# Table of Contents

1 INTRODUCTION .................................................................................................................. 6

1.1 ROHub Portal .................................................................................................................. 6

2 ROHUB PORTAL COMPONENTS ...................................................................................... 7

2.1 Visual components for non-authenticated users .............................................................. 7
  2.1.1 Basic search (keyword) ............................................................................................... 7
  2.1.2 Featured research objects ......................................................................................... 7
  2.1.3 Recent activity ........................................................................................................... 8
  2.1.4 Explore search (faceted) .......................................................................................... 8
  2.1.5 Activity search .......................................................................................................... 10
  2.1.6 People search ........................................................................................................... 12
  2.1.7 About details ............................................................................................................ 13
  2.1.8 RO manager ............................................................................................................ 16
  2.1.9 Sign-in and sign-up ................................................................................................... 25

2.2 Visual components for authenticated users .................................................................. 26
  2.2.1 Social components ................................................................................................... 26
  2.2.2 My ROs ................................................................................................................... 27
  2.2.3 Import/Export RO bundle ....................................................................................... 29
  2.2.4 RO manager ............................................................................................................ 29

3 ROHUB PORTAL USER GUIDE ....................................................................................... 34

3.1 How to search & discover research objects? ................................................................. 34

3.2 How to search & inspect activity stream in ROHub? .................................................... 36

3.3 How to inspect & visualize research objects? .............................................................. 38
  3.3.1 How to inspect & visualize the research objects indicators and metadata? ........... 38
  3.3.2 How to download the research object and/or its metadata? ................................. 41
  3.3.3 How to subscribe to the research object notification feed? ................................. 41
  3.3.4 How to import annotations in the research object? .............................................. 42
  3.3.5 How to navigate & visualize the research object contents? ................................. 42
  3.3.6 How to download individual resources? ................................................................. 45
  3.3.7 How to visualize & assess the research object quality? ........................................ 45
  3.3.8 How to visualize the research objects stability to assess preservation? ............... 47
  3.3.9 How to search, browse and visualize the research object activity? ....................... 48
  3.3.10 How to inspect & visualize the research object lifecycle? ................................. 49
  3.3.11 How to inspect & visualize the relations defined in the research object? ........... 50
  3.3.12 How to inspect & visualize the research object impact statistics? ....................... 50

3.4 How to create an account in ROHub? .......................................................... 51

3.5 How to Sign-in to ROHub? .......................................................... 52

3.6 How to create research objects? .......................................................... 53

3.7 How to manage research objects metadata? .................................................. 55

3.8 How to aggregate resources in the research object? ........................................... 58
### 3.9 How to manage resources metadata? ................................................................. 59
### 3.10 How to manage research objects relations? ....................................................... 61
### 3.11 How to aggregate an RO bundle? ................................................................. 62
### 3.12 How to manage research objects content? ......................................................... 63
### 3.13 How to manage research objects quality? ......................................................... 64
### 3.14 How to manage research objects lifecycle? ....................................................... 64
### 3.15 How to release a research object with a DOI? .................................................. 65
### 3.16 How to enable collaboration and manage research objects access control? ........ 66
### 3.17 How to comment and discuss over a research object/resource? ......................... 67
### 3.18 How to rate a research object? .................................................................... 68
### 3.19 How to mark a research object as favorite? ...................................................... 68
### 3.20 How to manage workflows in research objects? .............................................. 68
### 3.21 How to enrich automatically the research object annotations? ......................... 69

### Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Keyword search component</td>
<td>7</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Featured research objects component</td>
<td>8</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Recent activity component</td>
<td>8</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Faceted search results view component</td>
<td>9</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Faceted search filters list component</td>
<td>10</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Activity search results view component</td>
<td>11</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Activity search filters list component</td>
<td>12</td>
</tr>
<tr>
<td>Figure 8</td>
<td>People search component</td>
<td>13</td>
</tr>
<tr>
<td>Figure 9</td>
<td>About component - What is ROHub?</td>
<td>14</td>
</tr>
<tr>
<td>Figure 10</td>
<td>About component – News</td>
<td>15</td>
</tr>
<tr>
<td>Figure 11</td>
<td>About component - Team</td>
<td>16</td>
</tr>
<tr>
<td>Figure 12</td>
<td>RO overview basic view</td>
<td>18</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Geolocation popup window</td>
<td>19</td>
</tr>
</tbody>
</table>
Figure 61 RO impact (under development) .................................................................51
Figure 62 ROHub Sign-up ........................................................................................52
Figure 63 Everest Sign-up ........................................................................................52
Figure 64 Sign-in page ..............................................................................................53
Figure 65 Everest Sign-in .......................................................................................53
Figure 66 My ROs in menu bar ...............................................................................54
Figure 67 RO create buttons ...................................................................................54
Figure 68 Create RO dialog box ..............................................................................55
Figure 69 Create RO from ZIP ...............................................................................55
Figure 70 RO metadata management ......................................................................56
Figure 71 RO description field ...............................................................................57
Figure 72 Advanced RO metadata panel .................................................................57
Figure 73 Create RO annotation ............................................................................58
Figure 74 Aggregating RO resources .....................................................................58
Figure 75 Add resource - local file .........................................................................59
Figure 76 Add resource - Web resource .................................................................59
Figure 77 Resource metadata management ...........................................................60
Figure 78 Advanced resource metadata panel .......................................................61
Figure 79 Create resource annotation ...................................................................61
Figure 80 Managing RO relations .........................................................................61
Figure 81 Add new relations in RO ........................................................................62
Figure 82 Select resource in new RO relation ........................................................62
Figure 83 Aggregate an RO bundle ........................................................................63
Figure 84 create new folder ....................................................................................63
Figure 85 Selecting an RO resource .......................................................................63
Figure 86 RO resource actions ..............................................................................64
Figure 87 Managing RO lifecycle ..........................................................................65
Figure 88 Release a research object with a DOI .....................................................66
Figure 89 Setting RO access control ......................................................................66
Figure 90 Commenting an RO ................................................................................67
Figure 91 Reply to comment ..................................................................................67
Figure 92 RO social impact control (top right) .......................................................68
Figure 93 Rating an RO ..........................................................................................68
Figure 94 Managing workflows ............................................................................69
Figure 95 Annotate and transform workflow ........................................................69
Figure 96 Update semantic annotations .................................................................70
1 Introduction

ROHub\(^1\) is a research object management platform supporting the preservation and lifecycle management of scientific investigations, research campaigns and operational processes. As the only existing platform implementing natively the full research object model and paradigm, resources associated to a particular experiment are aggregated in a single digital entity (research object), and metadata relevant to understand and interpret the content is represented as semantic annotations that are user and machine readable.

ROHub can support different stakeholders, with the primary focus on scientists, researchers, students and enthusiasts, enabling them to manage and preserve their research work, to share it and make it available for publishing, to collaborate and to discover new knowledge. However, other user groups can be benefited by ROHub like the Industry that can leverage the platform to externalize their research to a community of researches worldwide in multiple scientific domains, e.g., launching campaigns for research on specific topics, and the follow and monitor the progress. Similarly, investors can keep up to date and track scientific advances to fund and get involved in future breakthroughs. As another example, publishers can also leverage ROHub to advertise their journals with researchers, have access to a pool of potential reviewers, and implement more interactive, review processes.

1.1 ROHub Portal

ROHub portal is a Web client application providing a comprehensive user interface for the management and preservation of research objects (ROs).

ROHub portal integrates and provides access to different research object services, including:

- The core RO backend services, provided by RODL component, enabling the creation, storage, maintenance and access to research objects, the management of their lifecycle, and their preservation.
- RO notification service, enabling the subscription to events related to a particular research object (e.g., changes in content or quality), or to the portal itself (e.g., when new ROs are created).
- WF-RO transformation service, enabling the transformation of workflows into research objects, and the exposure of the annotations and resources embedded in the workflow according to the RO model.
- RO checklists service, providing remote access to the minim-based evaluation of research objects, used to test for completeness, runnable or repeatability.
- RO stability service, enabling the evaluation of the RO through time by capturing concrete values provided by the checklist service in different moments of its evolution. It allows testing the ability of a research object to achieve its original purpose after being subject of changes on its resources.
- RO monitoring tool, providing an interface to visually monitor and keep track of the status of external datasets and web services required for workflow execution. It’s based on the stability service.
- RO collaboration spheres, providing an interface for the discovery of research objects that are similar or related to the selected research object or scientist.

[^1]: \url{http://www.rohub.org/}
• RO enrichment service, which generates automatically semantic annotations based on the (textual) resources aggregated in order to improve the discoverability and searchability of research objects.

Additionally, the portal provides interfaces for access control and user management, which are also part of the core services implemented by ROHub backend.

## 2 ROHub Portal components

The ROHub portal has been implemented as a set of visual components. This section describes each of these components and provides a graphical depiction of its implementation in the portal.

### 2.1 Visual components for non-authenticated users

#### 2.1.1 Basic search (keyword)

This component enables to find research object by keywords (Figure 1), looking through all the metadata annotations available, e.g., title, description, creator, etc. and optionally by selecting the research area related to the investigation encapsulated.

![Figure 1 Keyword search component](Image)

#### 2.1.2 Featured research objects

This component presents the list of ROs that are promoted because of their quality (measured based on the RO compliance according to some specified criteria like completeness) or because of their popularity (e.g., golden exemplars) as depicted in Figure 2.
2.1.3 Recent activity
This component presents the latest three ROs that were created, resourced added to research objects, snapshots and archives (Figure 3).

2.1.4 Explore search (faceted)
This component enables users to browse and navigate the research objects collection organizing the objects according to their associated semantic properties and allowing users to discover the objects by applying multiple filters. This component comprises two sub-components:

- Faceted search results view (Figure 4): contains the results list view, which enables the visualization of the results in different formats. The user may choose between default grid and list view. In both views the same information about ROs is presented.
- Faceted search filters list (Figure 5): contains all filters for searching through RO collection,
including the research object related research area, its type, creators, status, content and others. Categories for content filter are generated automatically by the Semantic Enrichment Service, see 2.4 for more details.

Figure 4 Faceted search results view component
2.1.5 Activity search

The activities component summarizes and presents activities conducted by all the users on all research objects available in ROHub. The list view shows when the activity took place, on what kind of object, short summary of the activity and user name who performed the activity. More detailed description of the actions and resources involved in particular activity is given in the activity extended view. This component comprises two sub-components:

- Activity search results view (Figure 6): contains the resulting list of the activities found with the specified filters
- Activity search filters list (Figure 7): contains all filters for searching through the activities collection, including the activity and resource type, research area, activity date, and responsible creator.
<table>
<thead>
<tr>
<th>Date</th>
<th>Object type</th>
<th>Title</th>
<th>Uploader</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object 04092017-fork has been deleted by</td>
<td>Marcin Berendt</td>
</tr>
<tr>
<td>21:26</td>
<td></td>
<td>Marcin Berendt</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object 04092017-fork has been deleted by</td>
<td>Marcin Berendt</td>
</tr>
<tr>
<td>21:25</td>
<td></td>
<td>Marcin Berendt</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>research_obj</td>
<td>Research Object Archive Colli_Albani_InSAR_1992_2010-release has been</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:24</td>
<td>ect_ar...</td>
<td>created by</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A new Research Object Archive has been created.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Research Object Archive URI is <a href="http://sandbox.rohub.org/rodliROs/">http://sandbox.rohub.org/rodliROs/</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colli_Albani_InSAR_1992_2010-release/</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>20:24</td>
<td></td>
<td>Colli_Albani_InSAR_1992_2010-release has been</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>added to the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>resource</td>
<td>A resource 03e76565-5bc7-4edc-95db-8770d43a73a.rdf has been added to</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>20:23</td>
<td></td>
<td>the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:23</td>
<td></td>
<td>Colli_Albani_InSAR_1992_2010-release has been</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>added to the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>research_obj</td>
<td>Research Object Archive Colli_Albani_InSAR_1992_2010-release has been</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:12</td>
<td>ect_ar...</td>
<td>created by</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A resource 03x97e0-0299-4202-a1de-935b4c2d931.rdf has been</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>added to the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:12</td>
<td></td>
<td>Colli_Albani_InSAR_1992_2010 has been updated</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:12</td>
<td></td>
<td>Colli_Albani_InSAR_1992_2010 has been created</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>resource</td>
<td>A resource 03xa97e0-0299-4202-a1de-935b4c2d931.rdf has been added to</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:12</td>
<td></td>
<td>the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for Research Object</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:12</td>
<td></td>
<td>Colli_Albani_InSAR_1992_2010 has been created</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>resource</td>
<td>A resource bf1c019f-f74a-4d88-90a0-3b0f1f48f8166bx.rdf has been added</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:12</td>
<td></td>
<td>to the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for resource DSC-300-disp-R16.dat has been created by</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:09</td>
<td></td>
<td>Elisa Trasatti</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>resource</td>
<td>A resource df45787e-be79-4e3-a014-8827817f366.rdf has been added to</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:09</td>
<td></td>
<td>the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for resource ASC-300-disp-R16.dat has been created by</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:08</td>
<td></td>
<td>Elisa Trasatti</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>resource</td>
<td>A resource 8c3965ec-5dec-4c5c-923c-f85f4977c79.rdf has been added to</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:08</td>
<td></td>
<td>the Research</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>annotation</td>
<td>An annotation for resource Table_1_EPS_ENVISAT_Data.xls has been</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:06</td>
<td></td>
<td>created by Elisa</td>
<td></td>
</tr>
<tr>
<td>23 October 2017,</td>
<td>resource</td>
<td>A resource f3153199-ae2c-4294-94e9-4c6e203c98b5.rdf has been added to</td>
<td>Elisa Trasatti</td>
</tr>
<tr>
<td>20:06</td>
<td></td>
<td>the Research</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6 Activity search results view component
2.1.6 People search

The people search component provides a simple interface to search among all the people that have an account in ROHub (creators, contributors). People are sorted by last name. The panel provides shortcuts to the alphabet letters, which upon selection, displays only people with last names starting with that letter. Currently, on clicking on a person name, the research objects created by this person are presented in the explore page. In the future, this will lead to the person profile page, currently under development.
2.1.7 About details

This component provides information about ROHub, including a short introduction to the system (What is ROHub? - Figure 9), to the research objects (What is Research Object?), news about or related to ROHub (Figure 10), showcases (under construction), publications, the ROHub team (Figure 11) and contact information.
About component - What is ROHub?

What is ROHub?

Research object management platform supporting the preservation and lifecycle management of scientific investigations, research campaigns and operational processes. As the only existing platform implementing natively the full research object model and paradigm, resources associated to a particular experiment are aggregated in a single digital entity (research object), and metadata relevant to understand and interpret the content is represented as semantic annotations that are user and machine readable.

ROHub can support different stakeholders, with the primary focus on scientists, researchers, students and enthusiasts, enabling them to manage and preserve their research work, to share it and make it available for publishing, to collaborate and to discover new knowledge. However, other user groups can be benefited by ROHub like the industry that can leverage the platform to externalize their research to a community of researches worldwide in multiple scientific domains, e.g., launching campaigns for research on specific topics, and the fellows and monitor the progress. Similarly, investors can keep up to date and track scientific advances to fund and get involved in future breakthroughs. As another example, publishers can also leverage ROHub to advertise their journals with researchers, have access to a pool of potential reviewers, and implement more interactive, review processes.

ROHub comprises both a back-end service, exposing a set of RESTful APIs implementing the RO model to support programmatically access to the provided functionalities, and a reference Web application exposing all the research object functionalities to the end-users. The full specification of all the APIs is publicly available at [GitHub](https://github.com). Note, however, that the back-end can support multiple client applications; some existing applications using ROHub include [alphal/myexperiment], [RO Manager](https://ropack.io), [cloud resource](https://ropack.io), and [VRC](https://ropack.io).

Internally, ROHub backed has a modular structure that comprises access components, long-term preservation components and the controller that manages the flow of data. For more information please refer to [publications](https://ropack.io). The system is released as Open Source with MIT license. The source code is available at [GitHub](https://github.com).

Figure 9 About component - What is ROHub?
Figure 10 About component – News

ROHub portal v0.9.0 (29 January 2018, 13:00)
ROHub portal v0.9.0 has been released. This release includes new social features enabling users to comment on ROs and their resources and to like/dislike comments. It also includes improvements on the RO content browser with further improved loading time, and minor fixes.

Show more

ROHub portal v0.8.4 (08 December 2017, 13:00)
ROHub portal v0.8.4 has been released. This release provides a much faster user experience in ROHub, supports the annotation of external workflows, and includes several improvements on the user interface along with some minor bug fixes.

Show more

ROHub presentation on the eScience 2017 conference (31 October 2017, 13:00)
ROHub was presented at the eScience 2017 conference that took place in Auckland New Zealand, 24-27 October 2017. The team of collaborators presented the paper “Towards a Human-Machine Scientific Partnership Based on Semantically Rich Research Objects” during the session of Repositories in the main conference, and presented four posters during the poster session. The results presented showed different research objects created in ROHub platform. Additionally, the main paper has been published as research object itself, comprising all the materials used and produced during the course of the research work that led to the results presented. See this Research Object at: http://oro.open.ac.uk/60407

Show more

Revamped ROHub portal has been officially released (v0.8.0) (24 October 2017, 14:00)
The completely renovated ROHub portal includes a new and modern design, improved performance, plus a set of new features focused on improving the user experience. Some of the key features in the current release include: the activity search page to find and inspect events related to the research objects and/or resources; the about section with information about ROHub, Research Objects, News, Publications and the team behind, and informative box for research objects in the featured ROs section, and in the search results; a totally new presentation of the research object overview that includes ...

Show more

ROHub will be presented on the eScience 2017 conference (16 October 2017, 14:00)
ROHub will be presented at the eScience 2017 conference, to be held in Auckland New Zealand, 24-27 October 2017, where the team collaborators have recently published a full paper plus three poster papers. The full paper, titled "Towards a Human-Machine Scientific Partnership Based on Semantically Rich Research Objects", deals with the semantic enrichment of research objects with semantic metadata extracted from research object content through a combination of Natural Language Processing, Semantic technologies and Machine Learning.

Show more
2.1.8 RO manager

2.1.8.1 RO overview
This component displays the RO information/metadata and enables to manipulate the research object.
It comprises two sections: the RO overview basic section, and the RO advanced metadata view section.

- **RO overview section** provides a summary of the RO information. This is the main entry point to the research object and consists of three sub-components (see Figure 12):
  
  o **Summary of the RO statistics**: including the number of views, downloads, resources, annotations, activity events, forks, snapshots/archives, as well as the RO quality score, and the research object size.
  o **The key metadata information**, including the title, description, research area, research object type, sketch and others. Some especially relevant metadata elements include the geospatial information associated to the research object that can be displayed in a map popup window (Figure 13), the sketch picture that can be opened in its original size when clicked, and the annotations added automatically by the semantic enrichment service.
  o **An action toolbar on the right side**, that allows the user to download the research object, or its metadata; to get the research object atom feed that can be used to subscribe to the research object notifications; manage the research object evolution if the user is allowed (e.g., to create snapshots, archives, or fork the research object); manage the research object annotations if the user is allowed (e.g., to update the annotations from the semantic enrichment service, import an annotation body, or display the advanced annotation view – see below)

- **RO advanced metadata view section**, which appear after selecting "show annotations" at the end of the overview panel. It provides the complete list of metadata annotations related to the RO, in a view targeted for advanced users (see Figure 14)
Figure 12 RO overview basic view
Figure 13 Geolocation popup window

Figure 14 RO advanced view
2.1.8.2 RO content

This component displays the RO aggregated resources, enabling browsing and navigation. When a resource is selected, its metadata information is displayed, including its URI for download.

It comprises three sections:

- First, the navigation section for traversing the RO content (Figure 15) (e.g., size or number of resources in a folder, creation time, creator), as well as for performing actions on these resources if the user is allowed, such as download and edition (see Section 3).
- Second, the resource details section, which appears after the user selects (or click on) a resource in the navigation panel. It shows basic resource metadata: title, URI, creation date, author and others.
- Third, the advanced metadata view section (Figure 17), which appears after selecting "show annotations" button in resource details panel. This component shows the complete list of metadata annotations related to the RO, in a view targeted for advanced users.

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
<th>Created</th>
<th>Creator</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Suitability Model_1D2D</td>
<td>183.0 KB</td>
<td>27 September 2016, 02:19</td>
<td><a href="http://fogliki.jivejournal.com/">http://fogliki.jivejournal.com/</a></td>
<td>--</td>
</tr>
<tr>
<td>Select_File-5de06f6914407e8b84b2341f.56</td>
<td>16.6 KB</td>
<td>14 April 2016, 21:48</td>
<td><a href="http://fogliki.jivejournal.com/">http://fogliki.jivejournal.com/</a></td>
<td>--</td>
</tr>
<tr>
<td>Workflow_WPS_2z2flo</td>
<td>241 KB</td>
<td>27 September 2016, 02:08</td>
<td><a href="http://fogliki.jivejournal.com/">http://fogliki.jivejournal.com/</a></td>
<td>--</td>
</tr>
<tr>
<td>Workflow_epi_flow</td>
<td>24.8 KB</td>
<td>27 September 2016, 02:08</td>
<td><a href="http://fogliki.jivejournal.com/">http://fogliki.jivejournal.com/</a></td>
<td>--</td>
</tr>
</tbody>
</table>

Figure 15 Resource navigation component
<table>
<thead>
<tr>
<th>Title</th>
<th>ArcGIS WPS in Taverna 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL</td>
<td><a href="http://swfbox.rchub.org/vid4/ROs/SeaMonitoring01/Workflow_slopecb_2.0flow">http://swfbox.rchub.org/vid4/ROs/SeaMonitoring01/Workflow_slopecb_2.0flow</a></td>
</tr>
<tr>
<td>Size</td>
<td>2.540 MB</td>
</tr>
<tr>
<td>Created on</td>
<td>27 September 2016, 02:08</td>
</tr>
<tr>
<td>Creator</td>
<td><a href="http://ffloggi.livejournal.com/">http://ffloggi.livejournal.com/</a></td>
</tr>
<tr>
<td>Description</td>
<td>Second attempt to use a WPS made in ArcGIS in a Taverna workflow. The WPS is very simple, one input, one process and one result. The workflow doesn't work.</td>
</tr>
<tr>
<td>Image</td>
<td>Not set</td>
</tr>
</tbody>
</table>

**Figure 16 Resource details - basic annotations view component**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Date</th>
<th>Creator</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://parallel.patterns/arcgis">http://parallel.patterns/arcgis</a></td>
<td>Second attempt to use a WPS made in ArcGIS in a Taverna workflow. The WPS is very simple, one input, one process and one result.</td>
<td>27 September 2016, 02:10</td>
<td><a href="http://ffloggi.livejournal.com/">http://ffloggi.livejournal.com/</a></td>
</tr>
<tr>
<td><a href="http://parallel.patterns/arcgis">http://parallel.patterns/arcgis</a></td>
<td>Second attempt to use a WPS made in ArcGIS in a Taverna workflow. The WPS is very simple, one input, one process and one result.</td>
<td>27 September 2016, 02:10</td>
<td><a href="http://ffloggi.livejournal.com/">http://ffloggi.livejournal.com/</a></td>
</tr>
<tr>
<td><a href="http://parallel.patterns/arcgis">http://parallel.patterns/arcgis</a></td>
<td>Second attempt to use a WPS made in ArcGIS in a Taverna workflow. The WPS is very simple, one input, one process and one result.</td>
<td>27 September 2016, 02:10</td>
<td><a href="http://ffloggi.livejournal.com/">http://ffloggi.livejournal.com/</a></td>
</tr>
<tr>
<td><a href="http://parallel.patterns/arcgis">http://parallel.patterns/arcgis</a></td>
<td>This workflow doesn't work.</td>
<td>27 September 2016, 02:10</td>
<td><a href="http://ffloggi.livejournal.com/">http://ffloggi.livejournal.com/</a></td>
</tr>
</tbody>
</table>

**Figure 17 Resource details - advanced annotations view component**
2.1.8.3 RO quality
This component enables users to assess the RO quality according to some predefined quality criteria (e.g., completeness) (Figure 18). This component interacts with the quality checklist service to get the results. Additionally, this component enables to open the RO monitoring tool to assess the RO quality through time.

![Figure 18 RO quality component](image)

2.1.8.4 RO activity
This component (Figure 19), a specialization of the activity search component, presents a list of notifications that were generated by the system regarding the activity of the selected RO
(e.g., changes in the RO content, modification of resources, and their associated metadata, including comments) and quality (e.g., changes in the completeness, stability and reliability). It is possible to narrow down the list of activities by applying filters. Currently available filters allow to search for activities that has occurred in specific time or involves specific users.

2.1.8.5 RO life cycle
This component displays the RO evolution (Figure 20), including the snapshots, forks, and if completed the archive (release), generated for the RO throughout time. It comprises two sections: the lifecycle chart on the left, and the changes panel on the right.

- The lifecycle chart provides a graphical representation of the related RO snapshots/forks/archive in a similar way like source control systems (to be released)
- The changes panel, which is displayed after clicking on any “diff” in the chart. It shows the list of changes corresponding to the difference between the two immutable objects (snapshots/archives). It can be filtered to show only additions, removal or modifications.
2.1.8.6 RO relations

The component enables to visualize relations between two resources: the first one must be the selected research object or an aggregated resource, while the second could also be an external resource (Figure 21).

2.1.8.7 RO impact

This component, currently under development, consists of three sections (Figure 22).

- The top section presents the statistics related to research object impact, including the number of views, downloads, resources and a graph of the activity through time.
- The middle section displays the details and links of the research object(s) and other (external) referenced by the current research object.
- Finally, the section at the bottom displays the research object(s) and other (external) that reference (or cite) the current research object. The format used for displaying references is similar to a standard citation.
2.1.9 Sign-in and sign-up

The sign-in component allows user to specify its username and password or to choose an OpenID provider for the authentication purpose (Figure 23). ROHub portal is integrated with the EVER-EST single sign on infrastructure, but support for other identity providers is under way. The sign-up component will allow users to create an account in ROHub if they don't use any OpenID provider (Figure 24). At the moment, only EVER-EST account are supported, so the user is redirected to the create account page in EVER-EST identity provider.
2.2 Visual components for authenticated users

2.2.1 Social components

2.2.1.1 Comments (discussions)
This component allows users of the ROHub platform to interact with each other by exchanging short messages related to the whole RO or to the individual resources aggregated. A discussion in comments may become a valuable source of information about RO quality and future RO development directions. The same component is available throughout the whole portal (Figure 25). The number of comments related to the research object is displayed in the RO social component at the top right in the RO overview panel (see Figure 26).
Through this component, authenticated users can
- add comments, edit/remove their comments
- reply to comments
- like or dislike comments
2.2.1.2 Rating
The RO social component displays the average rating of the research object, in a scale from 1
to 5 stars, as well as the number of rating votes (Figure 26). The component also allows
authenticated users to rate the RO, by selecting the number of stars to give.

2.2.1.3 Favorites
The RO social component also displays the number of times the research object has been
favorited (number next to the blue heart - Figure 26) and allows authenticated users to mark
the research object as favorite (clicking the empty blue heart), or to remove it from their
favorites later on (clicking the full blue heart).

2.2.2 My ROs
This component provides a view of all research objects that were created by the logged user
(Figure 27).
2.2.2.1 Create RO
Supporting user in creating research object is one of the main purposes of ROHub portal, which provides different methods for performing this operation (Figure 28). The most common scenarios of creating RO are:

- From scratch, the user creates an empty RO specifying its ID and optionally some basic metadata and an initial skeleton for organizing resources. Adding additional RO metadata and resources should be done using other UI components.
- From a zip upload, if the user already has a set of resources as basis for the RO, they can be collected in the form of a zip file and upload it to ROHub to create an RO aggregating these resources.

In the future, a wizard will provide the user with a step by step approach of creating RO. The user will fill in a set of simple forms, providing metadata information about the RO, initial content and structure for organizing resources.

After finishing the creation process, the user may use other UI components to manage RO resources.

2.2.2.2 Delete RO
A simple UI component that allows user to remove existing RO from the ROHub. It is available in the list of results from the My ROs component (Figure 29).
2.2.3 Import/Export RO bundle
An RO bundle is a special file format designed for distributing research objects. The existing RO may be exported from the ROHub or imported into it using Import/Export RO Bundle component. Currently this functionality is available only to import an RO bundle inside another research object as another resource (see resources manager), automatically extracting the resources and creating a nested research object.

2.2.4 RO manager
2.2.4.1 RO overview manager
The RO overview manager should be considered as a collection of other components grouped together in one place in order to provide user access to the most important functionality, such as add/remove/edit RO metadata (annotations). These functionalities are available from the RO overview component, in the RO basic view (see Figure 30) and the RO advanced view sections (see Figure 31).
Figure 30 RO overview basic view manager

Figure 31 RO advanced view manager
2.2.4.2  RO evolution manager
This component allows user to generate snapshots, forks or archiving the RO. This component is available from the action toolbar in the RO overview.

![RO evolution manager](image)

**Figure 32 RO evolution manager**

2.2.4.3  RO content annotations update
Although the annotations generated by the semantic enrichment service are updated automatically for new and modified research objects every day, the user is able to force manually an immediate update of these annotations (e.g., after making some changes in the research object) from the RO actions toolbar (Figure 33).
2.2.4.4 Import annotations File (bulk update)
To simplify the process of annotating RO user may upload a set of RO annotations at once. The annotations are read from the uploaded file and added to the selected RO or to the selected resource in the RO. The component is currently only available at the RO level (from the actions toolbar as depicted in Figure 33).

2.2.4.5 RO content manager
This component is a collection of functionalities for the management of resources. By using this component user may:
- Add/remove/edit/move resources and folders (Figure 34).
- Add/remove/edit resources metadata, both from the resource details section (Figure 35) and in the advanced metadata view section (Figure 36).
2.2.4.6 RO relations manager

The RO relations manager allows users to define and manage relations between RO resources. It provides a set of predefined relations that the users can assign to associate two resources. The source resource from the relation should be a resource of the selected research object (or the research object itself), and the target resource from the relation can be either another resource of the selected research object or an external resource (see Figure 37).
2.2.4.7 RO access control

The access control component gives the user the ability to manage the access rights of his research objects (Figure 38). The owner of the RO may change RO visibility status to: private (only users with permissions can read/write); public (any authenticated user can read, only users with permissions can write); or open (any authenticated user can read/write). This component also allows the RO owner to set read/write permissions to any other user of the ROHub platform. At the moment of writing this component still requires further development.

3 ROHub Portal user guide

3.1 How to search & discover research objects?

Users can search & discover ROs by keywords, by filtering their metadata, or by using the more advanced exploratory interface provided by the collaboration spheres (described in a different document).

Keyword-based search

1) Find the keyword search component in the home page, or at the top of every page in ROHub, and type the keyword(s) you are looking for:
   a. The input keywords will be searched within all the available metadata annotations associated to the RO, e.g., title, description, creators, etc. This will also look inside the annotations created automatically by the RO enrichment service.

2) The RO matching the keyword search criteria will be displayed in the Faceted Search Results List (see Figure 41)
Metadata-based search (faceted)

1) Go to the Explore page, selecting the option from the menu bar (see Figure 40).

![Figure 40 Faceted search in menu bar](image)

2) In the faceted filters list (left of Figure 41) select the search criteria for searching and discovering ROs. The available criteria include:
   a. Research area: the research area associated to the research object
   b. Creator: name of the person creating the research object
   c. Creation date: date the research object was created
   d. Type: the type of the research object (e.g., workflow-centric, data-centric, etc.)
   e. State: the lifecycle state of the research object (i.e., live, snapshot, archive, fork)
   f. Quality: the minimum quality of the research object (according to the associated checklist)
   g. Content: semantic annotations automatically extracted from the research object. These include: discipline, topic, frequent expressions, names of person, places and organizations.
   h. Metrics: number of resources, annotations or citations to the research object.
   i. Access rights: private (available to current user), public or open research objects

3) The results are displayed on the Faceted Search Results List (Right of Figure 41), and the total number of results is displayed on the top left corner of this panel.

4) Users can select the number of results to be displayed per page (9, 18 or 36)

5) Users can switch between grid view or list view to display results

6) Results can be sorted according to different fields, including:
   a. Date of creation
   b. Number of annotations
   c. Number of resources
   d. Status
3.2 How to search & inspect activity stream in ROHub?

1) Go to the activity search page by clicking “Activity” in the website menu bar (see Figure 42)
2) In the Activity Search Filters List (left of Figure 43) select the search criteria for searching and filtering activities. Available criteria include:
   a. resource type: the resource type associated to the notification (e.g., research object, snapshot, resource, etc.)
   b. activity type: the type of activity reported by the notification (e.g., create, add, update, etc.)
   c. research area: the research area of the research object associated to the notification
   d. publication date: date when the notification was issued
   e. creator: person associated to the notification event.

3) The results are displayed on the Activity Search Results List (Right of Figure 43)

4) The total number of results is displayed on the top left corner of this panel.

5) Users can select the number of results to be displayed per page (9, 18 or 36)

6) Results can be sorted according to different fields, including:
   a. Date of creation
   b. Creator

7) Users can inspect the details of an individual notification by clicking the sign ">" at the right side of the entry (see first entry in Figure 43)
3.3 How to inspect & visualize research objects?

1) Open a research object. This can be done by:
   a. Clicking "More" in a research object from the Faceted Search Result List
   b. Clicking "More" in one of the featured research objects from the home page
   c. Clicking a research object from the recent activity panel in home page
   d. Clicking an annotation related to the research object
   e. Writing the research object URI in the Web Browser

2) The RO overview page will load (Figure 44). From this page, the user can do the following:
   a. Visualize relevant research object indicators and quality, its key metadata, and a detailed view of all the associated annotations (overview tab) – Section 3.3.1.
   b. Download the research object or its metadata in different formats (overview tab) – Section 3.3.2.
   c. Import annotations into the research object (overview tab) – Section 3.3.3.
   d. Open & subscribe to the notification feed generated by the research object (overview tab) – Section 3.3.4.
   e. Navigate & visualize the research object contents, and for each resource visualize its details, and a detailed view of all the associated metadata (content tab) – Section 3.3.5.
   f. Download individual resources (content tab) – Section 3.3.6.
   g. Visualize & assess the research object quality (quality tab) – Section 3.3.7.
   h. Search, browse and visualize the research object activity (activity tab) – Section 3.3.8.
   i. Inspect & visualize the research object lifecycle (lifecycle tab) – Section 3.3.9.
   j. Inspect & visualize the relations defined in the research object (relations tab) – Section 3.3.10.
   k. Inspect & visualize the research object statistics (impact tab) – Section 3.3.11.

3.3.1 How to visualize & inspect the research object indicators and metadata?

1) Open the research object overview tab.

2) At the top of the overview tab (see Figure 44), the following indicators of the research object are displayed:
   - Number of views
   - Number of downloads
   - Number of resources aggregated, when hovered this indicator is broken down in number of resources and annotations
   - Number of activity events, including changes in the research object or its stability
   - Number of research object forked (initiated) from this one
   - Number of snapshots, when hovered this indicator is broken down in number of snapshots and archives
   - Research object quality (in percentage), when hovered the criteria used for the assessment is displayed
   - Size of the research object in bytes, that is the physical space used by the research object description and its internal resources

3) Below the indicators, the following metadata elements are displayed:
   - Research area associated to the research object
   - Title of the research object
   - Description of the research object
   - URL link to the research object which can be used for sharing
4) Below, the metadata extracted automatically from the research object content is also displayed (see Section 3.18). These include:

- Concepts - main concepts found in the content. A concept may be referred by different terms
- Domains - fields of knowledge associated to the content
- Frequent expressions - frequent terms found in the content. A term groups one or more words
- Places - named entities found denoting a place
- People - named entities found denoting a person
- Organization - named entities found denoting an organization

5) At the right side of the panel, the RO toolbox allows the user to:

- Download the research object or its metadata (see section 3.3.2)
- Open the research object evolution (see section 3.11)
- Update annotations (see section 3.18), import annotations (see section 3.3.3) and open the RO advanced annotation panel (see below)

6) At the bottom, the user can open the RO advanced annotation view panel by clicking the “show annotations” bar (or with the “view” annotations in the toolbox described above) (see Figure 45).

- This panel displays all the annotations of the research object in a view targeted for advanced users.
- For each annotation, it is displayed, the property and the value of the annotation, as well as the date of creation and the creator name.
Figure 44 Seamonitoring01 research object - RO overview tab
3.3.2 How to download the research object and/or its metadata?

1) Open the research object overview tab.
2) Go to the RO toolbox on the right side of the panel
3) Hover over the first menu “Downloads” (Figure 46) and
   a. Select “Metadata” to download the research object metadata, and then select the
      RDF format in which the metadata will be saved (turtle, rdf/xml, trig).
   b. Select “Zip” to download the whole research object as a zip file.

3.3.3 How to subscribe to the research object notification feed?

1) Open the research object overview tab.
2) Go to the RO toolbox on the right side of the panel
3) Hover over the second menu “Subscribe” and select “Subscribe” (Figure 47)
4) The URL of the notification feed is opened
5) Copy the URL into your feed reader (e.g., Google chrome extension RSS feed reader - Figure 48)
3.3.4 How to import annotations in the research object?

3) Open the research object overview tab.
4) Go to the RO toolbox on the right side of the panel
5) Hover over the fourth menu “Annotations” and select “Import” (Figure 49)
6) Select the RDF file with the annotation graph and click "ok"

The RDF file should be compliant with the underlying annotation ontology (see RO model).

3.3.5 How to navigate & visualize the research object contents?

1) Open the research object content tab. This tab allows users to navigate and visualize the
research object contents in a folder tree structure.

2) Initially, the content tab displays all the resources (files, links, folders) at the root level (see Figure 50).

3) For each resource, the tree shows the resource information (e.g., size in bytes for the files, number of entries for folders), in addition to the date of creation and the creator name.

![Figure 50 RO content tab (root level)](image)

4) Clicking a folder resource, displays its content (see Figure 51), allowing the user to navigate the content structure.

5) At the top of the folder tree there is a breadcrumb trail that reveals the user location in the content structure, and it can be used to return to the previous levels up to the root (home).

![Figure 51 RO content tab (first-level folder level)](image)

6) Clicking a non-folder resource, or selecting the resource checkbox, displays its key metadata information (see Figure 52), including:
   - title of the resource
   - URI link of the resource for sharing
- size in bytes of the resource
- type of resource, such as workflow, process, dataset, paper, etc.
- date of creation, i.e., the date the resource was aggregated in the research object
- creator, i.e., the name of the person aggregating the resource
- description of the resource
- image associated to the resource
- number or annotations associated to the resource

7) Clicking the “show the annotations” button displays the detailed view of all the annotations associated to the resource (see Figure 53). For each annotation the property and the value of the annotation, as well as the date of creation and the creator name is displayed.

SeaMonitoring01

![Image of SeaMonitoring01](image)

**Figure 52 RO content tab (resource details)**
3.3.6 How to download individual resources?

There are different options for downloading individual resources.

1) Open the research object content tab.
2) Navigate the tree structure until the desired resource is displayed.
3) Click on the action button next to the resource (Figure 54).
4) Click download

Alternatively, for internal resources

1) Write the URL link of the resource in the Web browser.

3.3.7 How to visualize & assess the research object quality?

1) Open the research object quality tab.
2) Select the recommended checklist (based on the research object type), or any other from the list of available checklists, to be used for assessing the research object quality (Figure 55).
3) Visualize and inspect the quality assessment result, including the percentage bar and value at the top, and the detailed criteria used for the evaluation (Figure 56)
Figure 55 checklist selection

Figure 56 RO quality assessment
3.3.8 How to visualize the research objects stability to assess preservation?

The above quality assessment of a research object (Section 3.13) provides information of the degree by which a research object contains all the required resources necessary for a purpose (e.g., runnability). Based on this dimension the stability measures the ability of a research object to preserve its overall quality state throughout a given period of time. Thereby, stability extends the scope of the analysis from a particular point in time to a given time period. Parameters like the impact of the information added or removed from the research object and of the decay suffered throughout its history are taken into account for its assessment. Hence, the stability information allows users to facilitate the preservation of a research object, and it can be visualized as follows:

1) Open the research object quality tab
2) Click “See quality history with RO Monitoring Tool” (Figure 56)
3) Visualize and analyze the stability graph in the RO Monitoring Tool (Figure 57 – top half)
   a. Select “single evaluation” (top left dropdown) and click on any point in the graph to see the checklist report
   b. Select “Compare two evaluations” (top left dropdown) and click on two points to see the corresponding checklist reports side by side (Figure 57 – lower half)

![Figure 57 RO Monitoring Tool](image-url)
3.3.9 How to search, browse and visualize the research object activity?

1) Go to the research object activity search page
2) In the Activity Search Filters List (left of Figure 58) select the search criteria for searching and filtering activities. Available criteria include:
   a. resource type: the resource type associated to the notification (e.g., research object, snapshot, resource, etc.)
   b. activity type: the type of activity reported by the notification (e.g., create, add, update, etc.)
   c. publication date: date when the notification was issued
3) The results are displayed on the Activity Search Results List (Right of Figure 58)
4) The total number of results is displayed on the top left corner of this panel.
5) Users can select the number of results to be displayed per page (9, 18 or 36)
6) Results can be sorted according to different fields, including:
   a. Date of creation
   b. Creator
7) Users can inspect the details of an individual notification by clicking the sign ">" at the right side of the entry (see first entry in Figure 58)

Figure 58 RO activity search
3.3.10 How to inspect & visualize the research object lifecycle?

1) Go to the research object lifecycle page

2) The lifecycle chart (left of Figure 59), provides a graphical representation of the RO evolution, in a similar way like source control systems (to be released). There are two views:
   a. In the summary view (the default), each node represents a live/snapshot/fork/archive research object (related to the current one).
      i. The first node is always the source live RO. Independently if the current research object is a live, snapshot, archive or fork, the graph shows the source live RO plus all snapshot/archives/forks created from the live one. Note a fork is also a live RO, thus if the current RO is a fork, the graph shows the fork RO plus all snapshot/archives/forks created from it, plus the source live RO.
      ii. the live research object node marks the start of the research object lifecycle (when it was created), to which the other nodes are connected in a chronological order
      iii. snapshots and archives are connected via a line of precedence with a diff label
      iv. clicking on a node will open the corresponding research object
   b. In the detailed view (when changes are selected), each of the bigger nodes represents a live/snapshot/fork/archive research object (related to the current one), while the smaller nodes represent changes (e.g., additions, removal, modifications). The same rules as in the summary view apply, except that:
      i. snapshots and archives are not connected via a line of precedence

3) The changes panel (right of Figure 59) is displayed after clicking on any "diff" in the chart (summary view).
   a. It shows the list of changes corresponding to the difference between the two immutable objects (snapshots/archives).
   b. It can be filtered to show only additions, removal or modifications
3.3.11 How to inspect & visualize the relations defined in the research object?

1) Go to the research object relations page
2) Visualize and inspect the list of relations defined in the research object (Figure 60)
   a. Each entry of the list is a triple in the form: <resource1, relation, resource2>
   b. resource1 can be the research object or any of its resources aggregated
   c. resource2 can be the research object, any of its resources aggregated or an external resource.
3.3.12 How to inspect & visualize the research object impact statistics?

1) Go to the research object impact page - under development
2) Visualize and inspect the research object impact information (Figure 61)
   a. The top section presents the statistics related to research object impact, including
      i. number of views
      ii. number of downloads
      iii. number of resources
      iv. a graph of the RO activity through time.
   b. The middle section displays the details and links of the research object(s) and other (external) resources (e.g., articles) referenced by the current research object.
   c. The section at the bottom displays the research object(s) and other (external) resources (e.g., articles) that reference (or cite) the current research object.
   d. The format used for displaying references is similar to a standard citation.

![Figure 61 RO impact (under development)](image)

3.4 How to create an account in ROHub?

1) Go to the sign-up page by clicking “Sign-up” in the website menu bar (top right Figure 62)
2) Currently ROHub portal supports only EVER-EST accounts. Hence, click on the link “Login with Everest” (red bar in Figure 62)
3) Click “Register Now” (left of Figure 63)
4) Enter the details in the registration form (right of Figure 63)
3.5 **How to Sign-in to ROHub?**

1) Go to the sign-in page by clicking “Sign-in” in the website menu bar (top right of Figure 64)
2) Currently ROHub portal supports only EVER-EST accounts. Hence, click on the link “Login with Everest” (red bar in Figure 64)
3) Enter username and password (left of Figure 65)
4) Click “Approve” in the OpenID user claims dialog (if needed).

Figure 64 Sign-in page

Figure 65 Everest Sign-in

3.6 How to create research objects?
There are three ways of creating a new research object in ROHub portal:

- From scratch, the user creates an empty RO specifying its ID and optionally some basic metadata and an initial skeleton for organizing resources (scenario A)
- From a zip file, if the user has a set of resources as the basis for the RO, they can be collected
in the form of a zip file and upload it to ROHub to create an RO aggregating these resources (scenario B).

- From an RO bundle (described in Section 3.11)

**Scenario A**

1) Sign-in to ROHub (Section 3.5)
2) Go to MyROs page by clicking “MY ROSs” in the website menu bar (Figure 66)

![Figure 66 My ROSs in menu bar](image)

3) Click on the “Create” button (Figure 67)

![Figure 67 RO create buttons](image)

4) Fill in the “Create RO” dialog box (Figure 68). The following information is requested:
   a. **RO Identifier**: the identifier of the research object is recommended to be a short & meaningful name, without spaces or special characters. This field is compulsory.
   b. **Title**: the title of the research object is recommended to be a short, but significant and relevant sentence. This field is compulsory.
   c. **Description**: a long text describing the research object associated investigation or observation. This field is optional
   d. **RO Type**: select the type of research object. Options include:
      i. **Basic RO**: a general, non-type specific research object (default value)
      ii. **Data RO**: a research object encapsulating primarily dataset resources
      iii. **Research Product RO**: a research object representing a research product
      iv. **Process RO**: a research object encapsulating primarily processes of any type, such as workflows, Web services, scripts, etc.
      v. **Code RO**: a research object encapsulating primarily code like scripts (e.g., python, R, etc.)
      vi. **Workflow RO**: a research object encapsulating primarily scientific workflows and related resources
      vii. **Service RO**: a research object encapsulating primarily services, e.g., Rest web services, SOAP web services, etc.
      viii. **Bibliographic RO**: a research object encapsulating primarily bibliographic resources
      ix. **Discussion RO**: a research object encapsulating primarily minutes and discussions notes
   e. **The research area related to the research object. By default, the root concept “natural and applied sciences” is selected**
   f. **The template used to generate the research object folder structure. By default, no template is used, i.e., no folders are created.**
5) Click “ok”

**Scenario B**

1) Sign-in to ROHub (Section 3.5)
2) Go to MyROs page by clicking “MY ROs” in the website menu bar (Figure 66)
3) Click on the “Create from ZIP” button (Figure 67)

4) Select an internal resource or write the location (URL) of an external zip file.
5) Click “ok”
6) The new RO identifier will be by default the name of the zip file (in the upcoming release, the user will be able to specify a different RO identifier).
7) The new RO will have the folder structure and all resources in the zip file.
8) If the zip file contains files with extension .url, they are treated as links. It is assumed one entry (the URL) per file. The URL link is aggregated and a title is set automatically as the name of the file with .url extension.

### 3.7 How to manage research objects metadata?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) In the main panel of the RO overview page (Figure 70), find the metadata element to add/edit/remove.
4) Click the blue pencil icon
5) Edit or enter the corresponding value. The possible values depend on the field, as follows:
   a. Research area, write in the autocomplete field the name of the related research area
   b. Title, write in the text field the title
   c. Description, write in the text field the description (e.g., Figure 71)
   d. URL link to the research object is not editable
   e. DOI (if available) of the research object is not editable
   f. Status (live/fork/snapshot/archive) of the research object is not editable
   g. Creator of the research object is not editable
   h. Creation date of the research object is not editable
   i. Credits for the research object, start typing in the autocomplete field the name of the person/organization having the credit. It is possible to specify a new value (if not available on the indexed list).
   j. Select the research object type (see Section 3.6)
   k. Geolocation (currently this field cannot be edited on the map, only visualized)
   l. Sketch edit will open a dialog box to select an internal picture or write the location (URL) of an external picture. This picture has to be in one of the supported formats (e.g., PNG, JPEG, PDF).
m. Contributors is not editable
n. Keywords, write in the text field the keywords, separated by “;”
o. Copyright holder, start typing in the autocomplete field the name of the person/organization having the credit. It is possible to specify a new value (if not available on the indexed list).
p. Ancillary documentation, write in the text field the URL of the documentation
q. Purpose, start typing in the autocomplete field the purpose of the research object. It is possible to specify a new value (if not available on the indexed list).
r. Content annotations, extracted automatically from the research object content are not editable

Figure 71 RO description field

6) In order to add or edit additional metadata fields not present in the main panel of the RO overview page, click on the “Show Annotations” bar to open the advanced RO metadata panel (Figure 72)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Date</th>
<th>Creator</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td><a href="http://purl.org/ro/ro.owl#ResearchObject">http://purl.org/ro/ro.owl#ResearchObject</a></td>
<td>26 January 2017, 16:10</td>
<td>Ralph Palma</td>
</tr>
<tr>
<td>description</td>
<td>This research object aggregates documentation and user guides related to ROHUB</td>
<td>26 January 2017, 16:11</td>
<td>Ralph Palma</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/17854/04">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/17854/04</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/54262/09/95">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/54262/09/95</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/54200/12/68">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/54200/12/68</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/53485/12/6">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/53485/12/6</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/51305/22/6">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/51305/22/6</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/12464/03/80">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/12464/03/80</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/12354/02/83">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/12354/02/83</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
<tr>
<td>subject</td>
<td><a href="http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/11395/82/6">http://rondow.rohub.org/mod/ROs/ROHUB-docs/subject/11395/82/6</a></td>
<td>04 September 2017, 12:46</td>
<td>ROHUB Service</td>
</tr>
</tbody>
</table>

Figure 72 Advanced RO metadata panel

a. Find the metadata field to edit/remove and click the pencil to edit it, or the bin to remove it
b. Click “Create new annotation” button to add a new metadata field in the “Create annotation” dialog box (Figure 73)
i. Start typing the property name in the autocomplete field to select one of the properties in the RO model, or add a new property value (fully qualified name)
ii. Write the value for the selected property
c. Click “ok”
7) The annotations automatically extracted from the RO content are automatically updated once a day (for new or updated research objects). However, it is possible to force updating these annotations by
   a. Go to the RO toolbox on the right side of the overview panel (Figure 70)
   b. Hover over the fourth menu “Annotations” and select “Update” (Figure 49)
   c. The process can take few minutes to finalize

3.8 How to aggregate resources in the research object?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Open the research object content tab (Figure 74)
4) Click “Add Resource” button
5) In the “Add Resource” dialog box, select the type of resource (local file or Web resource) and fill in the required information as follows:
   a. For an internal resource (Figure 75), click “choose file” and select the file in the filesystem, select (optionally) the resource type(s) by selecting the value(s) from the provided list, and select whether the resource is an RO bundle or not (Section 3.11).
   b. For a Web resource (Figure 76), write the URL of the external resource, and select (optionally) the resource type(s) by selecting the value(s) from the provided list
6) Click “Ok”
3.9 How to manage resources metadata?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Open the research object content tab
4) Select the resource in the navigation panel
5) In the resource details panel (Figure 77), find the metadata element to add/edit/remove.
6) Click the blue pencil icon to add/edit or the bin icon to remove.
7) Edit or enter the corresponding value. The possible values depend on the field, as follows:
   a. Title, write in the text field the title of the resource
   b. URI link of the resource is not editable
   c. Size in bytes of the resource is not editable
   d. Type of resource, click "+" to add a new type, pencil to edit it, or bin to remove it
   e. Date of creation is not editable
   f. Creator is not editable
   g. Description of the resource, write in the text field the description
   h. Image edit will open a dialog box to select an internal picture or write the location (URL) of an external picture. This picture has to be in one of the supported formats (e.g., PNG, JPEG, PDF).
   i. Number or annotations associated to the resource is not editable
8) In order to add or edit additional metadata fields not present in the resource details panel, click on the "Show the annotations" button to open the advanced resource metadata panel (Figure 78)
Figure 78 Advanced resource metadata panel

a. Find the metadata field to edit/remove and click the pencil to edit it, or the bin to remove it
b. Click “Add annotation” button to add a new metadata field in the “Create annotation” dialog box (Figure 79)
   i. Start typing the property name in the autocomplete field to select one of the properties in the RO model, or add a new property value (fully qualified name)
   ii. Write the value for the selected property
c. Click “ok”

Figure 79 Create resource annotation

3.10 How to manage research objects relations?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Open the research object relations tab (Figure 80)

Figure 80 Managing RO relations

4) To delete a relation, find the relation in the list and click “Delete”
5) To add a new relation, click “Add relations” (Figure 81)
3.11 How to aggregate an RO bundle?
This is particular case of Section 3.8.

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Open the research object content tab (Figure 74)
4) Click “Add Resource” button
5) In the “Add Resource” dialog box, select local file and fill in the required information as follows (Figure 83):
   a. Click "choose file" and select the RO bundle file in the filesystem, select the checkbox next to RO bundle, and select (optionally) the resource type(s) by selecting the value(s) from the provided list (e.g., Example Run, Prospective Run, Results Generation Run).
6) Click “Ok”
3.12 How to manage research objects content?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Open the research object content tab (Figure 74)
4) The following operations can be carried out:
   a. To add a new folder, click “New Folder”, and write the folder name in the “Create new folder” dialog box, and click “ok”

b. To aggregate a new resource, see Section 3.8.

c. To remove a resource, either a) select the resource (file or folder) by clicking on the resource checkbox (Figure 85) and click “Delete” button; or b) click the action button on a non-folder resource and select “Remove” (Figure 86). To remove multiple resources at once, follow option a), selecting all the resources by clicking on their checkbox and then click “Delete”
d. To select all resources in the current path, click “Select all”

e. To clear the selected resources, click “Clear all”

f. To move a resource (to another folder), either a) select the resource (file or folder) by clicking on the resource checkbox (Figure 85) and click “Move” button; or b) click the action button on a non-folder resource and select “Move” (Figure 86). To move multiple resources at once, follow option a), selecting all the resources by clicking on their checkbox and then click “Move”

g. To update (modify) an existing resource, click the action button on a non-folder resource and select “Update” (Figure 86). If it’s an internal file, choose the updated resource from the filesystem. If it’s an external resource write the new URL. – under development

3.13 How to manage research objects quality?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Visualize & assess the research object quality (Section 3.3.7)
4) Add any missing metadata as described in Section 3.7
5) Fix/update reported problems with external resources or services.

3.14 How to manage research objects lifecycle?

4) Sign-in to ROHub (Section 3.5)
5) Load a research object (Section 3.3)
6) In research object overview tab, go to the RO toolbox on the right side of the panel
7) Hover over the third menu “Evolution” and select one of the possible options (Figure 87):
   a. “Fork” to create a new live research object using as starting point the current RO. This is similar to the branch functionality in a source control system and facilitates reusing research objects. It can be used, for instance, to extend a previous line of work, to test alternative research paths, or to apply the research work in other settings/domains.
   b. “Snapshot” to create an immutable version of the research object at a particular time. Snapshots can be created with or without DOIs (Digital Object Identifier) – see Section 3.15. This is similar to the tagging functionality in a source control system and enables to keep a record of the state of the research throughout time. It can be used, for instance, to mark the achievement of a milestone, to reference and share the research state with colleagues or to submit it for review, or to revert to a previous state in the research and try alternative research paths.
c. “Archive” to create an immutable version of the research object at the end of its lifecycle. Archives can be created with or without DOIs (Digital Object Identifier) – see Section 3.15. It can be used, for instance, to mark the end of the research lifecycle, after reaching the final results, or because the research was discontinued. Making a fork of an archive, for example, enables the extension and continuation of a previous research work.

ROHUB-docs

5) The creation process can take few minutes. A message at the top of the overview tab is displayed when the process finishes.
6) Visualize and inspect the research object lifecycle as described in Section 3.3.7 to see all the related forks, snapshots, and archives.

3.15 How to release a research object with a DOI?
This is a particular case of Section 3.14. A Digital Object Identifiers (DOI) is a persistent identifier used to uniquely identify objects, standardized by the International Organization for Standardization (ISO), and link to it on the Web. DOIs are the most commonly used mechanism for citation. ROHub, as a DOI provider, can generate research objects with DOIs for their citation and reference in scientific papers, documents, and other research objects.

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) In the research object overview tab, go to the RO toolbox on the right side of the panel
4) Hover over the third menu “Evolution” (Figure 87) and select one of the possible options to generate a research object with a DOI.
   a. “Snapshot” and then “Snapshot+DOI” (Figure 88) to create an immutable version of the research object at a particular time, which can be properly cited.
   b. “Archive” and then “Archive+DOI” to create an immutable version of the research object at the end of its lifecycle, which can be properly cited.
5) The creation process can take few minutes. A message at the top of the overview tab is displayed when the process finishes.
6) Visualize and inspect the research object lifecycle as described in Section 3.3.7 to see all the related forks, snapshots, and archives.
7) The DOI information is displayed in the overview tab when loading the new (snapshot/archive) research object.

3.16 How to enable collaboration and manage research objects access control?
ROHub enables the collaboration between scientists in a research object throughout its lifecycle. For this, ROHub defines three different roles in a research object:

- Owner: the creator of the research object
- Editor: a person with rights to read and modify the research object
- Reader: a person with rights to read the research object

Additionally, ROHub defines three different access modes:

- Private: a research object that is not discoverable via search interfaces, and that nobody can read or modify it, except the owner and the people with permissions (read and/or edit roles in the research object).
- Public: a research object that is publicly accessible (anybody can read it), but that nobody can modify it, except the owner and the people with permissions (edit roles in the research object).
- Open: a research object that is publicly accessible (anybody can read it) and that anybody with a valid account can modify it.

By default, a research object is Public. To modify the access mode, and/or permissions (only the owner can modify these settings):

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Open the research object access control tab (Figure 89) – under development
4) Set the access mode, by selecting one of the possible options (private, public, open) in the dropdown list.
5) Add permissions, by start writing the name of the person in the autocomplete text box, select the person from the suggestions, select the role from the dropdown list (editor/reader), and click the check icon.
6) To remove a permission, find the person from the list of granted privileges, and click the bin icon.

3.17 How to comment and discuss over a research object/resource?
1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) To make new comment
   a. Go to the comments panel from any tab (Figure 90), make sure in the dropdown list next to the number of comments, it is selected the name of the target (the research object or the resource) that will be commented. By default, the dropdown list has the option “All comments”, and adding a new comment will associate it to the research object; however, in the content tab, when a user selects a resource, by default the dropdown list has the name of the resource selected.
   b. Type the comment in the text box and click “Add a comment”
   c. To edit a comment, click “Edit” or the Pencil icon
   d. To delete a comment, click “Delete”

![Figure 90 Commenting an RO](image)

4) To reply a comment
   a. Find the comment in the comments panel, and click “Reply” (Figure 91)
   b. Type the reply in the text box and click the check icon (or cross icon to cancel)

![Figure 91 Reply to comment](image)

5) To like or dislike a comment
   a. Find the comment in the comments panel and click the thumbs up icon or the thumbs down icon, accordingly.
6) To display a discussion
   a. Find the comment in the comments panel, and click "Show responses"
7) To view the number of comments in the research object (and its resources)
   a. Go to the comments panel and see the number next to the title "Comments", or
   b. Go to the social impact control (above the tabs, at the right) and see the number
3.18 How to rate a research object?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Go to the social impact control (above the tabs, at the right) (Figure 92), and hover over the stars.
4) Rate the research object, i.e., select the number of stars from 1 to 5 (Figure 93), where the higher the better. Rating is allowed only once per person per research object

3.19 How to mark a research object as favorite?

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Go to the social impact control (above the tabs, at the right) (Figure 92), and hover over the blue heart.
4) Click the (empty) blue heart to mark the research object as favorite
5) Click the (filled) blue heart to remove the research object from favorites

3.20 How to manage workflows in research objects?

ROHub provides access to some added value services to manage scientific workflows. Currently, these services support taverna workflows (.t2flow, .wfbundle). These services enable the extraction of metadata from the workflow, the extraction and aggregation of the workflow sub-components (e.g., scripts, web services, sub-workflows) in the research object, and the generation and aggregation of the workflow in the new taverna format (.wfbundle). To use these functionalities:

1) Sign-in to ROHub (Section 3.5)
2) Load a research object (Section 3.3)
3) Aggregate the scientific workflow as described in Section 3.8, making sure to specify “workflow” as resource type.
4) Open the research object content tab
5) Find the workflow in the navigation panel
6) Click its actions button and select “Annotate and Transform” (Figure 94)

![Figure 94 Managing workflows](image)

7) In the “Annotate & Transform” dialog box, select the location in the research object where the resources extracted (scripts, subworkflow, web service) or generated (wfbundle) will be placed. By default, the resource will be placed in root "/", but the dropdown list has all the folders in the research object.

![Figure 95 Annotate and transform workflow](image)

8) Click “ok” in the “Annotate & Transform” dialog box
9) The process can take few minutes. A message at the top of the overview tab is displayed when the process finishes.

### 3.21 How to enrich automatically the research object annotations?

ROHub integrates a semantic enrichment service in order to enhance the findability of research objects. This is done by complementing the user-generated annotations with new semantic metadata that is automatically gathered from research object content, more specifically from the resources containing textual content. To elicit the metadata the research object content is extracted and resources that may contain potentially text are identified according to the following resource types: Document, BibliographicResource, Conclusions, Hypothesis, ResearchQuestion, and Paper. The files associated with these resources must be of any of the following types: Word documents, PDF documents, Text files, or PowerPoint Presentations. Once the resource files are identified their text is extracted. All these pieces of text plus the title and description of the research object are then used to generate metadata representing the research object content (currently by means of Cogito system). In particular the following metadata types are identified:

- **Main Concepts**: Most frequent concepts mentioned in the text.
• Main Domains: Fields of knowledge in which the main concepts are most commonly used
• Main Lemmas: Most frequent lemmas found in the text.
• Main Compound Terms: Most relevant phrases or collocations found in the text.
• Named entities: all the named entities found in the text classified into People, Organizations and Places.

ROHub executes the semantic enrichment service once a day, during which all the research object new or modified during the day are processed. Hence, this is transparent to the user. However, there is a possibility to force the update of the semantic annotations by the user, for example, after making many changes in a research object, so it won’t be necessary to wait until the daily process. This is done as follows:

1) Open the research object overview tab.
2) Go to the RO toolbox on the right side of the panel
3) Hover over the fourth menu “Annotations” and select “Update” (Figure 96)