeskPage": "https://portal.ehri-project.eu/contact",
    "userManual": "https://training.ehri-project.eu/unit/7-ehri-portal-manual",
    "termsOfUse": "https://portal.ehri-project.eu/terms",
    "privacyPolicy": "https://portal.ehri-project.eu/data-policy",
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    "order": null,
    "paymentModel": null,
    "pricing": null
  },
  ...
]
```


Figure 5*: Example EOSC Portal API response showing an (abbreviated) list of EHRI services.*

3.6. EOSC and SSHOC

The aforementioned Social Science and Humanities Open Cloud (SSHOC) project also incorporates a Marketplace component, cataloguing not only tools and services, but datasets and workflows as well, and is intended to serve as an “entrypoint” into the EOSC Portal Marketplace for Humanities data. Given that EHRI is a project rooted in the Humanities, SSHOC would arguably be a more appropriate “backend” for EHRI’s SR, since resources catalogued there would have increased visibility to humanities scholars, whilst still maintaining a link to EOSC and the wider EU research environment.

At the time this task was initiated, however, the SSHOC Marketplace was not yet launched, and details about aspects of the system such as the link to EOSC were difficult for this report’s authors to clarify satisfactorily. The EOSC Portal was therefore favoured as a service catalogue since it was fully operational and open to Humanities resources. In the intervening period, SSHOC’s Marketplace has launched with comparable cataloguing functionality to EOSC’s and, as a discipline-oriented catalogue, promises greater possibilities for enrichment and contextualisation. Since Humanities data from EOSC is intended to be automatically propagated to SSHOC we will in future explore how these discipline-oriented enrichment

possibilities could enhance the visibility and discoverability of EHRI's resources, and the potential advantages of cataloguing directly in the SSHOC Marketplace.

3.7. EHRI Frontend interface prototype

The EHRI Service Registry frontend (Figure 6) is a web application built using the VueJS framework. The application is relatively small in size, consisting of only a few hundred lines of TypeScript and HTML templates, and uses the same styling libraries as other EHRI websites in order to maintain visual consistency.

When loaded, the SR queries the EOSC Portal API for EHRI's resources and presents the information within a predetermined set of categories, using the tagging approach described above. Since it is presenting information about EHRI's services within the EHRI "context", less information is displayed about each resource than exists in the EOSC Portal, since it is not necessary to distinguish EHRI's resources from those of other providers. This information consists of the resource logo, its title, the "marketing" summary (which is rendered as Markdown text, and can thus incorporate styled text, links and embedded images), and the available languages. The SR frontend also provides a link to the resource as catalogued on the EOSC Marketplace, where the user can find more information suitable for the broader context.

At the time of writing, the EHRI SR prototype frontend is available at a testing URL (https://services.ehri-project-stage.eu/) but will when released be hosted on EHRI's primary domain. The code is available on Github.[13]

[13] https://github.com/EHRI/ehri-service-registry-client

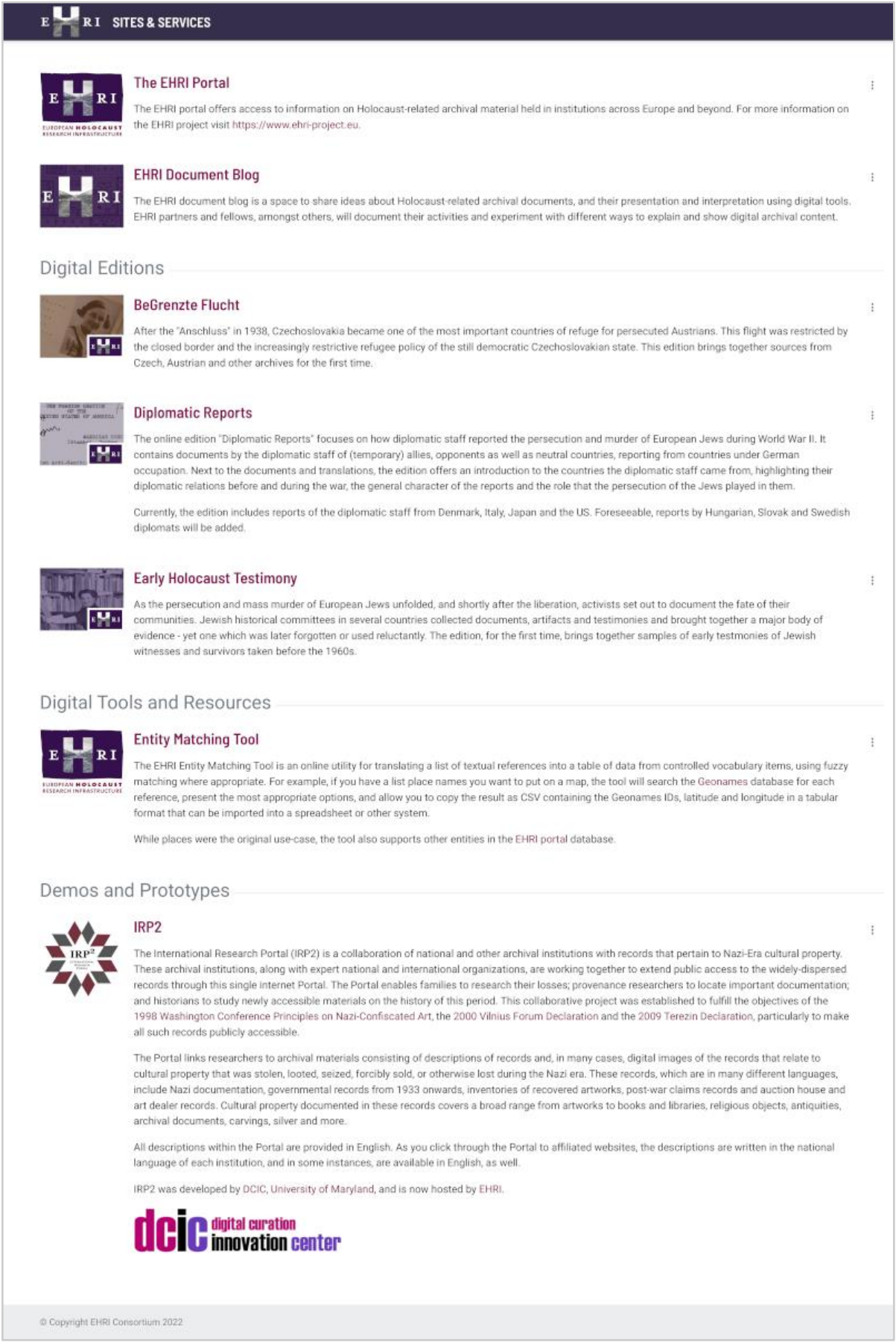

Figure 6*: Screenshot of the service registry prototype, generated from data from the EOSC*

Portal API.

3.8. Future frontend development

While the EHRI-RI Service Registry is available to use at the time of writing, we foresee further development adding a number of additional features when the EHRI-ERIC ecosystem achieves more maturity. These include:

3.8.1. Multiple provider support

As mentioned above, EHRI — in future the EHRI Central Hub — is currently registered as the provider of all EHRI's resources. In the EHRI-RI, however, National Nodes will expand the number of services available and in order to ensure visibility for these new services we anticipate that each National Node will register as its own provider in the EOSC Marketplace. The EHRI Service Registry, therefore, will need to be able and present information from multiple EOSC providers in a coherent manner.

3.8.2. Service monitoring status integration

For monitoring the health of its services EHRI currently employs a SaaS monitoring tool — Solarwinds Pingdom[14] — which provides uptime monitoring and email and/or SMS alerts in the event of unexpected outages. By integrating the Pingdom monitoring API with the Service Registry frontend it would be possible to inform users if a service was currently down for maintenance or otherwise experiencing an unplanned outage.

4. Summary

This deliverable has described the development of a prototype EHRI Service Registry, or catalogue of EHRI research resources, following an approach that can be further developed and scaled up to suit the future distributed RI. Although the SR is intended to incorporate only first-party resources and is thus not problematic in terms of scale, a distributed infrastructure makes managing a catalogue of services using a static website or CMS more challenging. At the same time, running a bespoke database-backed application, either from an existing open-source project or developed ourselves, was considered an excessive investment in IT resources.

We have therefore built our EHRI SR around the EOSC Portal's Catalogue and Marketplace and its accompanying API, augmented by a relatively simple EHRI-specific frontend. In future, EHRI-RI National Nodes will be able to register themselves as EOSC Portal providers in order to catalogue their own resources, which will be automatically listed in EHRI-RI's SR frontend. A secondary benefit of this approach is that EHRI's resources are discoverable via EOSC's infrastructure and more widely disseminated in the wider EU research context.

[14] https://www.pingdom.com/