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WP2



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WP2 - FINAL ACTIVITY REPORT AND HANDBOOK

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FINAL ACTIVITY REPORT WP2

INTRODUCTION

This final activity report aims at summarizing all the objectives, activities, tasks, partners involvement, results and workshops carried out for the successful achievement of the objectives set for the WP2 of the EUL project. It also includes the handbook with the best practice strategy for quality management within the EUL network and its services.

OBJECTIVES

The Baltic Sea Underground Innovation Network has been established and the joined effort of creating a Web-Based-Tool (WBT) for the network was succeeded. The network and the WBT allow for joint marketing and for the utilizers of the Underground Laboratories (ULs) one-stop-shop access to the ULs. In this work package, the created network and the WBT are placed under a set of tests. The aim is to gather user feedback from project partner and associative partner based virtual clients so that the functionalities and services would meet the needs of users with different backgrounds.

To evaluate the visibility of the network a set of dedicated web analysis tools will be used to analyse how well the network reaches the potential customer segments and from which geographical settings. The analysis will be used as a basis for more targeted marketing efforts.

From the BSUIN project, we have a thorough characterization of the participating ULs. Within the extension phase, we will widen the data analytics, monitoring the developed WBT, testing both the network and the WBT and finally improving the innovation platform and its WBT.

We provide and further strengthen a detailed knowledge of a great variety of potential projects in different mines and underground spaces in order to bring forward the constructive usage of underground space. The network shall be able to pursue a "best practice" strategy. For this, we will use existing experiences based on the characterization of the ULs. Particularly, we will complement this knowledge by extending the width of potential projects over the BSUIN to include other ULs, focusing on the Baltic Sea Region and Europe. Finally, we will provide the network with a knowledgeable innovation platform including a wide knowledge database about research and business potentials, best-practice-strategies to acquire and perform new projects and a strong WBT to allow for a great performance of future partners and projects.

ACTIVITIES AND TASKS

A2.1 Market analysis and creation of test scenarios

The goal is to search and verify research teams as a customer segment in Europe and to use the gained knowledge and existing experience to create test scenarios for the European Underground Laboratories association and to trial and improve its service. Having detailed information about the use of ULs will aid to create the test scenarios. These test scenarios are meant to cover different research/economical fields and varying underground conditions.

Subtasks

I. BIG DATA analysis

The literature metadata, database analyses and Geographic Information Systems (GIS) are the key methodologies to be applied here. The aim is to broaden the understanding of what types and research fields ULs are used for, what are the institutions (location) using the ULs, what are the ULs used in their projects and the information on the conducted projects and so on. UO together with the support from partners (SKB, KaRC, TUBAF, GFZ, KGHM Cuprum) extends the BIG DATA analysis of ULs. The priority languages are English, Finnish, Swedish, Polish, German, Russian, French, Spanish and Italian as all these represent countries where European ULs exist.

II. Web Analytics

The Web analytics concentrates on the user information e.g., location, frequency, time-on-site, time of entry, basically visitor analysis of the homepages. The data is collected through the homepages of the European Underground Laboratories association and the BSUIN project, and the usage and the impact of the web-based-tool (WBT). The work is done by VU together with UO by using Google analytics tools. The resulting information contains data on the user /client groups and their organisations.

In addition, the user analysis helps to target marketing and to monitor the success of the marketing and digital dissemination of the social media platforms used by the project. Feedback to WP4.

III. Creation of test scenarios

Results of the BIG DATA analysis are used to look for most common disciplines such as engineering, earth and planetary sciences, environmental sciences, physics, astronomy, as well as energy, material, computer and social sciences. Four test scenarios are prepared by diverse partners e.g. GFZ, TalTech, BSI, VU and UO. The created scenarios address subject areas not in scope of the ULs of BSUIN project to test their services with potential clients. Test scenarios are meant to be cases of either hypothetical (due to time limitations) research projects or real research projects. The required steps are:

- Realistic (real or hypothetical) research/ economical projects in UL are prepared: a test-user is created - These scenarios are tailored to target a specific topic or provide different solutions for ULs of the BSUIN project.
- Each scenario includes a path of a new client using the homepage of the association and the WBT to establish contact with an UL and to initialise a project request or other customer need. This process is tested under realistic conditions in WP2.2.

Output

O2.1 Report of analysis and test scenarios

Report has three parts that can be published separately in different forms.

Part 1: Results of BIG DATA analysis will be openly made available. It will be used for WP4

Part 2: Report of Web Analytics will be an ongoing process to evaluate the effects of marketing and dissemination. It will be used for WP4

Part 3: Created of test scenarios will be used in the A2.2

A2.2 Test phase of EUL association Innovation Platform

Based on the results of A 2.1 namely the test scenarios (each addressing a different discipline and/or UL characteristics), the service of the European Underground

Laboratories association is to be trialled, improved and, if necessary, expanded. The aim of the test scenarios is to produce information for developing a quality measure for the UL network and its web-based tool and thus also serve to improve the tool. For this purpose, the scenarios created will be regarded as real project requests.

Subsequently, the applicants will also be interviewed via the service in order to provide appropriate feedback.

Subtasks

I. Preparation of questionnaire

The questionnaire will give feedback on how the EUL service was received and how smoothly the interaction with the homepage, the web-based-tool and the subsequent handling goes. Questions will address topics such as 1) the overall impression, 2) duration of proposal handling, 3) technical and methodological challenges while sending in the proposal, 4) expectation fulfilment (major differences?) and 5) necessary adaptations for the service. The questionnaire will also include results from the BSUIN project A2.4. (organisational characterisation). The questionnaire is prepared for "applicants" who send in the test scenarios (proposals) to be answered in the following test run. There will be a close collaboration with WP3 customer relationship management.

II. Actual test phase including responses

Test scenarios will be run/implemented into the WBT and checked by European Underground Laboratories association's web page or specifically use association office/contact which will then internally forward and handle the requests to the most fitting Underground Laboratory from the existing network, most likely being TUBAF, SKB, Ruskeala, UO/Callio Lab.

The ULs will process the fictive projects (i.e. including some but not exclusively: cost estimate, answer questions, pose questions of unclarified items, make time schedule, project planning) according to their management processes. The answers and the feedback from the ULs will be prepared and send back to the proposal maker and to be checked in iterative ways in order to push the proposed project forward. That means, that it could theoretically be implemented afterwards and the preparation phase is finished – which is the main phase where the network and European Underground Laboratory association are involved.

III. Evaluation

- Partners are asked on how this service was conducted using the questionnaire developed in A 2.2 I (i.e. concerning WBT, association's response). At the end a best practice strategy is to be set up, the test scenarios act as examples of possible future projects and should be archived as if they were real proposals. The gathered information shall be condensed as feedback to optimize WBT as well as giving the WP 4 Marketing information on additional fields of interest (customers segments) to focus on.

Output

O2.2 Experiences and feedback for web-based tool (WBT) development

- Receiving and processing of test scenarios
- Collecting the user experience
- Feedback and derivation of recommendations

- Reporting: final activity report as summary to be used for dissemination and marketing (WP4)

A2.3 Refinement of the Innovation tools of the EUL association

The activity 2.3 includes the update of the decision tree and the tools used by the European Underground Laboratories association, as well as an update of the design of the homepage and the web-based tool. This will allow to attract future users, keep them on the homepage and provide them with the best possible interface providing information and offering advice. First, the great variety of research/projects conducted in Underground Laboratories will be presented. Second, a decision tree or similar process will help to define the Process Workflow for New Project Inquiries, and to choose the most appropriate ULs for an incoming proposal by providing user-specified information for specific interests via a drop-down menu originally implemented in the main BSUIN project phase. Further adaption will enable a better user experience and thus higher chances to attract new projects making use of ULs, which ultimately make better use of the existing UL structures.

Subtasks

I. Implementation of changes

The existing WBT and the decision tool are updated according to the feedback from A2.2. The results from the A2.2. are also used to optimize the support functions and process flows of the EUL homepage. The updates and the optimisation will be of great benefit in order to attract potential users by providing users with a clear information structure, allow for automated suggestions of the most appropriate ULs for the handled user proposal and making the project implementation phase as smooth and easy as possible. The ease-of-use is a critical instrument in keeping the homepage visitors on the homepage and the users of the WBT to end up as customers of ULs.

II. Development of best practice strategy for services offered by the European Underground Laboratory association (EUL network)

A best practice strategy on the basis of hypothetical and real project proposals will be formulated. This will be of importance for the quality management within the EUL network. In future, the proposal handling as tested in WP2.2 and the improvements triggered by it in WP2.3 will have to be tested regularly to adapt the EUL network and it's a web-based tool to the most recent requirements. Having a routine for this will make the process more efficient thus contributing to the success of the EUL network. This will include a handbook formatted summary that will help shape the network. Additionally, the “best practice” - section on the on European Underground Laboratories association web site will be updated and/or extended accordingly.

Output

O2.3 EUL Innovation Platform and WBT: Tested and approved

The EUL innovation platform and the Web-Based-Tool (WBT) created in the regular project allow for joint marketing and for the utilizers of the Underground Laboratories (ULs) one-stop-shop access to the ULs. The test scenarios and tests run at the A2.1. and A2.2. with the feedbacks are concluded in this activity summarizing the WP2. The final report on the WP2 activities and results are provided.

The big data-based test users, scenarios and questionnaires provided detailed knowledge of the ease-of-use of the EUL Innovation platform, the WBT and the proposal handling of the EUL. The test scenario feedback -based updates and improvements of the web-based tool are implemented here in A2.3.

A handbook with the best practice strategy for quality management within the EUL network and its services, namely Innovation platform and the WBT, is created. The documented routine for quality management contributes to the further success of the EUL network.

PARTNERS INVOLVEMENT

- PP 1 - University of Oulu (UO)
- PP 4 - Swedish Nuclear Fuel and Waste Management Co. (SKB)
- PP 5 - KGHM Cuprum Research & Development Centre Ltd. (CUPRUM)
- PP 6 - Technical University mining academy Freiberg (TUBAF)
- PP 7 - Helmholtz Centre Potsdam German Research Centre for Geosciences GFZ
- PP 8 - Vilnius University (VU)
- PP 10 - Tallinn University of Technology (TalTech)
- PP 12 - Karelian Research Center of the Russian Academy of Sciences (KarRC RAS)
- PP 13 - Joint stock company 'Khlopin Radium Institute'

PP1 UO takes part in the WP2 in following roles:

- A2.1 activity leader: Provides key expertise in the BIG DATA analysis and Web analytics related to website activity monitoring and linking the activities to project activities. Creates one of the test scenarios for the task III based on user cases at Callio Lab.
- A2.2 Provides input and a test case for the activity as an UL
- A2.3 Contributes to the upgrade of the WBT both content- and technical-wise

PP4 SKB

- A2.1 Provides keyword input (especially in Swedish, and to topic of spent nuclear fuel storing) for the BIG DATA analysis to find what kind and where underground research is conducted.
- A2.2 Provides input and a test case for the activity as an UL. Expertise in the Web-Based-Tool development.

- A2.3 Contributes to the upgrade of the WBT both content- and technical-wise.

PP5 CUPRUM

- A2.1 Provides keyword input (especially in Polish) for the BIG DATA analysis to find what kind and where underground research is conducted.
- A2.2 Provides input and a test case for the activity as an UL.

PP6 TUBAF

- A2.1 Provides keyword input (especially in German, and topic of mining engineering) for the BIG DATA analysis to find what kind and where underground research is conducted. Provides test scenarios (task III) for the activity based on their own expertise as a client of UL and/or a host to an UL user.
- A2.2 Activity leader: Lead developer of the EUL service feedback questionnaire. Provides a test case for the activity as an UL.
- A2.3 Activity leader: Coordinates the WBT upgrade based on the results gained during the A2.1 and A2.2.

PP7 GFZ

- A2.1. Provides keyword input (especially in German, and topic of geophysics) for the BIG DATA analysis to find what kind and where underground research is conducted.
- A2.2. Provides input and a test case for the activity as an UL or as a facility user.
- A2.3 Contributes to the upgrade of the WBT both content- and technical-wise.

PP8 VU

- A2.1 task II Web analytics as task leader, and is responsible for creating one of the test scenarios for the task III.
- A2.2. Collaborates with the questionnaires and assignments. Expert on Web-Based-Tool development.

PP10 TalTech

- A2.1 Provides test scenarios (task III) for the activity based on their own expertise as a client of UL.

PP12 KarRC RAS

- A2.1 Provides keyword input (especially in Russian, and topic of underground tourism) for the BIG DATA analysis to find what kind and where underground research is conducted. Provides test scenarios (task III) for the activity based on their own expertise as a client of UL and/or a host to an UL user.

PP13 Khlopin

- A2.1 Provides keyword input (especially in Russian, and topic of underground radiation measurements) for the BIG DATA analysis to find what kind and where underground research is conducted.

Associated organisations involvement

- **AO 1 - Region Kalmar County**
- **AO 2 - Town of Pyhäjärvi**
- **AO 3 - Kolmas Karelia, Ltd.**
- **AO 4 - GIG Experimental Mine Barbara**

AO1, AO2 and AO3 are providing feedback on the Web-Based-Tool based on test scenarios and supporting services they could offer. **AO4** will take part in developing the questionnaire.

WORKSHOPS

WORKSHOP #1: May 27th, 2021

An invitation to participate in the workshop was sent via an appointment in Outlook Calendar to all EUL partners and stakeholders around 4 weeks before the workshop's date. In order to test, improve and expand the services offered by the EUL Association different Test Scenarios were used for the preparation of this workshop.

The aim of these TS was to produce information for developing a quality measure for:

- The EUL network
- Its Web-based tool
- Improving the tool, if possible

List of attendants (sorted by first name)

George Barakos	Katarzyna Szkliniarz	Nikolai Kolesnikov
Helmut Mischo	Katrin Jaksch	Ossi Kotavaara
Irina Savelyeva	Krzysztof Fuławka	Päivi Aro
Jari Joutsenvaara	Marcus Laaksoharju	Pavel Petrov
Jose Garcia del Real	Marko Holma	Rüdiger Giese
Karin Robam	Michael Lay	Vytenis Mockus

Objectives:

1. Checking how well the network reaches the potential customer segments based on the BIG DATA. (Exercise 1)
2. Securing that all expected functionalities and services of the EUL Innovation Platform meet the needs of users with different backgrounds, based on different test scenarios. (Exercise 2, 3, 4 and 5).

Objective 1:

To date of the Workshop #1, May 27th 2021, a **first BIG DATA analysis** was carried out by OULU partner in (A2.1) with the goal of searching and verifying research teams as a customer segment in Europe using such information to creating Test Scenarios.

- What types and research fields ULs are used for?
- What are the institutions (location) using the ULs?
- What are the ULs and the information used in their projects?

A total of 96 ULs were identified world-wide, plus 14500 Scopus articles with UL name and 12800 articles analysed from Web of Science.

Excel files were prepared and uploaded to the Ownsky cloud for further analysis. Results of the first BIG DATA analysis would be analysed further in detail in order to identify what are

the most common scientific disciplines and what could represent a market niche for the EUL Association.

Later, on August 25th 2021, a **second BIG DATA analysis** was undertaken by the partner OULU since finding the research fields through the previous downloaded Scopus datasets was not possible. OULU partner decided to use the upgraded Web of Science database as a source instead of the former database from Scopus. The reason was that Scopus did offer keywords, but it was not possible to convert to research fields from those.

For this second BIG DATA analysis, English name, native name, and former names from the underground laboratories were used to search for the related articles. Experiment names, e.g. in Kamioka (130 articles vs Kamiokande ~2500 articles) from the data set were excluded.

Using this new criterion, a total of 8577 articles were found. An additional quality criterion was needed for the articles found. Thus, the number of accepted articles was reduced from 8577 to 2200 articles, quite a drop, but in the opinion of OULU partner it allowed full analysis of these article metadata.

The quality criteria used was the following:

- Title, institute, publication year, WoS category does exist, and the article is not an ERRATUM
- Underground Laboratory name must be found within the article metadata (title, institute address, keywords, abstract)

Three new files were prepared for this purpose by the OULU partner, according to the following description:

- 2021Aug25-EUL-WoS-article-data-for-marketing (tab-separated txt file)
- 2021Aug25-EUL-WoS-categories-within-criteria-matching-articles (tab-separated txt file)
- 2021Aug25-EUL-WoS-figures (excel file)

The first file “2021Aug25-EUL-WoS-article-data-for-marketing” contains, among other things, information of the first author, their institute, mail address and email address (not all, though), WoS research area definition and linked Underground Laboratory.

When creating additional test scenarios, these materials can be of big help. Excellent material for marketing planning as well, as there is a direct link to the person and the research they had been doing in a specific laboratory.

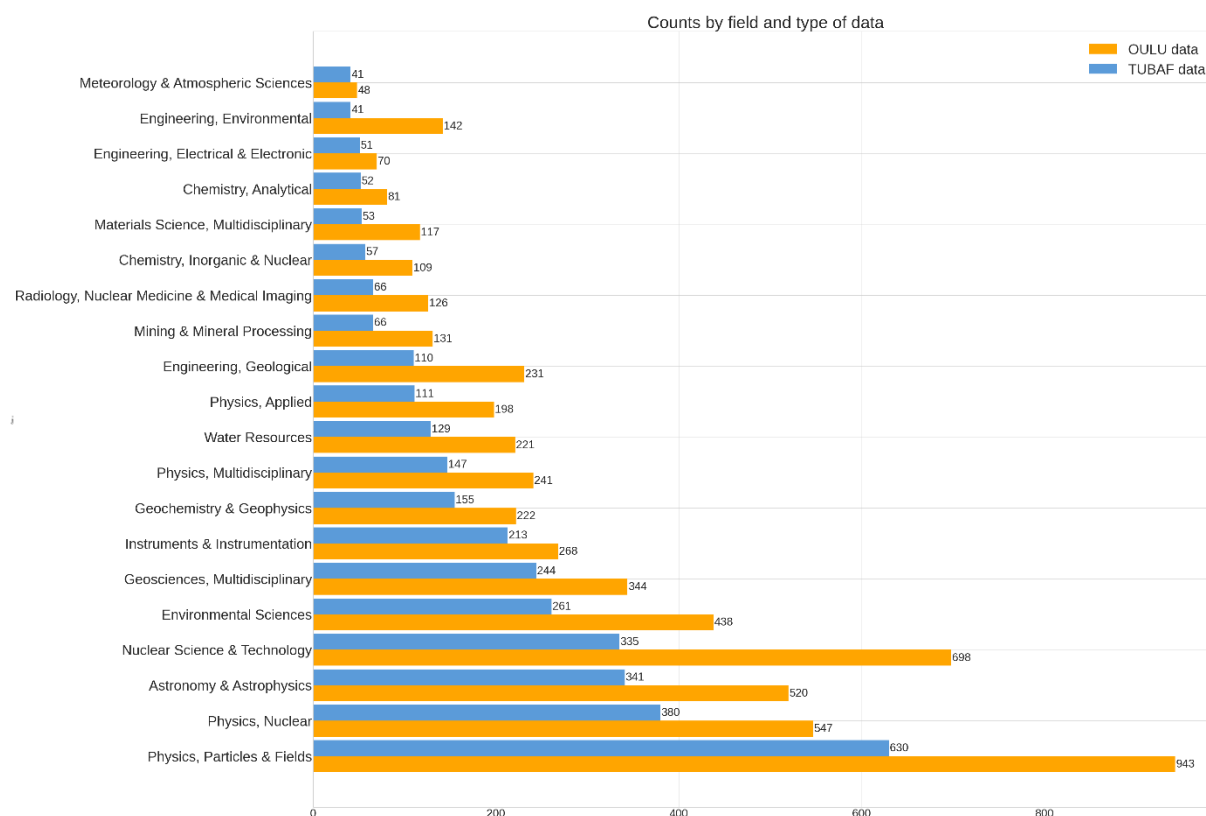
The second file “2021Aug25-EUL-WoS-categories-within-criteria-matching-articles” contains the frequency of WoS research categories within these 2200 articles. Some articles do have several classifications. From there, EUL partners can easily find the most common research categories within the Underground Laboratories.

The third file “2021Aug25-EUL-WoS-figures” contains the context and several different types of illustrations of the data, from which the following graph was extracted.



Graph 1: WoS research categories within selected Underground Laboratories

In addition to the work performed by OULU partner, regarding the second BIGDATA analysis, TUBAF partner carried out also a BIGDATA analysis based on the most updated dataset file “2021Aug25-EUL-WoS-article-data-for-marketing.txt” provided by OULU partner in August 2021. A summary of such analysis is shown below.



Graph 2: OULU vs. TUBAF results of WoS research categories within selected Underground Laboratories

Duplicated rows and some differences in the number of publications for each specific scientific domain or area were found by TUBAF when TUBAF’s and OULU’s analyses were compared and discussed.

Recommendation: Further analysis of this dataset would be recommendable in order to clarify what could be the potential market niches in which the EUL Association would like to carry out its activity. So that, EUL Association can be a trustable and competitive organization capable to provide value to its users.

EXERCISE 1. Disruption on new segments

In order to check how well the network reaches potential customer segments, it would be important to analyse if there is any room for disruption on new segments, for which the Exercise 1 was prepared, and carried out successfully during this workshop.

According to the Strategic Scientific Domains for Research Infrastructures (ESFRI) in EU, there are a total of 6 scientific areas in which the EUL Association could be focused on, and develop its scientific interconnections. **Fig 1.**

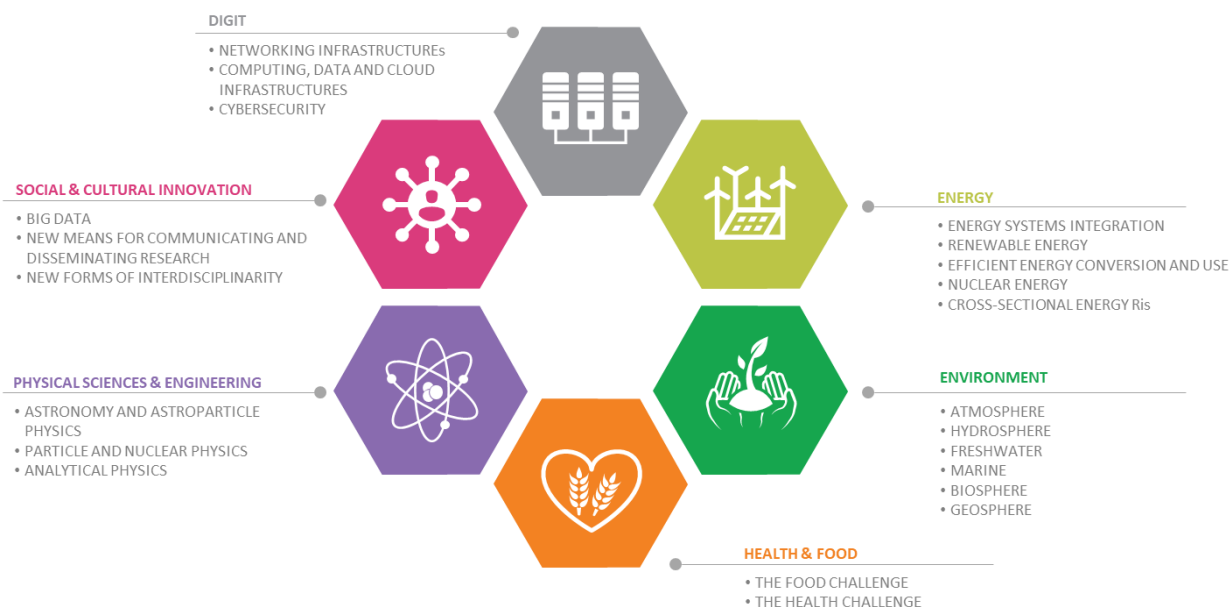
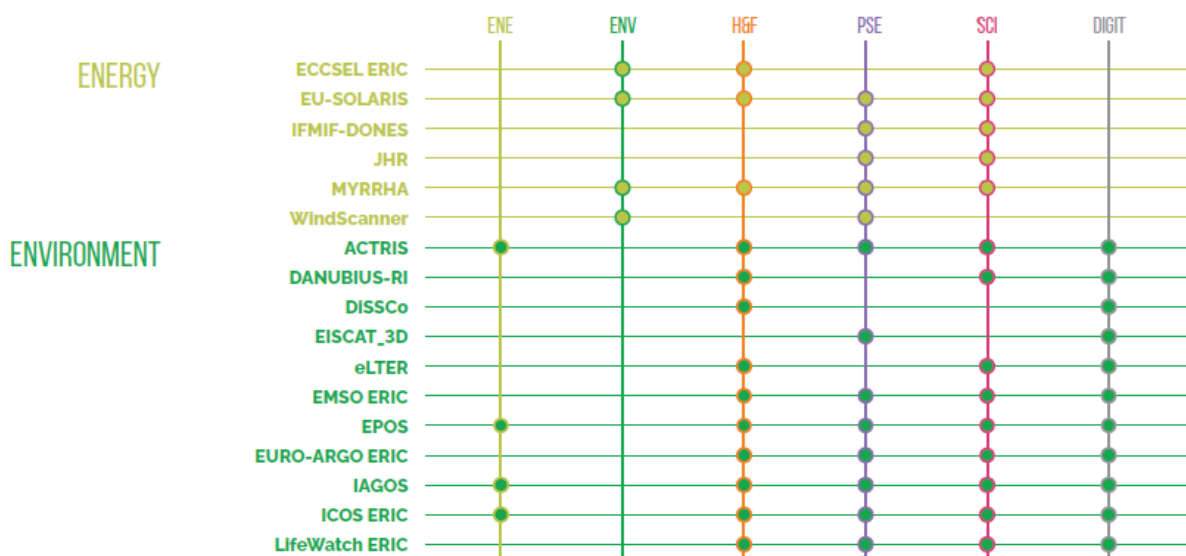


Fig 1: Potential scientific areas for EUL to develop scientific interconnections

Potential Strategic Interconnections to be explored by EUL, between ESFRI RIs and the above scientific domains are shown in the pictures below. A PDF file was uploaded to the Ownsky Cloud, so that, all attendees to the Workshop may have the opportunity to read further information about the ESFRI's potential interconnections. (File "WP2 Workshop #1 - ESFRI Scientific Domains & Projects.pdf" that can be found in folder "EUL Project 2021/WP2 Innovation Platform/WP2.2 Test phase of EUL association Innovation Platform").



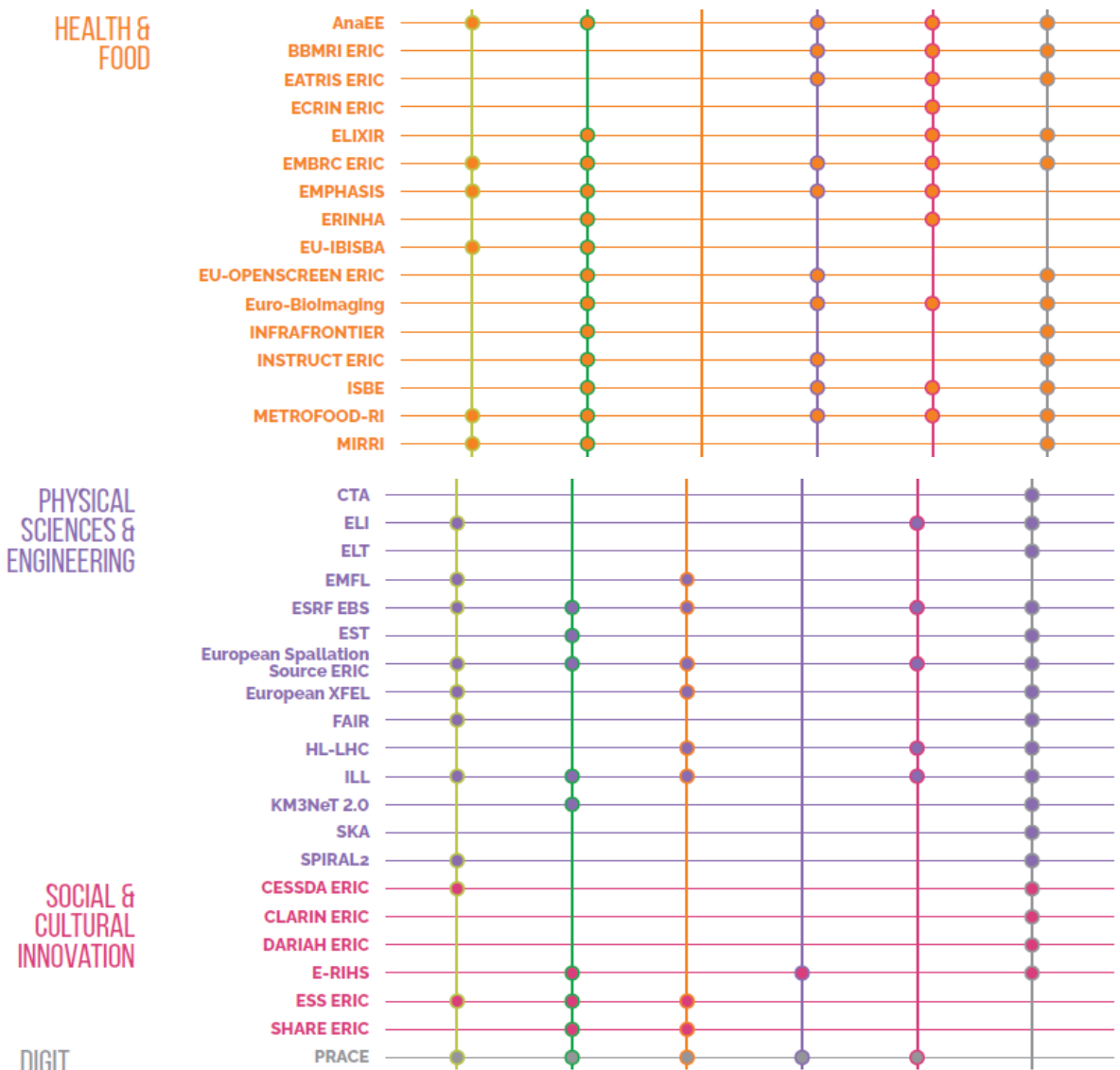


Fig 2: Existing interconnections in ESFRI infrastructures

A Google Form (Link: <https://forms.gle/24EdduJKmYehYL8g7>) including the following four questions was prepared to collect the opinion of all EUL partners and stakeholders that attended the workshop. **Fig 3.**

- **Question 1:** Among the 6 Scientific Domains prescribed by ESFRI, please tell us, in what Scientific Domains should the EUL Association be focused on?
- **Question 2:** Please, take a look at the different ESFRI projects and the 6 Scientific Domains prescribed by ESFRI, and tell us with what Scientific Domains do you think the EUL Association should develop its interconnections?
- **Question 3:** Please, take a look at the different ESFRI projects and the 6 Scientific Domains prescribed by ESFRI, and tell us with what ESFRI Projects do you think the EUL Association should develop its interconnections?

- **Question 4:** Please, take a look at the different ESFRI projects and the 6 Scientific Domains prescribed by ESFRI. In your opinion, what aspects should be considered by the EUL Association in order to secure constant improvement on new segments?


Exercise 1. | Workshop#1 WP2. EUL Project

Is there any room for disruption on new segments?

* Erforderlich

DATE *

Datum

dd/mm/yyyy 

FIRST NAME: *

Meine Antwort

LAST NAME: *

Meine Antwort

AFFILIATION *

Meine Antwort

Among the 6 Scientific Domains prescribed by ESFRI, please tell us, in what Scientific Domains should the EUL Association be focused on? Please, pick the answer that better fit your thoughts. *

- ☐ Only one Scientific domain
- ☐ More than one Scientific domain

Please, take a look at the different ESFRI projects and the 6 Scientific Domains prescribed by ESFRI, and tell us with what Scientific Domains do you think the EUL Association should develop its interconnections? Please, pick the answer that better fit your thoughts. Multiple selection is also possible. *

- ☐ Energy
- ☐ Environment
- ☐ Ealth & Food
- ☐ Physical Sciences and Engineering
- ☐ Social and Cultural Innovation
- ☐ Digit
- ☐ Sonstiges: _____

Please, take a look at the different ESFRI projects and the 6 Scientific Domains prescribed by ESFRI, and tell us with what ESFRI Projects/Infrastructures do you think the EUL Association should develop its interconnections? Multiple selection is also possible.

ENERGY

- ☐ ECCSEL ERIC
- ☐ EU-SOLARIS
- ☐ IFMIF-DONES
- ☐ JHR
- ☐ MYRRHA
- ☐ WindScanner

ENVIRONMENT

- ☐ ACTRIS
- ☐ DANUBIUS-RI
- ☐ DiSSCo
- ☐ EISCAT_3D
- ☐ eLTER
- ☐ EMSO ERIC
- ☐ EPOS
- ☐ EURO-ARGO ERIC
- ☐ IAGOS
- ☐ ICOS ERIC
- ☐ LifeWatch ERIC

HEALTH & FOOD

- ☐ AnaEE
- ☐ BBMRI ERIC
- ☐ EATRIS ERIC
- ☐ ECRIN ERIC
- ☐ ELIXIR
- ☐ EMBRC ERIC
- ☐ EMPHASIS
- ☐ ERINHA
- ☐ EU-IBISBA
- ☐ EU-OPENSOURCE ERIC
- ☐ Euro-BioImaging
- ☐ INFRAFRONTIER
- ☐ INSTRUCT ERIC
- ☐ ISBE
- ☐ METROFOOD-RI
- ☐ MIRRI



PHYSICAL SCIENCES AND ENGINEERING

- ☐ CTA
- ☐ ELI
- ☐ ELT
- ☐ EMFL
- ☐ ESRF EBS
- ☐ EST
- ☐ European Spallation Source ERIC
- ☐ European XFEL
- ☐ FAIR
- ☐ HL-LHC
- ☐ ILL
- ☐ KM3NeT 2.0
- ☐ SKA
- ☐ SPIRAL2

SOCIAL AND CULTURAL INNOVATION

- ☐ CESSDA ERIC
- ☐ CLARIN ERIC
- ☐ DARIAH ERIC
- ☐ E-RIHS
- ☐ ESS ERIC
- ☐ SHARE ERIC

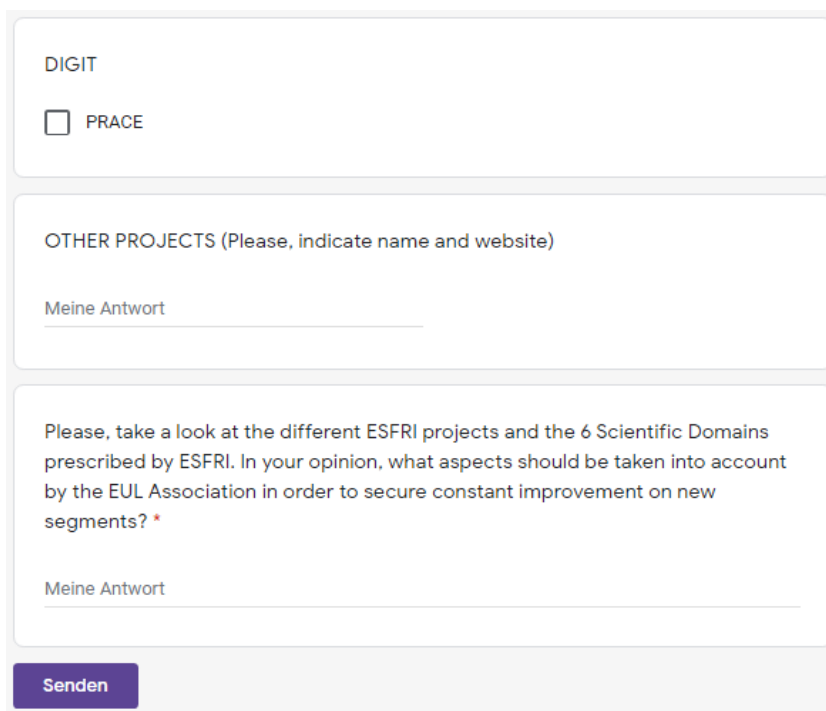


Fig 3: Google Form used to explore the interest of EUL partners

Objective 2:

For achieving this objective, a total of two different tasks were considered necessary to prepare the questionnaire that would be used later for the Applicants Interview.

- T1. Evaluation and discussion about impressions and ideas for improvement of EUL Website (<https://undergroundlabs.network/>).
- T2. First session of evaluation and discussion to processing of Test Scenarios.

Furthermore, a brief introduction of the EUL website was carried out during the workshop, giving the possibility that all participants may get familiar with its content.

EXERCISE 2. Feedback about the website

It was designed and carried out for knowing the opinion of all workshop's attendees. Evaluating and discussing about impressions and ideas that may improve the current EUL Website.

Padlet tool (Link: <https://padlet.com/michaellay/2ybch6sv9usj1h3t>) was used for this exercise, in which all attendees had the opportunity to make their contribution by answering the following predefined questions.

1. What do you think about the design of the website? Please write down some ideas in new boxes below.

2. Do you think the website works well? Please write down your experience in new boxes below.
3. What needs to be improved at the website? Please share your suggestions in new boxes below.
4. Is the content of general EUL information well balanced?
5. Do you think the underground laboratories are well presented at the EUL website?
6. At the moment potential customers can submit their inquiry by inserting a message on the website form. EUL representatives receive it as an email. Do you think the website should provide more options to upload project related content?

EXERCISE 3. Feedback from the perspective of a potential customer

It was designed making participants to imagine they are a potential customer and want to contact the EUL network for sending an inquiry for a project within one or more UL's.

Padlet tool (Link: <https://padlet.com/michaellay/jngs2jtj90q2powi>) was used for this exercise, in which all attendees had the opportunity to make their contribution by answering the following predefined questions.

1. Which are the most useful information provided at the website undergroundlabs.network to submit your inquiry?
2. Imagine you want to start your project in an underground laboratory. How would you like to start the first contact to communicate your inquiry after visiting the EUL website?
3. Do you wish to add content as plain text to the inquiry?
4. Do you wish to upload figures (diagrams, photographs, maps, sketches, etc.)?
5. Do you wish to get a confirmation via email containing all the data of your inquiry?

EXERCISE 4. Feedback from the perspective of an EUL responsible

It was designed making participants to imagine they are one EUL responsible for the reception of project inquiries.

Padlet tool (Link: <https://padlet.com/michaellay/wrptr58f0jn61o0a>) was used for this exercise, in which all attendees had the opportunity to make their contribution by answering the following multi-answer predefined questions.

1. In general, what formal type do you prefer for processing submitted inquiries at the EUL?
 - a) An open inquiry as plain text only is enough.
 - b) Data based parameters illustrated in lists or diagrams are useful. A project abstract as plain text should be included in the inquiry.
2. What is a sufficient size of a project abstract as plain text?

- a) 1/2 A4 page (approx. 250 words)
 - b) one A4 page (approx. 500 words)
 - c) More than one page is necessary for the abstract. Please write the maximum page number in a new box below
3. Additional figures are ...
- a) Rejected
 - b) Optional
 - c) Mandatory

Test Scenarios

A total of 7 Test Scenarios were prepared by the EUL project partner SKB (Marcus Laaksoharju) and TalTech (Veiko Karu and Karin Robam) as below. Files of the TS #1 to #7 was annexed to the appendix.

1. Geophysical Detection of EDZ/HDZ Around Tunnels
2. Unravelling the cryptic microfossil Frutexitites – a biosignature for microbial Fe-cycling through Earth history?
3. Tracing the precipitation of calcite by a multiproxy approach – In situ experiments in an UL
4. Developing and implementation of Real Time Grouting Control Method (RTGCM) for rational tunneling with focus on grout penetration ability and real spread
5. Fe(II) biomineralisation and La enrichment during oxidation of fracture groundwater
6. Microbial community structures and activities in deep sub-surface fracture waters
7. 3D underground mine surveying with drone mounted laser scan sensors

In order to introduce them to the different workshop attendees, the following four tasks were designed, so that, everybody could get familiar with the Test Scenarios that would be used in a later stage to check that all expected functionalities and services of the EUL Innovation Platform meet the needs of users with different backgrounds.

- a. Short Presentation of 6 Test Scenario: 3' each
- b. Assignment of TS (Individual Analysis): 10'
- c. Presentation of guidelines for processing TS: 10'
- d. Evaluation and discussion of TS: Homework.

EXERCISE 5. Evaluation and discussion of Test Scenarios

Short Presentation of 6 Test Scenario:

A Summary Introduction of TS #1, #3 and #5 was carried out by Mr. Michael Lay and the remaining TS #2, #4 and #6 were introduced by Mr. Jose Garcia del Real.

A Keyword analysis was undertaken identifying main keywords in groups of one, two and three words for each TS already introduced. During the short presentation of 3 minutes, each TS was explained emphasizing its objectives, tasks, required resources and duration, based on the information previously provided by the partner SKB.

TS #1 Geophysical Detection of EDZ/HDZ Around Tunnels

Keyword Density x1	Keyword Density x2	Keyword Density x3
9 (3%) damage	5 (2%) edz hdz	2 (1%) detection edz hdz
7 (2%) edz	3 (1%) geophysical methods	2 (1%) cross hole seismic
6 (2%) geophysical	3 (1%) cross hole	2 (1%) within eul network
6 (2%) hdz	3 (1%) res ip	2 (1%) European electrical outlet
6 (2%) methods	3 (1%) been performed	2 (1%) 30 extension cord
6 (2%) been	3 (1%) eul network	2 (1%) or bring Canada
6 (2%) ul	3 (1%) extension cord	2 (1%) bring Canada more
5 (1%) project	2 (1%) detection edz	2 (1%) Canada more difficult
5 (1%) using	2 (1%) micro scale	2 (1%) more difficult logistically
4 (1%) detection	2 (1%) non invasive	1 (0%) test case project

Table 1: Keyword analysis for TS#1.

Objectives

Detection of EDZ/HDZ with geophysical methods to understand the nature of macroscopic fractures after constructed excavation

Tasks

Correlate spatial distribution of damage around an excavation with geophysical properties
Recommend a methodology for damage monitoring and detection
Correlate damage detected levels with laboratory strength thresholds

Resources Required

Type of Access to the UL:	By car	Personnel:	For transportation
Other Labs:	N/A	Utilities:	
Other Resources:			
Onsite transportation of staff and material		Computing Services:	N/A
Duration:	4 working days	Tools:	Hilti hand held drill with bits and core drill, borehole camera
		Third Parties:	N/A

Fig. 4: Content introduced to attendees related to TS#1.

TS #2 Unravelling the cryptic microfossil Frutexites – a biosignature for microbial Fe-cycling through Earth history?

Keyword Density x1	Keyword Density x2	Keyword Density x3
8 (4%) frutexites	2 (1%) cryptic microfossil	1 (1%) unravelling cryptic microfossil
6 (3%) samples	2 (1%) microbial fe	1 (1%) cryptic microfossil frutexites
4 (2%) microbial	2 (1%) earth history	1 (1%) microfossil frutexites biosignature
4 (2%) project	2 (1%) recent ancient	1 (1%) frutexites biosignature microbial
4 (2%) recent	2 (1%) living frutexites	1 (1%) biosignature microbial fe
3 (2%) fe	2 (1%) frutexites samples	1 (1%) microbial fe cycling
3 (2%) structures	2 (1%) water samples	1 (1%) fe cycling through
3 (2%) ancient	1 (1%) unravelling cryptic	1 (1%) cycling through earth
3 (2%) biosignatures	1 (1%) microfossil frutexites	1 (1%) through earth history
3 (2%) different	1 (1%) frutexites biosignature	1 (1%) stromatolitic iron rich

Table 2: Keyword analysis for TS#2.

Objectives

Investigation of recent microbial structures which are quite similar to the fossil Frutexites and the identification of characteristic biosignatures.

Tasks

Sampling of living Frutexites (microscopically and geochemically investigated and compared)

Immediate cooling and sample preparation and conservation

Chemical Analysis of adjacent water samples

Resources Required

Type of Access to the UL: By car

Other Labs: nearby chemistry lab

Other Resources:

Site for Immediate cooling and sample /preparation and conservation

Personnel: N/A

Utilities: N/A

Computing Services: N/A

Tools: N/A

Third Parties: N/A

Duration: 3 working days

Fig. 5: Content introduced to attendees related to TS#2.

TS #3 Tracing the precipitation of calcite by a multiproxy approach – In situ experiments in an UL

Keyword Density x1	Keyword Density x2	Keyword Density x3
7 (3%) calcite	2 (1%) multiproxy approach	2 (1%) selected ul ul's
4 (1%) ul	2 (1%) carbonate minerals	1 (0%) test case application
4 (1%) using	2 (1%) elements isotopes	1 (0%) case application australian
4 (1%) present	2 (1%) within eul	1 (0%) application Australian university
4 (1%) ul's	2 (1%) several ul's	1 (0%) Australian university tracing
3 (1%) university	2 (1%) selected ul	1 (0%) university tracing precipitation
3 (1%) tracing	2 (1%) ul ul's	1 (0%) tracing precipitation calcite
3 (1%) approach	1 (0%) test case	1 (0%) precipitation calcite multiproxy
3 (1%) situ	1 (0%) case application	1 (0%) calcite multiproxy approach
3 (1%) project	1 (0%) application australian	1 (0%) multiproxy approach situ

Table 3: Keyword analysis for TS#3.

Objectives

Investigating in situ calcite precipitation from fracture groundwater in UL to discover the environmental conditions during growth

Tasks

Measuring elemental and isotopic signals by using a multiproxy approach
Understand incorporation behaviour of elements and isotopes during growth
Investigate timing and temperature relationships between groundwater and minerals

Resources Required

Type of Access to the UL: By car
Other Labs: Own facilities for batch-tests
Other Resources:
Own laboratory for experimental setup tests,
Access to two or four boreholes to install
Equipment in UL

Personnel: N/A
Utilities:
Computing Services: N/A
Tools: N/A
Third Parties: N/A

Fig. 6: Content introduced to attendees related to TS#3.

TS #4 Developing and implementation of Real Time Grouting Control Method (RTGCM) for rational tunnelling with focus on grout penetration ability and real spread

Keyword Density x1	Keyword Density x2	Keyword Density x3
14 (5%) project	4 (2%) bore holes	3 (1%) senior research project
10 (3%) method	3 (1%) grout spread	2 (1%) real time grouting
10 (3%) grout	3 (1%) senior research	2 (1%) time grouting control
8 (3%) grouting	3 (1%) research project	2 (1%) grouting control method
6 (2%) time	2 (1%) real time	2 (1%) control method rtgcm
6 (2%) aperture	2 (1%) time grouting	2 (1%) hydraulic aperture geometric
6 (2%) fractures	2 (1%) grouting control	2 (1%) aperture geometric aperture
6 (2%) selected	2 (1%) control method	2 (1%) three four suitable
5 (2%) field	2 (1%) method rtgcm	2 (1%) four suitable test
5 (2%) bore	2 (1%) grout penetration	2 (1%) suitable test places

Table 4: Keyword analysis for TS#4.

Objectives

Calculation of grout penetration in time (Method's verification in field)

Tasks

2 Projects (PhD and a Senior Research project). The PhD model tests in lab with long slot with varied aperture. The Senior project will verify the RTGC method in field. Suitable conductive fractures in an UL would be selected, investigated and grouted.

Resources Required

Type of Access to the UL: N/A

Other Labs: N/A

Other Resources:

Access to tunnel excavation data

Access to an UL-tunnel (three or four suitable test places)

Personnel: N/A

Utilities: N/A

Computing Services: N/A

Tools: N/A

Third Parties: For Grouting and Drilling

Duration: N/A

Fig. 7: Content introduced to attendees related to TS#4.

TS #5 Fe(II) biomineralisation and La enrichment during oxidation of fracture groundwater

Keyword Density x1	Keyword Density x2	Keyword Density x3
6 (3%) fe	4 (2%) light source	3 (2%) synchrotron radiation facility
5 (3%) la	3 (2%) source usa	2 (1%) ray absorption fine
5 (3%) source	3 (2%) synchrotron radiation	2 (1%) absorption fine structure
4 (2%) project	3 (2%) radiation facility	2 (1%) advanced light source
4 (2%) advanced	2 (1%) la enrichment	2 (1%) light source usa
4 (2%) ray	2 (1%) eul network	2 (1%) radiation facility swiss
4 (2%) synchrotron	2 (1%) microbial mat	2 (1%) facility swiss light
4 (2%) light	2 (1%) oxide layers	2 (1%) swiss light source
3 (2%) two	2 (1%) ray absorption	2 (1%) allocation beamline time
3 (2%) ul	2 (1%) absorption fine	2 (1%) beamline time any

Table 5: Keyword analysis for TS#5.

Objectives

Investigating samples of Fe(II) biomineralization and La enrichment in UL fracture groundwater during oxidation with advanced x-ray techniques

Tasks

Find UL with hits in data base and possibility of sampling
Specify environmental conditions and chemical phases of fracture groundwater
Analyse samples with SXTM, NEXAFS, EXAFS with respect to iron and metal species

Resources Required

Type of Access to the UL: By car
Other Labs: Advanced x-ray laboratories
Other Resources:
Allocated beamline to analyse samples

Personnel: N/A
Utilities:
Computing Services: N/A
Tools: N/A
Third Parties: X-ray laboratories for material analyses

Fig. 8: Content introduced to attendees related to TS#5.

TS #6 Microbial community structures and activities in deep sub-surface fracture waters

Keyword Density x1	Keyword Density x2	Keyword Density x3
6 (3%) deep	3 (2%) deep subsurface	2 (1%) eul research database
6 (3%) project	2 (1%) fracture waters	2 (1%) access ul tunnels
5 (2%) eul	2 (1%) deep biosphere	1 (1%) microbial community structures
4 (2%) subsurface	2 (1%) eul research	1 (1%) community structures activities
4 (2%) environment	2 (1%) research database	1 (1%) structures activities deep
4 (2%) ul's	2 (1%) access ul	1 (1%) activities deep sub-surface
4 (2%) access	2 (1%) ul tunnels	1 (1%) deep sub-surface fracture
3 (1%) microbial	1 (1%) microbial community	1 (1%) sub-surface fracture waters
3 (1%) microorganisms	1 (1%) community structures	1 (1%) continental subsurface estimated
3 (1%) data	1 (1%) structures activities	1 (1%) subsurface estimated contain

Table 6: Keyword analysis for TS#6.

Objectives

To investigate diversity, viability and metabolic activity of microorganisms from at least twenty groundwaters with different depth and origins.

Tasks

Biology data will be linked to the chemistry, geology, and hydrology of the environment to create a comprehensive model

Resources Required

Type of Access to the UL: N/A

Other Labs: N/A

Other Resources:

Access to EUL research database (e.g. geochemistry and hydrology)

Access to an UL-tunnel (project leader and co-workers)

A list of suitable boreholes to be sampled

Physiochemical data collection

Personnel: Technical assistance for sampling

Utilities: N/A

Computing Services: N/A

Tools: N/A

Third Parties: N/A

Duration: N/A

Fig. 9: Content introduced to attendees related to TS#6.

TS #7 3D underground mine surveying with drone mounted laser scan sensors

Test scenario #7 was added after the workshop. The corresponding document was uploaded to the project server in order to provide access for every project partner.

Assignment of Test Scenarios

Table 7. below depicts the list of assigned Test Scenarios to the workshop participants for a further individual analysis. After the first workshop, a seventh test scenario was added from TalTech. This was integrated on the assignment process after the workshop. A wrap-up document with a brief overview about the different possibilities to contribute, providing feedback with respect to the evaluation and discussion of the test scenarios was sent to all EUL partners on June 7th 2021. They had the opportunity to pick the two pre-assigned test scenarios and providing their answers to the pre-defined questions available via the online form provided in advance.

#	Title	Assigned to
1	Geophysical Detection of EDZ/HDZ Around Tunnels	Vytienis Mockus Rüdiger Giese Katarzyna Szkliniarz Katrín Jaksch Michael Lay
2	Unravelling the cryptic microfossil Frutexitites – a biosignature for microbial Fe-cycling through Earth history?	Vytienis Mockus Rüdiger Giese Katarzyna Szkliniarz Ossi Kotavaara Jose Garcia del Real
3	Tracing the precipitation of calcite by a multiproxy approach – In situ experiments in an UL	Paivi Aro Marko Holma Marcus Laaksoharju Pavel Petrov Irina Savelyeva
4	Developing and implementation of Real Time Grouting Control Method (RTGCM) for rational tunneling with focus on grout penetration ability and real spread	Paivi Aro Marko Holma Marcus Laaksoharju Pavel Petrov George Barakos
5	Fe(II) biomineralisation and La enrichment during oxidation of fracture groundwater	Nikolai Kolesnikov Jari Joutsenvaara Krzysztof Fulawka Helmut Mischke Karin Robam
6	Microbial community structures and activities in deep sub-surface fracture waters	Nikolai Kolesnikov Jari Joutsenvaara Krzysztof Fulawka Ossi Kotavaara Jose Garcia del Real
7	3D underground mine surveying with drone mounted laser scan sensors	Karin Robam Irina Savelyeva George Barakos Katrín Jaksch Michael Lay

Table 7: List of assigned Test Scenarios.

Presentation of guidelines for processing Test Scenarios

All participants included in the list of assigned TSs have had the chance to read the two test scenarios they were assigned to. After reading the TS, they had to answer more detailed questions about the assigned TS that were provided via the online Google Form prepared for this exercise. Questions should be answered considering both perspectives, 1) as a potential customer and 2) as responsible of reception from EUL. Input must be provided individually by each participant.

Evaluation and discussion of TS.

For the individual Evaluation and discussion of the assigned TS, the following online form and questions were provided to all attendees.

(Link of the Online Form:

https://docs.google.com/forms/d/e/1FAIpQLSfEdWppw_bMLHsoHHvN3Qf6tn3-S0VNZbcj85F0yBrFaIWdQA/viewform)



EUL WP2 First workshop

Exercise 5 Evaluation and discussion of test scenarios

* Erforderlich

Name

Meine Antwort

Affiliation *

Meine Antwort

Number of test scenario *

- | | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Due to your impression, do you think the current test scenario is representative?

- | | | | |
|-----|-----------------------|-----------------------|----|
| | 1 | 2 | |
| Yes | <input type="radio"/> | <input type="radio"/> | No |

Which data based parameters should a web form contain to transfer the project information from the test scenario to the recipients? *

- ☐ Personal information of contact person: name, affiliation, department, sub-department, email, phone numbers, address
- ☐ Project title, abbreviation, keywords, related subjects, ESFRI-goals
- ☐ Project category: basic research, applied research, contract research, industrial research and development
- ☐ Project partners: name, affiliation, department, sub-department, email, phone numbers, address
- ☐ Current project phase: pre-application, proposal sent, proposal accepted, budget granted
- ☐ Total budget, own contribution, co-financing amount/ sources
- ☐ Project duration, kick-off date
- ☐ Total demand of planned time duration within the underground laboratory including setup and shutdown
- ☐ Planned activities within the underground laboratory
- ☐ Application of methods
- ☐ Usage of materials from outside UL
- ☐ Demand of special rock type, rock conditions and approx. base area of investigated rock section
- ☐ Environmental requirements: temperature, air pressure, humidity
- ☐ special environmental requirements due to desired laboratory conditions (vibrations, dust, natural radiation, electromagnetic radiation, sound immission)
- ☐ Approx. underground base area of long duration demand of mined void space (besides temporal personnel or equipment setting during working days)
- ☐ Approx. base area of long duration demand on surface (besides temporal personnel or equipment setting during working days)
- ☐ Onsite transportation demand
- ☐ Onsite infrastructure demand: Electricity (mean/ peak power consumption), underground work lighting, air, water, etc.
- ☐ Onsite equipment demand
- ☐ Office space capacity: underground/ on surface
- ☐ Sonstiges: _____

Besides above mentioned data based parameters and the project abstract, what kind of information are additionally necessary to be included in the inquiry based on the current test scenario?

Meine Antwort

Due to your impression, what could be possible obstacles during the submission and processing of your inquiry at the EUL association in general and/ or based on your current test scenario? *

Meine Antwort

What are your suggestions for improving the process of submitting inquiries to the EUL association?

Meine Antwort

Do you have additional comments regarding to the submission and processing of the inquiry? Please let us know:

Meine Antwort

Senden

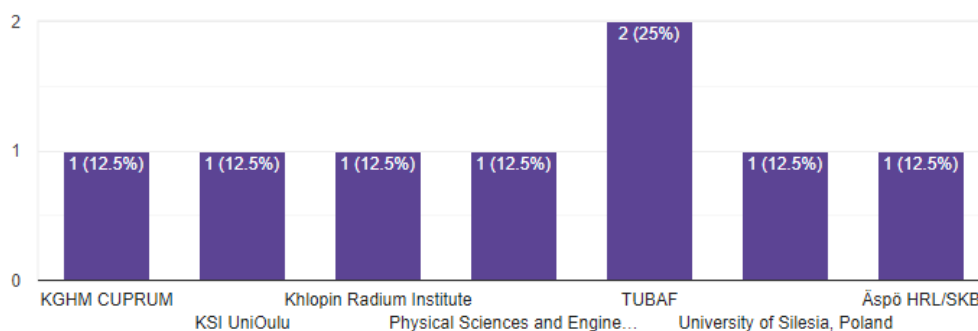
Fig. 10: Google Form for Evaluation and discussion of the assigned TS

Results Exercises #1 to #5

EXERCISE #1 – Results. Disruption on new segments

AFFILIATION

8 responses



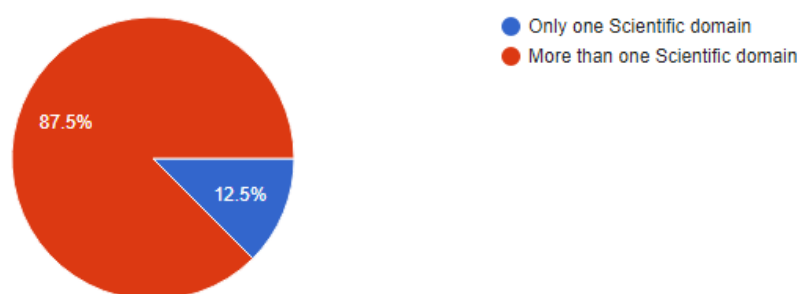
Graph 3: Affiliation

Results:

8 Responses from 7 Project Partners out of 13 Partners in total. Participation: **53.8%**

Among the 6 Scientific Domains prescribed by ESFRI, please tell us, in what Scientific Domains should the EUL Association be focused on? Please, pick the answer that better fit your thoughts.

8 responses



Graph 4: Number of Scientific domains to be focused on

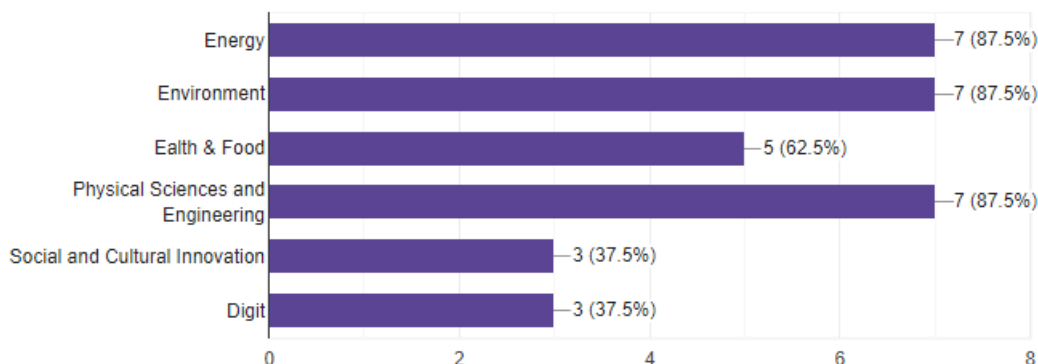
Results:

At this moment, EUL Association is not interested in becoming a distributed Research Infrastructure (ESFRI).

8 Responses from 7 Project Partners out of 13 Partners in total. Participation: **53.8%**

Please, take a look at the different ESFRI projects and the 6 Scientific Domains prescribed by ESFRI, and tell us with what Scientific Domains do you think the EUL Association should develop its interconnections? Please, pick the answer that better fit your thoughts. Multiple selection is also possible.

8 responses



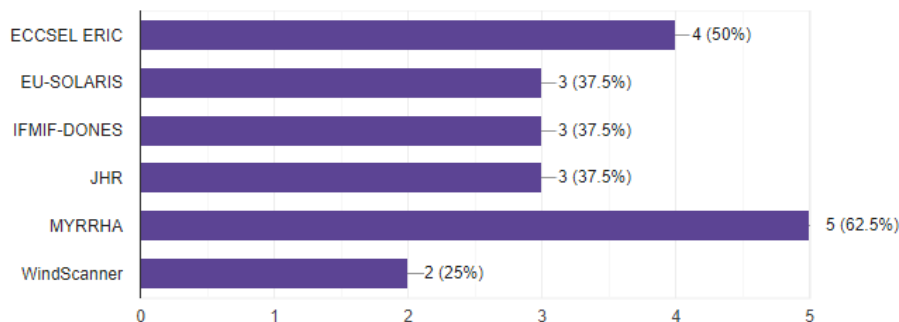
Graph 5: Preferred ESFRI domains for EUL to develop its interconnections

Results:

8 Responses from 7 Project Partners out of 13 Partners in total. Participation: **53.8%**

ENERGY

8 responses



Graph 6: Preferred Potential Interconnections with existing RIs in the Energy field

Results:

8 Responses from 7 Project Partners out of 13 Partners in total. Participation: **53.8%**

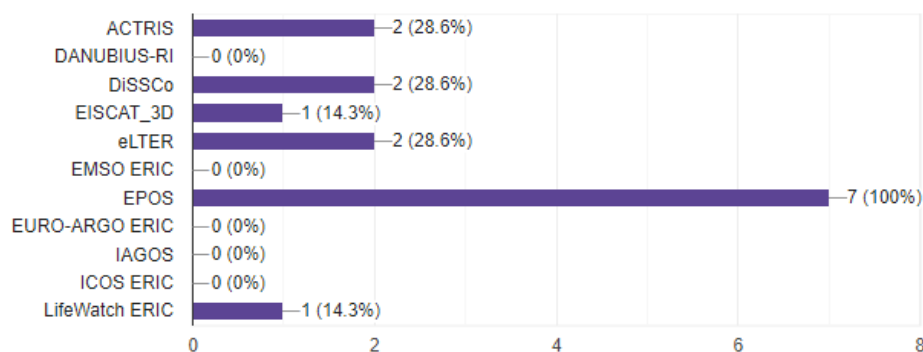
Potential Interconnections with existing Research Infrastructures:

- MYRRHA: Multi-purpose hybrid Research Reactor for High-tech Applications
- ECCSEL ERIC: European Carbon Dioxide Capture and Storage Laboratory Infrastructure
- EU-SOLARIS: European Solar Research Infrastructure for Concentrated Solar Power

- IFMIF-DONES: International Fusion Materials Irradiation Facility - DEMO Oriented Neutron Source
- JHR: Jules Horowitz Reactor
- WindScanner: European WindScanner Facility

ENVIRONMENT

7 responses



Graph 7: Preferred Potential Interconnections with existing RIs in the Environment field

Results:

7 Responses from 6 Project Partners out of 13 Partners in total. Participation: **46.15%**

Potential Interconnections with existing Research Infrastructures:

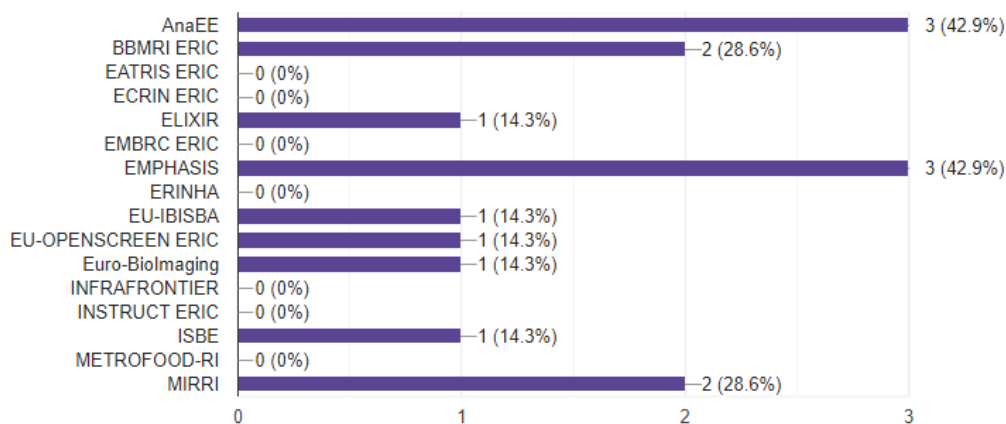
- EPOS European Plate Observing System
- ACTRIS Aerosols, Clouds and Trace gases Research Infrastructure
- DiSSCo Distributed System of Scientific Collections
- eLTER Long-Term Ecosystem Research in Europe
- EISCAT_3D Next generation European Incoherent Scatter radar system
- LifeWatch ERIC e-Infrastructure for Biodiversity and Ecosystem Research

0% of Votes:

- DANUBIUS-RI International Centre for Advanced Studies on River-Sea Systems
- EMSO ERIC European Multidisciplinary Seafloor and water-column Observatory
- EURO-ARGO ERIC European contribution to the international Argo Programme
- IAGOS In-service Aircraft for a Global Observing System
- ICOS ERIC Integrated Carbon Observation System

HEALTH & FOOD

7 responses



Graph 8: Preferred Potential Interconnections with existing RIs in the Health & Food fields

Results:

7 Responses from 6 Project Partners out of 13 Partners in total. Participation: **46.15%**

Potential Interconnections with existing Research Infrastructures:

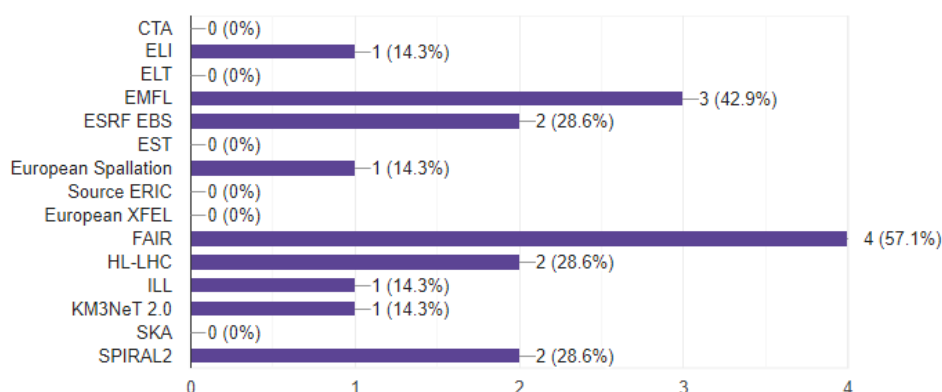
- AnaEE Infrastructure for Analysis and Experimentation on Ecosystems
- EMPHASIS European Infrastructure for Multi-scale Plant Phenomics and Simulation
- BBMRI ERIC Biobanking and BioMolecular Resources Research Infrastructure
- MIRRI Microbial Resource Research Infrastructure
- ELIXIR A distributed infrastructure for life-science information
- EU-IBISBA Industrial Biotechnology Innovation and Synthetic Biology Accelerator
- EU-OPENSOURCE ERIC European Infrastructure of Open Screening
- Euro-BiolImaging European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences
- ISBE Infrastructure for System Biology Europe

0% of Votes:

- METROFOOD-RI Infrastructure for promoting Metrology in Food and Nutrition
- EATRIS ERIC European Advanced Translational Research Infrastructure in Medicine
- ECRIN ERIC European Clinical Research Infrastructure Network
- EMBRC ERIC European Marine Biological Resource Centre
- ERINHA European Research Infrastructure on Highly Pathogenic Agents Platforms for Chemical Biology
- INFRAFRONTIER European Research Infrastructure for the generation, phenotyping, archiving and distribution of mouse disease models
- INSTRUCT ERIC Integrated Structural Biology Infrastructure

PHYSICAL SCIENCES AND ENGINEERING

7 responses



Graph 9: Preferred Potential Interconnections with existing RIs in the Physical Sciences and Engineering fields

Results:

7 Responses from 6 Project Partners out of 13 Partners in total. Participation: **46.15%**

Potential Interconnections with existing Research Infrastructures:

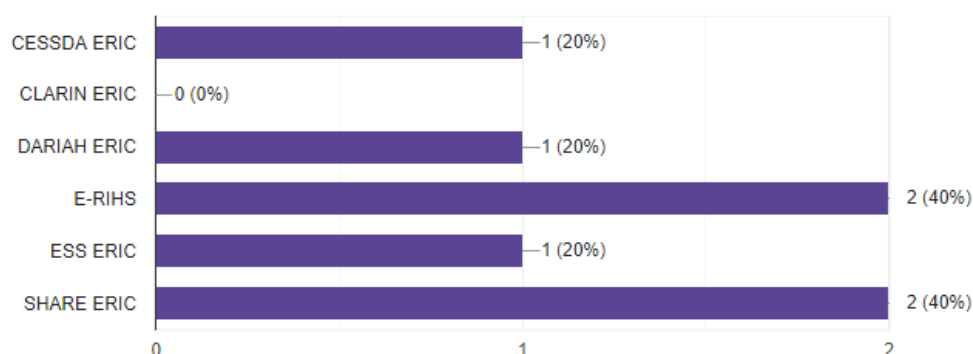
- FAIR Facility for Antiproton and Ion Research
- EMFL European Magnetic Field Laboratory
- ESRF EBS European Synchrotron Radiation Facility
- HL-LHC High-Luminosity Large Hadron Collider
- SPIRAL2 Système de Production d'Ions Radioactifs en Ligne de 2e génération
- ELI Extreme Light Infrastructure
- European Spallation Source ERIC European Spallation Source
- ILL Institut Max von Laue-Paul Langevin
- KM3NeT 2.0 KM3 Neutrino Telescope 2.0

0% of Votes:

- CTA Cherenkov Telescope Array
- ELT Extremely Large Telescope
- Extremely Brilliant Source
- EST European Solar Telescope
- European XFEL European X-Ray Free-Electron Laser Facility
- SKA Square Kilometre Array

SOCIAL AND CULTURAL INNOVATION

5 responses



Graph 10: Preferred Potential Interconnections with existing RIs in the Social and Cultural Innovation fields

Results:

5 Responses from 4 Project Partners out of 13 Partners in total. Participation: **30.76%**

Potential Interconnections with existing Research Infrastructures:

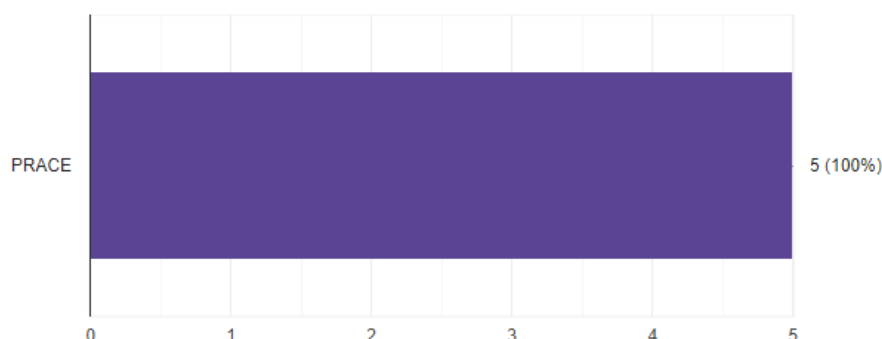
- E-RIHS European Research Infrastructure for Heritage Science
- SHARE ERIC Survey of Health, Ageing and Retirement in Europe
- CESSDA ERIC Consortium of European Social Science Data Archives
- DARIAH ERIC Digital Research Infrastructure for the Arts and Humanities
- ESS ERIC European Social Survey

0% of Votes:

- CLARIN ERIC Common Language Resources and Technology Infrastructure

DIGIT

5 responses



Graph 11: Preferred Potential Interconnections with existing RIs in the Digit field

Results:

5 Responses from 4 Project Partners out of 13 Partners in total. Participation: **30.76%**

Potential Interconnections with existing Research Infrastructures:

- PRACE Partnership for Advanced Computing in Europe

What aspects should be considered by the EUL Association in order to secure constant improvement on new segments?

Regarding this last question included in Exercise 1, a total of 7 answers were provided by the participants of the workshop, summarized below.

- Scope of the projects and ideas should be prepared with respect to current EU policy and trends. We should not be attached to one way of laboratory/association development.
- To follow a) the EU level policies and aims to see here the different ESFRIs (and also to be ESFRIs) are going b) to hear out what the member ULs are doing, aiming at and how these would fit into the existing and future ESFRI. ULs themselves could easily get a status of European cluster collaboration / Cost action network or even that of ERIC within the ESFRI roadmap as a collaborative action.
- By the look of ESRI projects - they should be multidisciplinary, focused on human well-being and social oriented.
- Keep in touch with new project developments.
- Especially energy, physics and engineering domains should be taken into focus. Probably health and nutrition sciences could be very soon a prospective domain. For every project the social-cultural impact should be integrated.
- EUL could promote towards ESFRI establishing new underground research items and innovations concerning e.g. geo-energy, development of underground infrastructure, final disposal of dangerous materials and super safe storage.
- Implementation of an international proven management system to optimize performance, assuring quality and continuous improvement (e.g. LEAN).

EXERCISE #2 – Results. Feedback about the website

Here below can be found a Summary of the workshop attendees' opinions on the EUL website design, content, structure and main functionalities.

Design:

- „... design is perfect.“
- Good graphical design
- Site is very clean

Is the content of general UL information well balanced?

- It has to be emphasized
- Extend of information on the website for each UL needs to be provided, this would help to compare the ULs

Functionality:

- Good from practical and multiplatform point of view
- Selection tool for ULs does not exist yet
- Works nice also via smartphones
- No problems when using the website

Are the ULs well presented?

- General information of the ULs is there, but they need to be brought more to the front

Do you think the website should provide more options to upload content for inquiries?

- It could be an interactive and stepwise process:
- First stage: contact details and basic project information only
- Second stage: detailed project information

Room for improvement: aspects that should be improved, based on the opinion of the workshop's attendees.

Design & structure

- Pop up banners with latest news, news & events on upper horizontal menu
- List of events where and when there is an opportunity to meet the EUL
- Each pages should have their own title, not one title for all pages
- Map of ULs should be more interactive
- ULs should provide 360 virtual visit
- City could be added to display of the ULs
- At the page .../section add footer that highlights that the project was EU funded

Service and policy

- We should ask feedback about the website from users
- Explaining the advantages of EUL „members“
- Short service product description should be added
- A call to fill the form or contact in other forms could be added
- Privacy and cookie policy page should be added

Remake of ULs presentation

- EUL members should provide more and more specific data
- For description page a template could be help to standardize UL information
- ULs scientific domains of interest and section for current research projects should be added
- List or summary of performed and ongoing research project of each UL under .../research
- Section with reviews and opinions from former customers and scientific experts added to the ULs description page
- Logos and hyperlinks of related companies could be added right over the circles section under .../innovation
- Training courses and education initiatives could be added over the circles section under .../education

EXERCISE #3 – Results. Feedback from the perspective of a potential customer

Imagine you are a potential customer and you want to contact the EUL for sending an inquiry for a project within one or more UL's.

Which are the most useful information provided at the website undergroundlabs.network to submit your inquiry?

- Brief outline of each UL with contact information
- EUL website form for implementing a project
- Map of underground laboratories

How would you like to start the first contact to communicate your inquiry after visiting the EUL website?

I would like a fast feedback on the progress of the first contact.

I would propose a two-step approach.

I want to contact an underground laboratory for submitting my inquiry directly.

Do you wish to add content as plain text to the inquiry?

An open inquiry as plain text is enough.

Yes, uploading one A4 page (approx. 500 words) plain text would be useful.

I would propose going with a template structure with mandatory information and then the free form part with attachments as well.

Do you wish to upload figures (diagrams, photographs, maps, sketches, etc.)?

Figures better help to understand the project. They should always be optional.

The first step should be more general. They could be uploaded in the second step.

Do you wish to get a confirmation via email containing all the data of your inquiry?

Yes, and I would also like to receive a confirmation that the inquiry is received.

EXERCISE #4 – Results. Feedback from the perspective of an EUL responsible

Imagine you are an EUL responsible for the reception of project inquiries.

Question 1: In general, what formal type do you prefer for processing submitted inquiries at the EUL?

- a) An open inquiry as plain text only is enough. Result **7 Votes**.
- b) Data based parameters illustrated in lists or diagrams are useful. A project abstract as plain text should be included in the inquiry. Result **0 Votes**.

Question 2: What is a sufficient size of a project abstract as plain text?

- a) 1/2 A4 page (approx. 250 words). Result **1 Vote**.
- b) one A4 page (approx. 500 words). Result **7 Votes**.
- c) More than one page is necessary for the abstract. Please write the maximum page number in a new box below: ... Result **0 Votes**.

Question 3: Additional figures are ...

- a) Rejected. Result **0 Votes**.
- b) Optional. Result **8 Votes**.
- c) Mandatory. Result **0 Votes**.

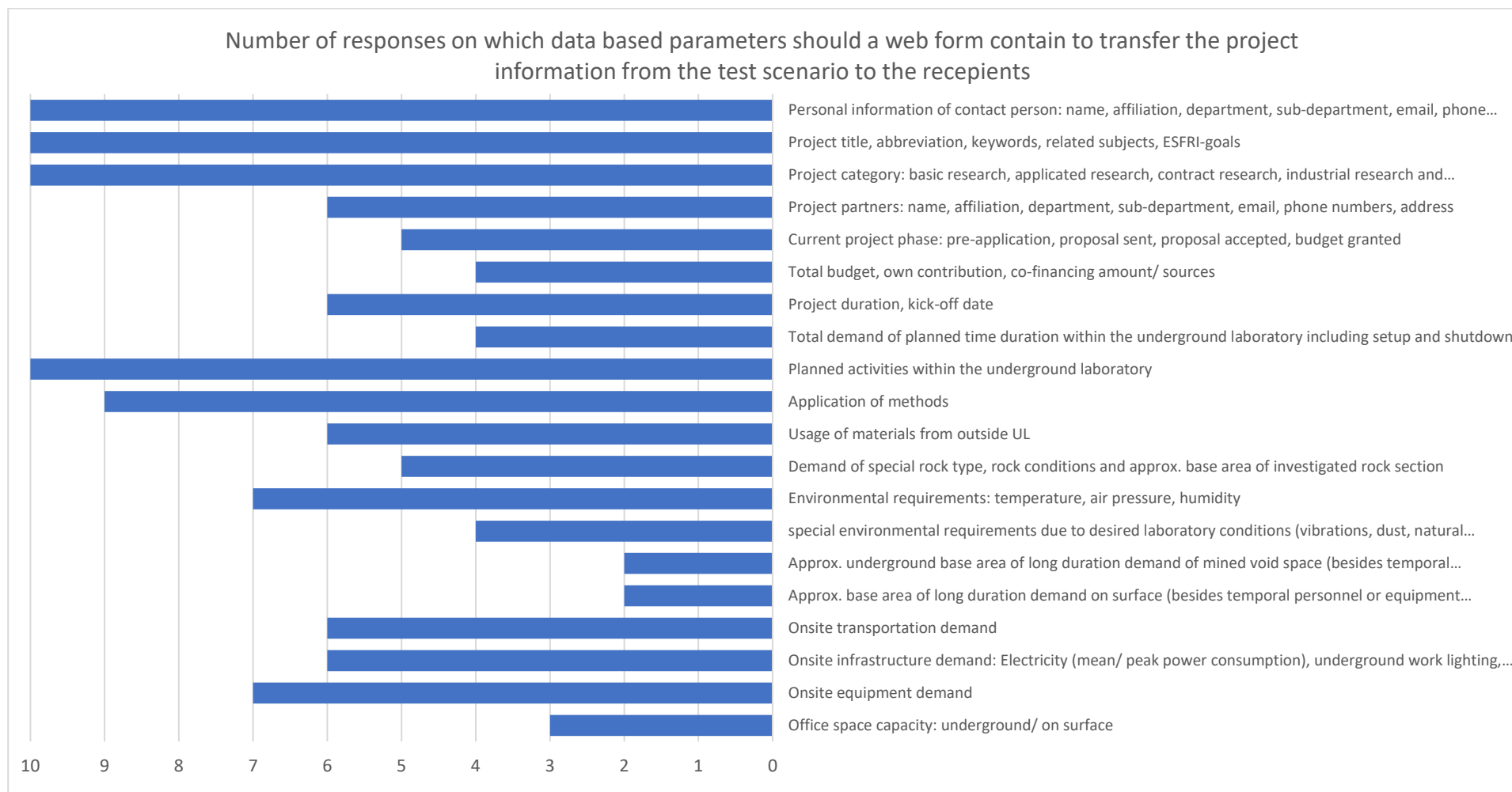
EXERCISE #5 – Results. Evaluation and discussion of Test Scenarios

For the individual Evaluation and discussion of the assigned TS, one online Google Form including some questions was prepared and introduced to all attendees of the Workshop #1 that took place in May 27th, 2021.

Link of the Online Form provided can be found below.

https://docs.google.com/forms/d/e/1FAIpQLSfEdWppw_bMLHsoHHvN3Qf6tn3-S0VNZbcj85F0yBrFaIWdQA/viewform

Guidelines for processing TS, were explained accordingly and all participants were asked to evaluate two TS individually. Results of the evaluation are shown in the **Graph 12** and **Table 8** below.



Graph 12: Results of the Individual Evaluation and discussion of the assigned TS

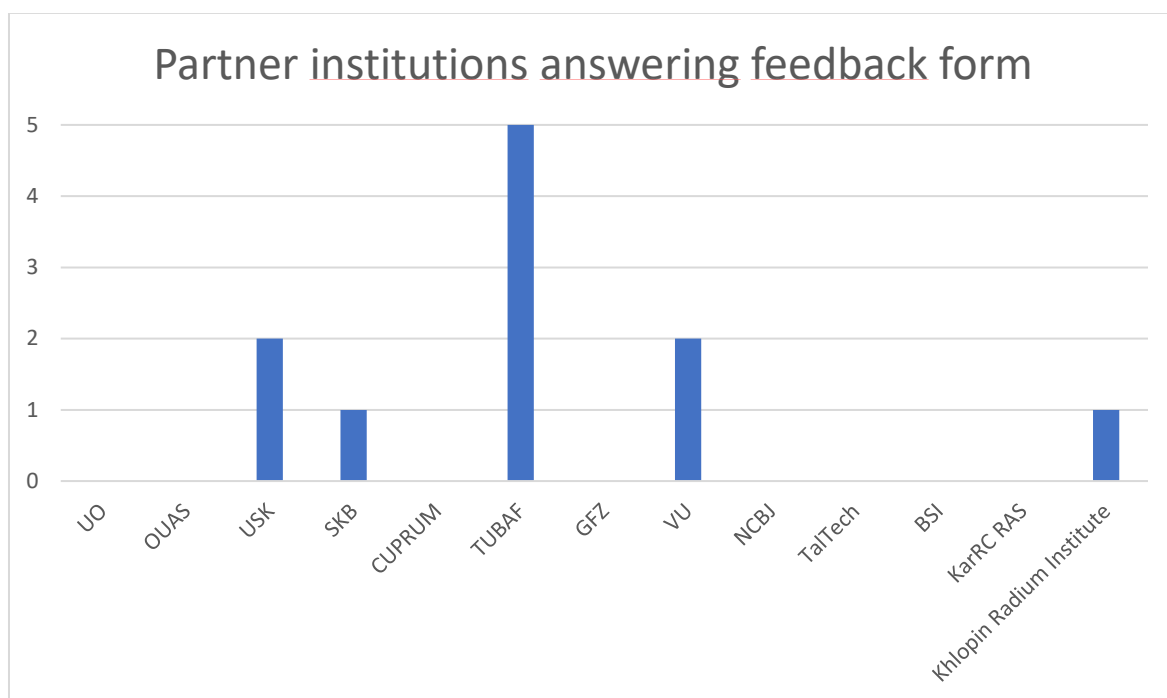
Date	Name	Affiliation	Test Scenario #	Due to your impression, do you think the current test scenario is representative?	Besides above-mentioned data-based parameters and the project abstract, what kind of information are additionally necessary to be included in the inquiry based on the current test scenario?	Due to your impression, what could be possible obstacles during the submission and processing of your inquiry at the EUL association in general and/ or based on your current test scenario?	What are your suggestions for improving the process of submitting inquiries to the EUL association?	Do you have additional comments regarding the submission and processing of the inquiry? Please let us know.
2021/06/07 10:47:15 AM OEZ	Marcus Laaksoharju	Äspö-HRL/SKB	4	1	The first contact should be easy to do and not contact to many detailed questions and to be to complex, the complex discussions should be done at a later stage	To many complex questions may turn away a potential user such as a small business	Simple form is important, the EUL should not judge but distribute the inquiries to all the UL's to see which UL is capable/interested to handle the inquire	Important to establish a first contact as soon as possible
2021/06/07 11:42:36 AM OEZ	Michael	TUBAF	1	1	Health and safety standards valid inside UL, requirements for the potential customers	timing could be critical, but should be not a big issue	EUL association should act under transparent guidelines	
2021/06/07 12:01:48 PM OEZ	Michael	TUBAF	7	1		I am wondering if a drone can maybe lose connection to the controller if it flights around an edge when the distance of void space is getting too long. Maybe this was already analysed during past projects or if not, it could be an interesting point at this project.		
2021/06/07 2:16:08 PM OEZ	Irina	Khlopin Radium Institute	7	1	Requirements for free "airspace" in the mine (no other large-sized moving equipment) and the absence of equipment that can interfere with the frequency of the drone (field "other technical requirements" in database)	Too strict requirements will not allow you to choose the UL, while too soft ones may not consider critical points for the project (in this example, active traffic in narrow tunnels may not allow the drone to move safely)	To include the field "other technical requirements" to the inquiry	
2021/06/08 7:05:47 PM OEZ	Katarzyna Szkliniarz	University of Silesia, Poland	2	1		delay in responding to inquiries due to insufficient information being provided		no
2021/06/08 7:34:04 PM OEZ	Katarzyna Szkliniarz	University of Silesia, Poland	1	1		delay in responding to inquiries due to insufficient information being provided		
2021/06/15 10:58:59 AM OEZ	Vytenis Mockus	Vilnius University	1	1		Too much information needed for the first contact.	It should consist of 2 stages. 1st - online form with basic information with 3-4 fields to get a lead and 2nd - online form (2nd step) with more details, or a possibility to download Word/PDF form to fill in offline and send to the dedicated email/upload to the web.	The process of submission could be explained for the user in an infographic (or text in steps) together with the timeline.

2021/06/15 11:04:15 AM OEZ	Vytenis Mockus	Vilnius University / Project Manager	2	1		For the first contact it should be OK, but would need more details for the final approval and confirmation.		
2021/06/25 1:08:04 PM OEZ	Michael	TUBAF	6	1	Is it possible to extend the research project to a worldwide scale (not only EU laboratories)? This maybe could improve the project.	Accessibility and grade of purity of fracture groundwater from underground laboratories	First step: getting into contact via web-based questionnaire, second step: internal discussion of options at EUL, third step: customer journey	
2021/06/26 11:34:19 PM OEZ	Jose Garcia del Real	TUBAF	3	1	Type of access to the UL	The current form of the EUL Association is basic and doesn't allow to provide all project's information	I would like to receive an email with the confirmation that my inquiry was submitted successfully.	It would be recommendable to add one help section including information on the steps and time frame required to accomplish each step of my inquiry.
2021/06/26 11:51:59 PM OEZ	Jose Garcia del Real	TUBAF	5	1	Type of Access, Use of Third parties	Current EUL Association form is too basic and I cannot communicate efficiently what are my needs for the project.	I would need a prompt response from the EUL Association, to know if they could meet my expectations at what cost. I must make my decision quickly, so that, I can allocate funds to my project on time.	I would need a confirmation email from the EUL Association including the details of my inquiry, and the link over which I can click on to know the status of my inquiry.

Table 8: Results of the Individual Evaluation and discussion of the assigned TS

Based on the individual analysis of 7 Test Scenarios, User Type, Type of Access, Origin, SRL approach, and the assumption that EUL Service was supposedly received, the following aspects were pursued, in order to achieve the objectives of the WP2.

- The overall impression
- Technical and methodological challenges while sending the proposal
- Expectation fulfilment
- Necessary adaptations for the service



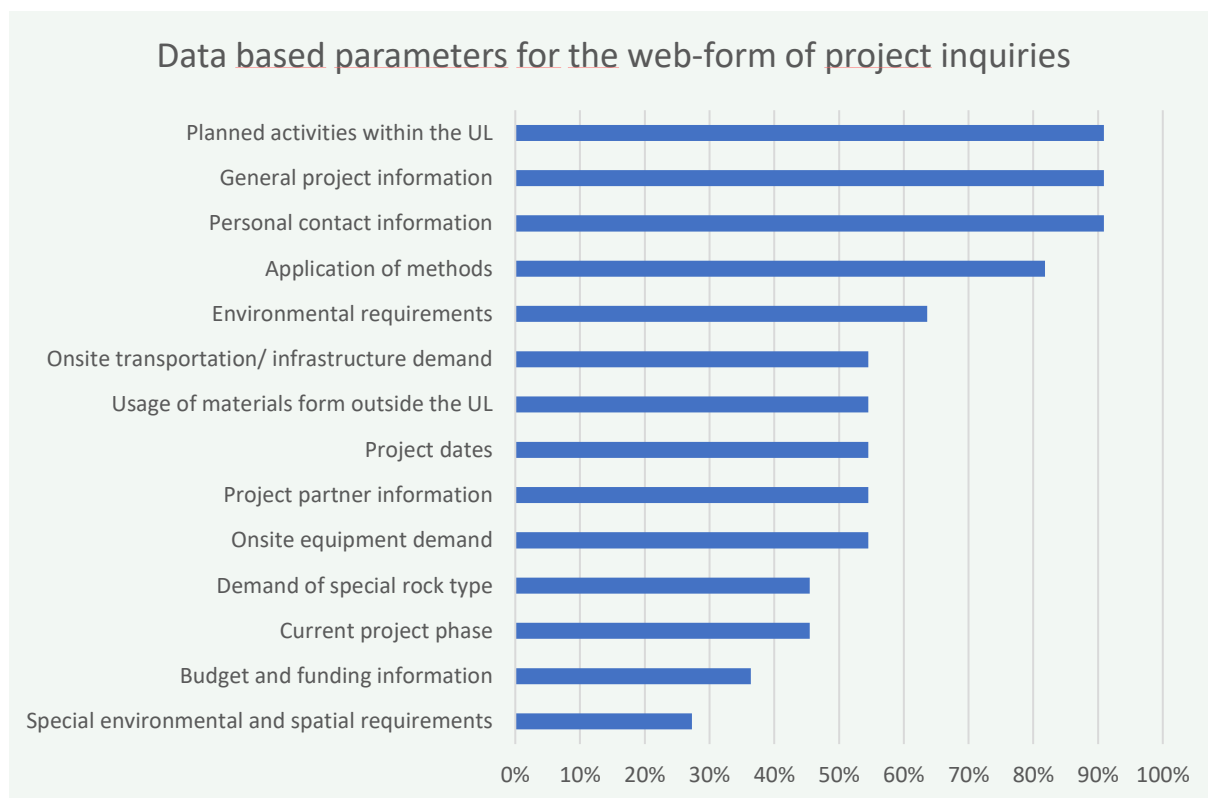
Graph 13: Partner institutions answering feedback form

Results:

11 Responses from 5 Project Partners out of 13 Partners in total. Participation: **38.46%**



Graph 14: Processed Test Scenarios based on 11 received answers



Graph 15: Data based parameters for the web-form of project inquiries

WORKSHOP #2: June 29th, 2021

An invitation to participate in the workshop was sent via an appointment in Outlook Calendar to all EUL partners and stakeholders around 4 weeks before the workshop's date.

List of attendants (shorted by name)

Irina Savelyeva	Marcus Laaksoharju
Jari Joutsenvaara	Michael Lay
Jose Garcia del Real	Nikolai Kolesnikov
Katarzyna Szkliniarz	Veiko Karu

Agenda: Introducing the results of WS#1 to EUL partners, and development of Exercise #6 for pre-processing of Test Scenarios.

1. On checking how well the network reaches the potential customer segments. (Results **Exercise #1**).
2. On securing that all expected functionalities and services of the EUL Innovation Platform meet the needs of users with different backgrounds, based on different test scenarios.
 - a. How smoothly the interaction with the homepage and WBT was? (Results **Exercises #2, #3, #4**).
 - b. How the EUL service was received? (Result **Exercise #5**). Processing Test Scenarios.
3. Test phase including responses. Pre-processing of Test Scenarios in EUL homepage and WBT. **Exercise #6**.

Open Question 1: Besides the data-based parameters and the project abstract, what kind of information are additionally necessary to be included in the inquiry form?

Is it possible to extend the project to a worldwide scale?

Health and safety standards valid inside UL, requirements for the potential customers

The first contact should be easy to do and not contact to many detailed questions and to be too complex, the complex discussions should be done at a later stage

Type of Access to the UL, Use of Third parties

Special needs of applied methods and investigations (as plain text)

Open Question 2: In general, what formal type do you prefer for processing submitted inquiries at the EUL?

Current EUL form is too basic and is not requesting all the information to efficiently submitting my inquiry.

Too strict requirements will not allow you to choose the UL, while too soft ones may not take into account critical points for the project.

Delay in responding to inquiries due to insufficient information being provided

Timing could be critical, but should be not a big issue.

To many complex questions may turn away a potential user such as a small business.

Too much information needed for the first contact.

For the first contact it should be OK, but it would need more details for the final approval and confirmation.

Open Question 3: What are your suggestions for improving the process of submitting inquiries to the EUL association?

I would need a prompt response from the EUL Association, to know if they could meet my expectations at what cost.

First step: getting into contact via webbased questionnaire,
second step: internal discussion of options at EUL, third step: customer journey

EUL association should act under transparent guidelines

EUL should not judge but distribute the inquiries to all the UL's to see which UL is capable/interested to handle the inquiry

I would like to receive an email with the confirmation that my inquiry was submitted successfully.

At the second step an option could be to download the form to fill in offline and send it as pdf to the dedicated email/upload to the web.

Include the field "other technical requirements" to the inquiry

Open Question 4: In general, what formal type do you prefer for processing submitted inquiries at the EUL?

Important to establish a first contact as soon as possible

The process of submission could be explained for the user in a infographic (or text in steps) together with the timeline.

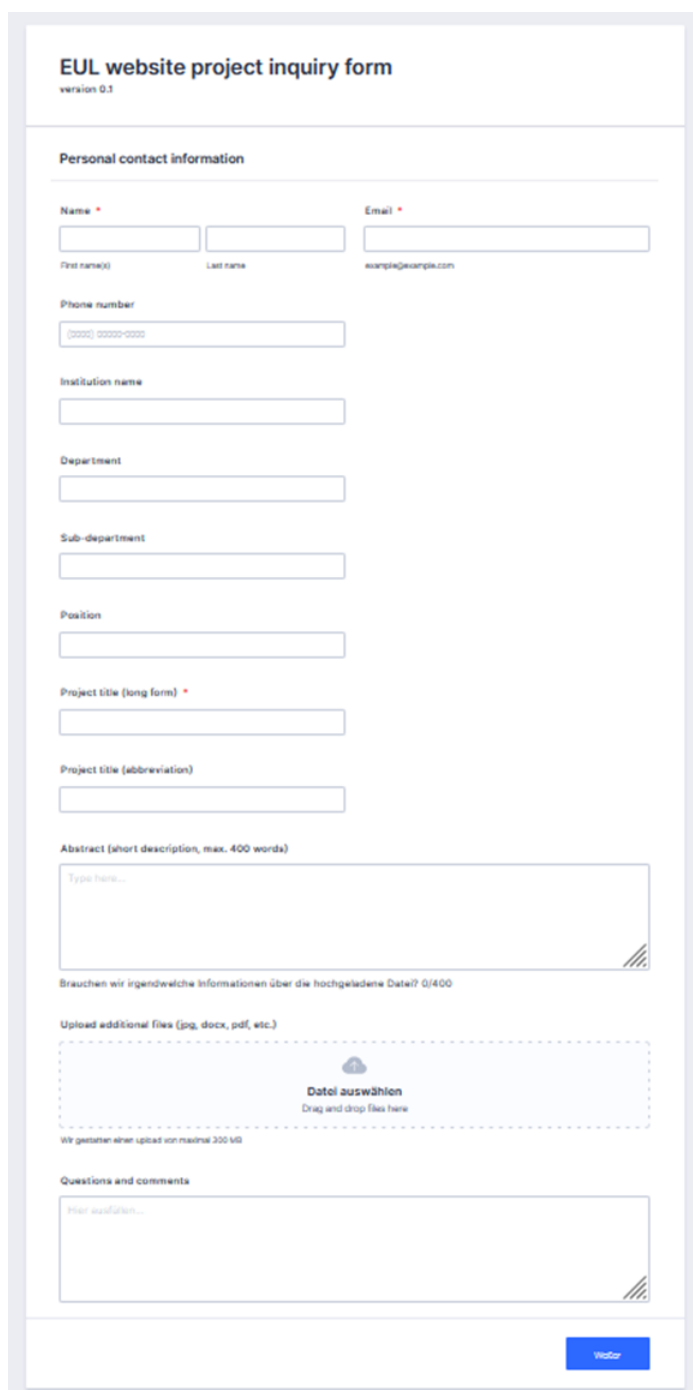
It would be recommendable to add one help section including information on the steps and time frame required to accomplish each step of my inquiry.

I would need an confirmation email from the EUL Association including the details of my inquiry, and the link over which I can click on to know the status of my inquiry.

Proposed Questionnaire

For collecting and evaluating the different research proposals that may be submitted to the EUL network via its online website, a two stages approach was followed to properly address the different requests supposedly made by potential customers.

With respect to the Questionnaire, the following online contact form, provisionally developed using the online tool JOTFORM (<https://eu.jotform.com>), was introduced to all workshop attendees, in order to obtain their feedback and contribution.



First stage:

- Contact information
- Very basic project information
- Upload of abstract
- Possibility to upload more content
- **Space for questions and comments**

Fig. 11: Google Form Stage 1

Research project information

Keywords

Type here...

Suchen sie geeignete Informationen über Ihr Technologieziel?

Methods

Type here...

Suchen sie geeignete Informationen über Ihr Technologieziel?

Objectives and tasks

Here add them...

Deliverables

Here add them...

Expected project duration from to

Daily work schedule from to , in total working hours.

Researcher staff

Name	Last name	Email	Phone	Institution name	Institution type	Address	Country	Role

System- und Datenmanager

Current project phase

☐ Pre-application
☐ Proposal sent
☐ Proposal accepted
☐ Budget granted
☐ Other

Types of access to the UL

☐ Physical
 ☐ Remote
 ☐ Virtual

Research driver

☐ Basic research
 ☐ Applied research
 ☐ Combined research
 ☐ Technical need

☐ What ESFR goal could be related to your project?
☐ Option 1 (to be edited)
☐ Option 2 (to be edited)
☐ Option 3 (to be edited)
☐ other...

Technology readiness level (TRL)

☐ Current
 ☐ Improved after completed project

Symbolic readiness level (SRL)

☐ Current
 ☐ Improved after completed project

Second stage

(after questions from first step are answered):

Detailed project information:


- Keywords, methods, objectives, tasks, deliverables
- Timing
- Staff
- Status
- Access
- Research driver
- ESFR goals
- Technology/ symbiosis readiness levels

Fig. 12: Google Form Stage 2 (first part)

Required resources

Transportation inside the Underground laboratory

Cooperation with other facilities

<  >

Personnel

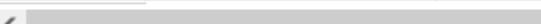
Quantity	Title	Background	Skills	Total working hours	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Speichern und Zelle hinzufügen"/>

Third parties (sub-contractors)

Working field	Company name	Tasks	Total working hours	Provided by UL	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Speichern und Zelle hinzufügen"/>

Utilities

Additional needs


<  >

Computing services

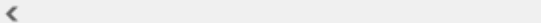
Other resources

Other tools

Upload additional files (jpg, docx, pdf, etc.)



Datei auswählen
 Drag and drop files here

<  >

Wir gestatten einen Upload von maximal 200 MB

Comments

Hier ausfüllen...

Second stage

(after questions from first step are answered):

Required resources provided by UL:

- Transportation
- Cooperation with other facilities
- Personnel
- Third party engagements
- Utilities/ additional needs/ resources/ tools
- Further data upload and comments

Fig. 13: Google Form Stage 2
(second part)

EXERCISE 6. Pre-processing of 7 Test Scenarios.



PROCESS WORK FLOW – NEW PROJECT INQUIRY

STAGE1

First Contact

Q1: Do you agree with the information requested (N/Y)?

Q2: Any missing information (N/Y)?

Q3. On Informing all EUL partners about the NEW Inquiry, Should we: (Pick one)

- a) Forward ALL Contact Information to all EUL partners
- b) Forward only TITLE and ABSTRACT to all EUL partners

Q4. On Informing all EUL partners about the NEW Inquiry, Should we : (Pick one)

- a) Answer Q3.a) + Forward ALL Information to Evaluation Committee (to be created)
- b) Answer Q3.b) + Forward ALL Information to Evaluation Committee (to be created)
- c) Only forward ALL Contact Information to the Evaluation Committee (to be created)
- d) None of the above. At this stage, only process the Information internally.
- e) Other

Results:

Q1. Do you agree with the information requested?

Yes: 7 ||||| 100%

No: 0 | 0%

Other: 0 | 0%

Q2. Any missing information?

Yes: 1 ||| 14%

No: 6 ||||| 86%

Q3. On informing all EUL partners about NEW inquiry, should we:

a) Forward ALL contact information to all EUL partners: 4 ||||| 57%

b) Forward only TITLE and ABSTRACT to EUL partner: 3 ||||| 43%

Q4. On informing all EUL partners about the NEW inquiry, should we:

- a) Answer Q3a+Forward ALL information to EUL committee: 4 ||||| 57%
- b) Answer Q3b+Forward ALL information to EUL committee: 2 ||||| 29%
- c) Only forward ALL contact inform. to EUL committee: 1 ||| 14%
- d) None of above. At this stage, process internally: 0 | 0%
- e) Other: 0 | 0%

PROCESS WORK FLOW – NEW PROJECT INQUIRY

STAGE2

Project Submission

Q1: Do you agree with the information requested (N/Y)?

Q2: Any missing information (N/Y)?

Q3: On Informing all EUL partners about the details of the NEW PROJECT: (Pick one)

- 1) Forward ALL detailed Information to all EUL partners
- 2) Only forward ALL detailed Information to the Evaluation Committee (to be created)
- 3) Answer 1) + Forward Information to the Evaluation Committee (to be created)
- 4) None of the above. At this stage, only process the Information internally
- 5) Other

Results:

Q1: Do you agree with the information requested?

Yes: 7 ||||| 100%

No: 0 | 0%

Other: 0 | 0%

Q2: Are there any missing information?

Yes: 1 ||| 14%

No: 6 ||||| 86%

Other: 0 | 0%

Q3: On informing all EUL partners about the details of the NEW PROJECT?

- 1) Forward ALL information to EUL partners: 1 ||| 14%**
- 2) Only forward ALL detailed information to EUL: 2 ||||| 29%**
- 3) Answer 1+Forward information to committee: 2 ||||| 29%**
- 4) None of the above. Only process internally: 1 ||| 14%**
- 5) Other: 1 ||| 14%**

WORKSHOP #3: September 14th, 2021

A workshop to help EUL's members to optimize the WBT process flow (stages 3, 4, 5 and 6) for processing and testing all Test Scenarios (A2.2), refining the WBT tool of the EUL Association (A2.3), and formulating the best practice strategy for project handling based on tested project proposals was scheduled and carried out in Sept 14th, 2021.

List of attendants (shorted by name)

Jari Joutsenvaara Jose Garcia del Real Karin Robam	Katarzyna Szkliniarz Marcus Laaksoharju Michael Lay	Nikolai Kolesnikov Ossi Kotavaara Vytenis Mockus
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Agenda

A2.2: Test Phase: Completing the Process Work Flow for New Projects based on TS.

- Defining Stages #3, #4, #5 and #6. (**Exercise #7: 10'**).

A2.3: Implementation of changes in the EUL Homepage and WBT. (**Presentation: 5'**).

A2.3: Development of Best-practice-strategy to acquire and perform new projects based on TS.

- Identifying best and poor-quality management practices. (**Exercise #8: 15'**).
- Improving Quality Management. (**Exercise #9: 15'**).

Process Workflow for New Project Inquiries

For processing and managing all new project inquiries, a two-steps process was agreed among participants during Workshop #2 that took place in June 2021. Therefore, based on the information previously prepared by the Partner OAMK for the "Awareness" and "Consideration" stages of the Customer Journey, a six stages process was envisioned and proposed to the attendants of this workshop, according the **Table 9** and **Fig. 15** shown below.

For managing all data related to each EUL project proposal that could be related to new project inquiries, a Customer Relationship Management system (CRM) based in the FAIR Principles for Research Data Management was proposed and described accordingly. FAIR principles are commonly used to secure a sustainable research data management nowadays. Therefore, all data associated to new project inquiries, would be prepared and stored in a proper way, assuring a transparent process, and also, that other EUL partners and potential users can reuse it when need it. **FAIR** stands for **F**indable, **A**ccessible, **I**nteroperable, and **R**eusable data.

FIRST CONTACT	PROJECT SUBMISSION	PROJECT EVALUATION	OPEN TENDER	CUSTOMER'S DECISION	CONTRACT SUBMISSION
1. Reception of Personal Contact Information 2. Reception of Basic Project Information	1. Reception of Project Information 2. Reception of Required Resources	1. Submission of Project Proposal to Evaluation Members 2. Project Proposal Assessment 3. Communication of Project Acceptance or Rejection to Customer	1. Blind Invitation to Tender (ITT) 2. Offers Preparation 3. Offers Submission	1. Reviewing Period 2. Offer Acceptance	1. EUL sends Contract 2. Partner sends Contract

Table 9: Stages of the Awareness and Consideration steps for New Project Inquiries

Findable	The first step in (re)using data is to find them. Metadata and data should be easy to find for both humans and computers.
Accessible	Once the user finds the required data, she/he needs to know how can they be accessed, possibly including authentication and authorisation.
Interoperable	The data usually need to be integrated with other data. In addition, the data need to interoperate with applications or workflows for analysis, storage, and processing.
Reusable	The ultimate goal of FAIR is to optimise the reuse of data. To achieve this, metadata and data should be well-described so that they can be replicated and/or combined in different settings.

Fig. 14: FAIR Principles for Research Data Management

Explanation of Stages #3 to #6 for processing New Project Inquiries

Stage 3: Project Evaluation.

After Project proposal submission, EUL's Evaluator would have to evaluate the project proposal to accept it or not. Here below can be found the steps suggested to successfully accomplish this phase.

- 1) Submission of the Project proposal.** All EUL's Evaluators will have a copy of the information of the project proposal available at the EUL website.
- 2) Assessment of Project Proposal.** EUL's evaluators will have up to 3 days to evaluate the project proposal received, accepting or rejecting the project proposal.
- 3) Communication of Project Acceptance/Rejection.** Customer would be informed about the acceptance or rejection of his/her project proposal by the EUL's evaluators.

Stage 4: Open Tender.

The goal of opening a competitive tender evaluation process is to provide a fair and open process to ensure that any potential research project submitted to the EUL network is getting the best service from the best possible EUL member, according to the researcher's needs or interests. At the end, the final decision of choosing a specific research UL would be up to the Research project team and based on its interests.

After a project proposal is evaluated positively, the following steps are suggested:

- 1) **Blind Invitation to Tender (ITT).** It is sent by the Head of the EUL Evaluation Committee to all EUL's members.
 - a. No contact information about the Research Team or Institution would be provided, in order to avoid any temptation or potential circumvention.
 - b. It will outline the scope of the project and the following information
 - i. RESEARCH PROJECT INFORMATION
 1. Project Title
 2. Abstract
 3. Keywords
 4. Methods
 5. Objectives and Tasks
 6. Deliverables
 7. Expected project duration (From/to)
 8. Daily work schedule
 9. Current project phase
 10. Type of access to the UL
 11. Research driver
 12. ESFRI goal
 13. TRL
 14. SRL
 - ii. REQUIRED RESOURCES
 1. Transportation inside the Underground Laboratory
 2. Cooperation with other Facilities
 3. Personnel
 4. Third Parties (sub-contractors)
 5. Utilities
 6. Additional needs
 7. Computing services
 8. Other Resources
 9. Other Tools
 10. Comments

- 2) **Offer's Preparation and Deadline.** All EUL partners would have the same time to prepare their offer to the research proposal. All offers from EUL partners would use

the same PDF template provided by the EUL Association. Offers from EUL partners would be prepared within a period of 14 days, counted from the day the ITT is sent to each partner. After deadline offers from partners would not be accepted.

- 3) **Submission of Offers to the Research Project/Team.** Head of the Evaluation Committee would be in charge of submitting via EUL online platform all offers received to the interested Research project/team within a period of 7 days after previous deadline.

Stage 5: Customer's Decision

After Research Project/Team receives all offers from the EUL members interested in offering their infrastructures and services for hosting the research project, there will be 14 days for the potential customer to make his/her decision by picking the offer that better fits his/her interests.

Different phases suggested at this stage can be found below.

- 1) **Reviewing period.** Customer would have up to 14 days to review all EUL's offers.
- 2) **Acceptance of EUL's offer.** Within the reviewing period, Customer would have to accept or reject the offers sent by the EUL Association, via its online platform. Only one offer could be accepted by the Customer. Offers would expire after 14 days reviewing period.

Stage 6: Contract Submission

After Customer accepts the offer sent by the EUL Association, he/she will receive an automatic email with the EUL Contract. Within a 3 days period, Customer would receive the final contract with the EUL Partner. It would be submitted by the EUL Association to the Customer and sent back to the Association after execution by the Customer.

- 1) **EUL Contract.** After accepting the EUL's offer, Customer would receive one email from the EUL Association attaching EUL Contract. A first contract that would regulate the Customer's relationship with the EUL Association.
- 2) **Partner Contract.** Within a 3 days period, EU Partner would submit its contract to the EUL Association that would forward the contract to the Customer. This second contract would regulate the Customer's relationship with the EUL Partner. Partner's offer would be attached to this contract.

PROCESS WORK FLOW – NEW PROJECT INQUIRY

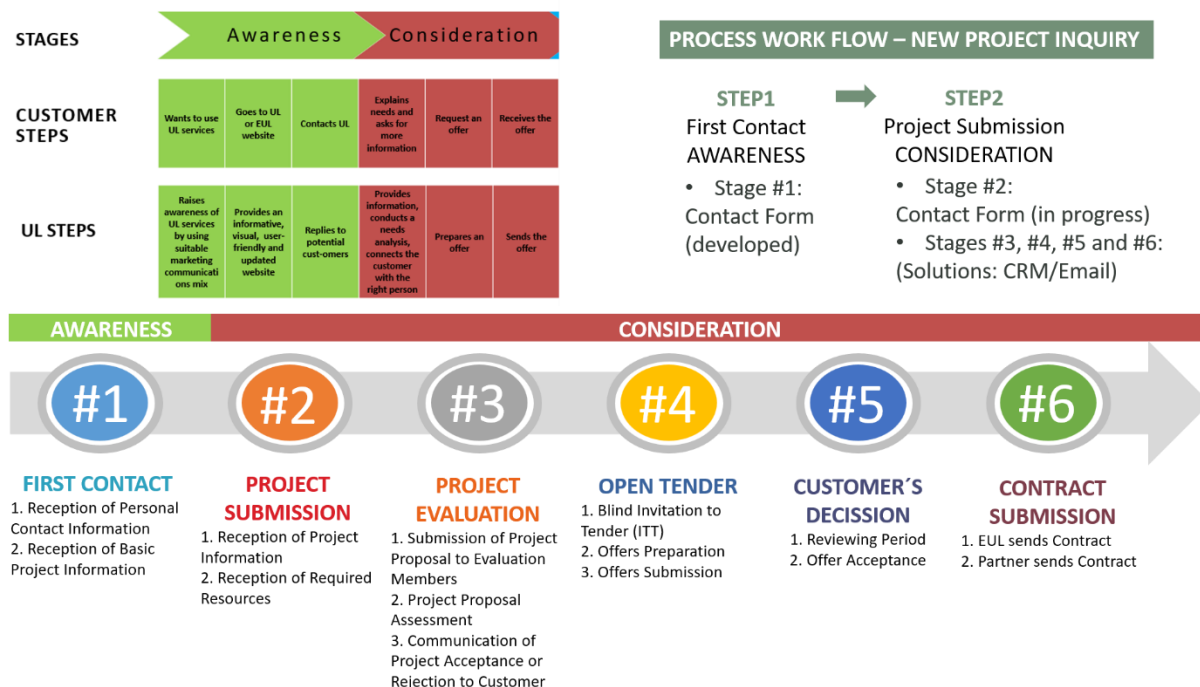
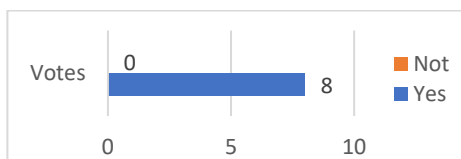


Fig. 15: Stages of the “Awareness” and “Consideration” steps for New Project Inquiries

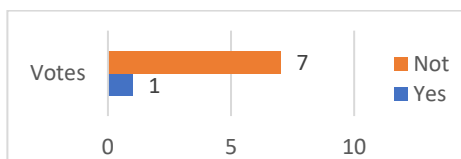
EXERCISE #7. Defining Stages #3, #4, #5 and #6.

Q1: Do you agree with the suggested Process Work Flow (6 Stages) for evaluating a New Project Inquiry (N/Y)?



Results:
 Yes: 100%
 Not: 0%

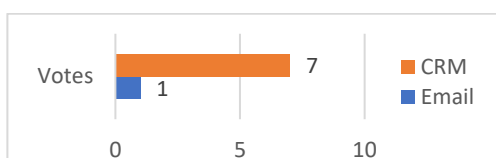
Q2: Any missing information (N/Y)?



Results:
 Yes: 13%
 Not: 88%

Q3. For Managing Stages #3 to #6 in the CONSIDERATION phase, which system should EUL use? Please, pick one option a) or b).

- a) Email system (for Project Evaluation, Open Tender, Customer's Decision, Contract Submission stages)**
- b) A Customer Relationship Management System (CRM) developed in the EUL's backend based on the "FAIR Principles" for research data management.**



Results:

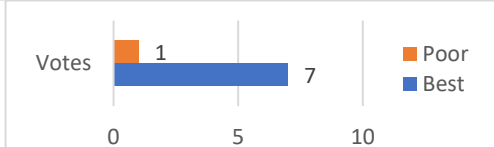
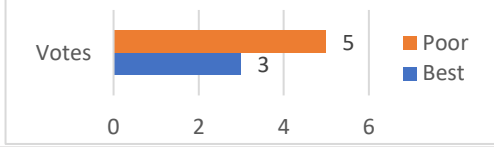
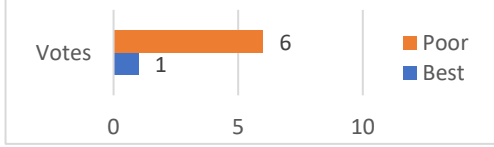
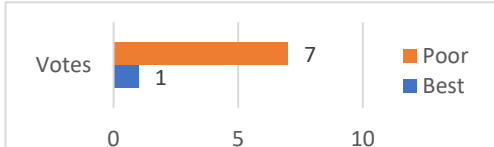
Email: 13%

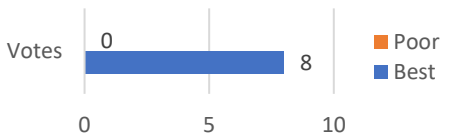
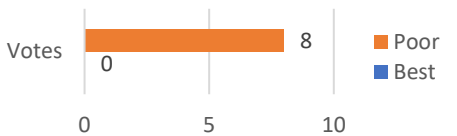
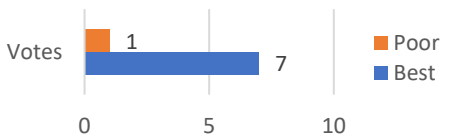
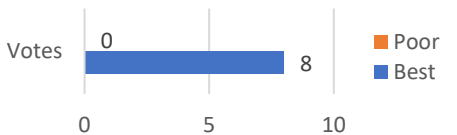
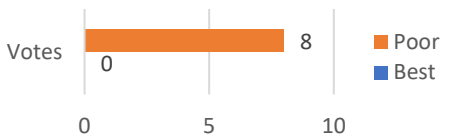
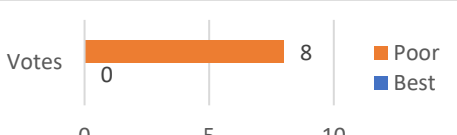
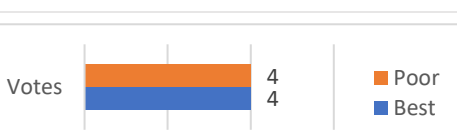
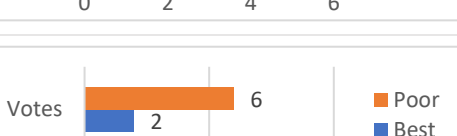
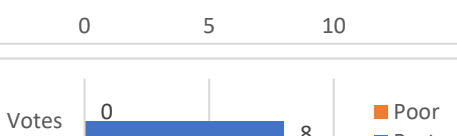

CRM: 88%

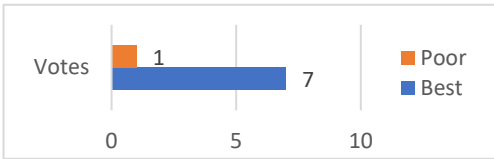
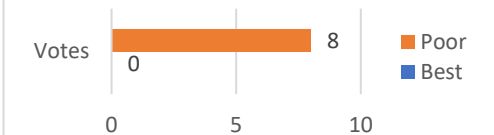
EXERCISE #8. Identifying best and poor-quality management practices.

Quality is powerful, and when is well managed, it is a Strategic Advantage.

Q: Among the following statements, please, identify if they could be considered as a BEST or POOR practice for Quality Management. Please, pick for each statement a BEST or POOR option

Statement	Answers	Percentage	Right Answer
S1: Having the Right Facility Design is vital for me to start the quality journey		Results: Best: 88% Poor: 13%	Best
S2: My daily agenda is pretty full. I am very proud of my "Firefighting" skills		Results: Best: 38% Poor: 63%	Poor
S3: Validation of processes is time consuming and it is not necessary anymore		Results: Best: 14% Poor: 86%	Poor
S4: Life is in constant change. Then, investing in the development of my colleagues is a waste		Results: Best: 13% Poor: 88%	Poor

S5: Procedures and Instructions must be well-written and adhered to		Results: Best: 100% Poor: 0%	Best
S6: I am the leader. I have the “authority” and my colleagues must obey me		Results: Best: 0% Poor: 100%	Poor
S7: I have no choice but to accept that a level of defects or errors is inevitable		Results: Best: 88% Poor: 13%	Poor
S8: Performing regular Audits helps me to check that I am on the right path		Results: Best: 100% Poor: 0%	Best
S9: I love freedom, defining team roles is an old-fashion practice		Results: Best: 0% Poor: 100%	Poor
S10: I prefer to say “Sorry, it’s not my problem”, since I have no time, and we all have problems		Results: Best: 0% Poor: 100%	Poor
S11: People is unpredictable. I rather control people through systems to avoid surprises		Results: Best: 50% Poor: 50%	Poor
S12: Leaders are totally free to do what they really want. That’s why they are the leaders		Results: Best: 25% Poor: 75%	Poor
S13: Good documentation must be kept accurately and promptly		Results: Best: 100% Poor: 0%	Best
S14: Behaving within the “blur area” helps me a lot to better manage the risks and to avoid surprises		Results: Best: 38% Poor: 63%	Poor

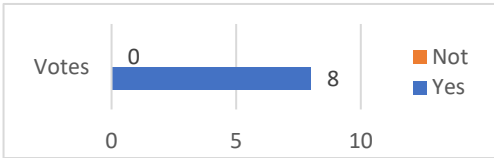
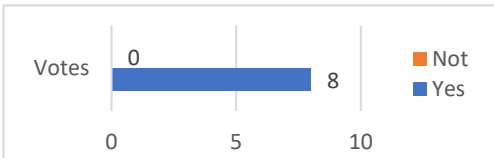

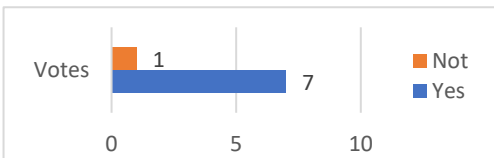
S15: I do respect peoples freedom; thus, I prefer each department to work as they wish, only for itself		Results: Best: 13% Poor: 88%	Poor
S16: I cannot compete with my competitors, so I rather to ignore them		Results: Best: 0% Poor: 100%	Poor

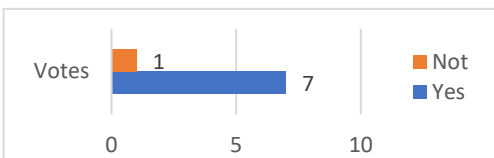
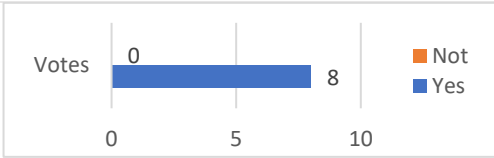
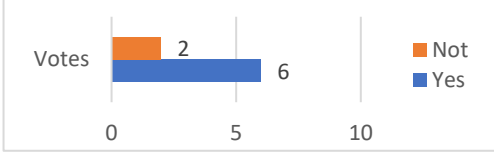
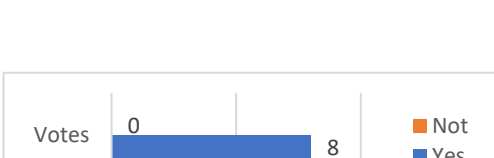

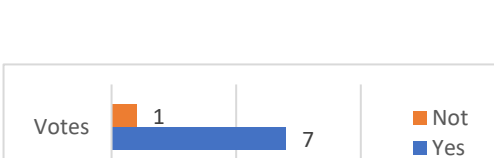
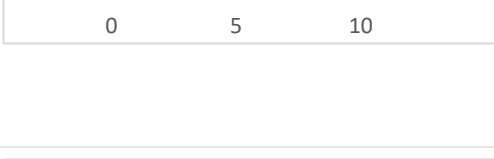
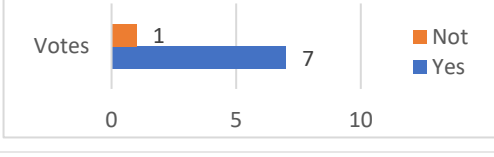
Room for improvement: all practices associated to poor quality management practices, and particularly practices S1, S2, S3, S4, S7, S11, S12, S14, and S15.

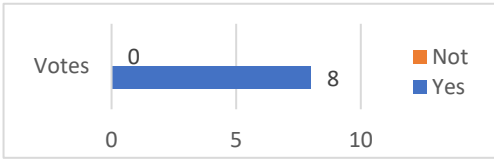
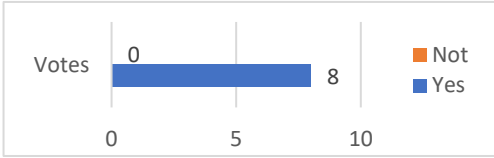
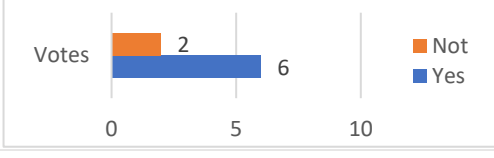
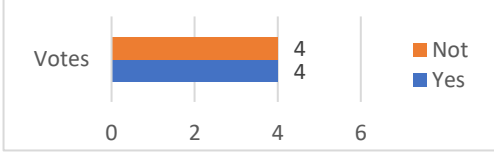
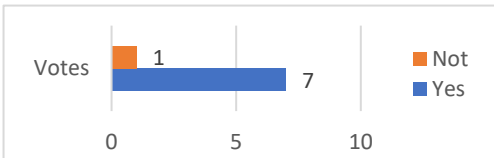
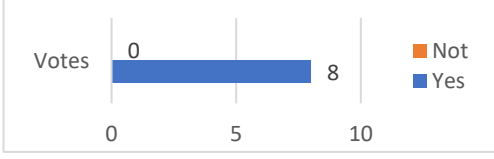
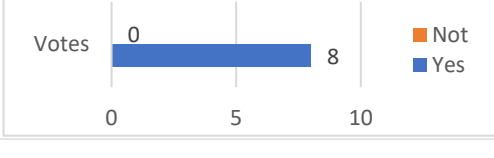
Poor practices considered as Critical that should be improved first: S2, S7, S11, S12, and S14.

EXERCISE #9. Improving Quality Management.

Q: Among the following list of initiatives, please, tell us which one do you believe should be a priority, and then, considered by the EUL network to secure its quality management. Please, pick one option YES or NOT for each initiative.

Statement	Answers	Percentage	Right Answer
I1: The EUL network must have its own Quality Management Plan		Results: Yes: 100% Not: 0%	Yes
I2: The EUL network needs a long-term commitment to continuous improvement		Results: Yes: 100% Not: 0%	Yes
I3: EUL should adopt the philosophy of zero errors/defects to change the culture to "right first time"		Results: Yes: 13% Not: 88%	Yes
I4: EUL should train people to understand the customer/supplier relationships		Results: Yes: 88% Not: 13%	Yes

I5: EUL does not buy products or services based on price alone – looks at the total cost		Results: Yes: 88% Not: 13%	Yes
I6: I do recognize that improvement of the systems must be managed		Results: Yes: 100% Not: 0%	Yes
I7: EUL must adopt modern methods of supervising and training – eliminating fear		Results: Yes: 75% Not: 25%	Yes
I8: EUL must eliminate barriers between partners and departments, by managing the processes, and improving communications and teamwork		Results: Yes: 100% Not: 0%	Yes
I9: EUL must eliminate goals without methods, standards based only on numbers, and barriers to pride of workmanship and fiction. Then, getting facts by studying processes		Results: Yes: 88% Not: 13%	Yes
I10: EUL must constantly educate, retrain, and develop experts in the organization		Results: Yes: 88% Not: 13%	Yes
I11: Development of a systematic approach to manage the implementation of Total Quality Management		Results: Yes: 100% Not: 0%	Yes
I12: Processes are documented with measures to		Results: Yes: 100% Not: 0%	Yes

understand performance			
I13: Partners and their employees understand the processes that are related to their own work		Results: Yes: 100% Not: 0%	Yes
I14: Direct customer interactions, feedback or studies about customers influence decisions about products/services		Results: Yes: 100% Not: 0%	Yes
I15: Problems must be solved by teams		Results: Yes: 75% Not: 25%	Yes
I16: Partners and their employees demonstrate, by words and actions, that they understand the mission, vision and values of EUL		Results: Yes: 50% Not: 50%	Yes
I17: Directors, and senior executives sponsor and actively support quality improvement projects.		Results: Yes: 88% Not: 13%	Yes
I18: The EUL network demonstrates, by words and actions, that continuous improvement is part of the EUL culture		Results: Yes: 100% Not: 0%	Yes
I19: EUL Commitment to change is articulated in the strategic plans		Results: Yes: 100% Not: 0%	Yes

Room for improvement: All quality aspects related to initiatives I3, I4, I5, I7, I9, I10, I15, I16 and I17.

Initiatives considered as Critical that should be improved first: I3, I4, I7, I10, I15, I16 and I17.

HANDBOOK – GUIDELINES WP2

The content of this handbook is suggested on the basis of hypothetical and real project proposals that could be submitted to the EUL network, and on the results obtained in the different workshops (WS #1, WS #2, and WS #3) carried out in May, June and September 2021 to meet the objectives of the WP2.

Content is structured in three sections as below, in order to analyse the business potential of the EUL Association, what could be the best strategy to acquire and perform new projects, and what should be the documented routine recommended to secure quality management, processes efficiency and constant improvement of the EUL network.

Sections:

1. Business potential.
2. Best-practice-strategies to acquire and perform new projects.
3. Quality management.

1. Business potential

In addition to the 6 scientific domains previously explained in which the EUL network could be focused on, and develop its scientific interconnections, it would be important to emphasize the vital role that Joint Research Activities actually play to contribute to the qualitative and quantitative improvement of the EUL services, and to increase the level of satisfaction of its growing users' community. Therefore, **Table 10** below summarizes a shortlist of recommendations to increase the impact, engagement and business potential of the EUL network and its Joint Research Activities. They should be focused on Research & Innovation and on the Technology Areas required to meet the Smart Specialization priorities of each EUL partner and its EU region.

Moreover, in order to maximize the business potential and the impact of the EUL network, it would be truly recommendable spare no efforts in developing synergies with the **European Structural and Investment Funds (ESIF)** as well. Identifying and aligning the research and innovative projects developed by each partner and user of the EUL network with the smart specialization fields of their respective EU region, on the base of properly identifying and considering the added values of the **Responsible Research and Innovation (RRI)** dimension, and other cross-cutting priorities (international cooperation, socio-economic science and humanities, open science, gender and blue growth). Avoiding the duplicity of allocated resources, and expanding the impact and scope of the funds in terms of scientific excellence and place-based socio-economic development respectively.

	Recommendation	EUL's potential contribution
INDUSTRY ENGAGEMENT	New Business opportunities	Via Procurement of products and/or services and attracting economic activities.
	Direct Support with Services	Providing direct support with services, developing complementary capabilities and synergies with operators of the EUL network, improving the industrial symbiosis and efficient use of resources within the EU.
	Providing Testbeds and Technology	Providing state-of-the art labs, testbeds for real-world applications and new technologies, high-quality staff, resources and services (including but not limited to major scientific equipment, knowledge-based resources, scientific data, computing systems, communication networks and other e-tools).
	Collaboration with Industry	Collaborating with the Industry's stakeholders on pre-competitive research.
	True Insight	Taking information from different sources for the same complex phenomena in order to facilitate that researchers obtain the expected true insight in their project results.
	Interoperable Services	Developing interoperable and complementary services, producing and analysing valuable data going across different disciplines.
	Close links with Stakeholders	Providing significant opportunities to establishing close links with the stakeholders in regional innovation ecosystems, as for instance, incubators, local research infrastructures, technology parks, businesses, and also universities. On top of that, EUL could be proactively integrated into the smart specialisation strategies of each region and the local planning.
	Co-creation/Co-design	Using co-creation and co-design as vehicle used by scientific excellence to create new knowledge between the EUL network and the industry.
INNOVATION ENGAGEMENT	Cross-disciplinary fertilisations within academia and industry	Actively encouraging cross-disciplinary fertilisations among researchers from different scientific domains within the EUL network. Furthermore, developing closer interactions among researchers from different ULs, boosting the sharing of ideas, information, technologies and insight among researchers and with other stakeholders including Industry as well. Developing a Networking and Strategy Plan as well.
	More advanced UL services	Developing tools and implementing a Quality Management system in order to have continuous improvement of EUL network processes and to get a continuous feedback from all stakeholders. It would allow EUL network to provide new and more advanced UL services, making multidisciplinary research available to a wider EUL user community.
	Better Access	Providing integrated, harmonized, simplified, wider, and more efficient access to all types of users and interest groups to both, a virtual e-infrastructure and to a state-of-the-art trans-national infrastructure, regardless their country of origin within the EU.
	Training	Via training of scientists and also a new generation of researchers, engineers, and professionals, so that, they are able to optimally exploit all tools offered by EUL for their research and work.
	Mobility	Creating opportunities for scientists and engineers' mobility to and from science and industry, or services.

	Providing High-quality data	Throughout the opening of high-quality and well documented research data, that is duly supported by an effective and a reliable data service.
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Table 10: Recommendations to increase Business Potential of EUL Network.

The EUL network aims to develop and to apply cutting-edge technologies developing interconnections within 6 scientific domains as for instance the domains shown in **Fig. 16** below. At this early stage, attention has been paid to those market niches and technologies that will likely have a **bigger impact and contribution** in the common goal of developing a clean, modern and fair economy in the EU.

Simultaneously, the EUL network would contribute to **promote industrial competitiveness, empowering citizens and revitalizing regions**, researching and developing **the most sustainable and innovative technologies** that use less energy, avoid pollution and reduce waste. **Investing also in** a workforce of **talented individuals with the right skills** for achieving the EUL's goals, which would be fully aligned with those required for the development of a New Circular Economy in the EU.

In order to ensure the long-term sustainability of the EUL network, the preliminary technologies suggested here below would be flexible and subjected to the necessary adjustments depending on the continuous feedback obtained from the users and stakeholders of the EUL network, based on their demands, and on the complexity and needs of a constantly changing society.



Fig. 16: Application of cutting-edge technologies within the 6 scientific domains potentially served by the EUL network

In addition to the potential interconnections that could be developed by the EUL network with other Research Infrastructures within the EU, in **Table 11** below can be found some examples of Research, Innovation and Technology areas suggested to the EUL network, that could be explored by the different underground labs, based on the initial interest in the 6 scientific domains recommended by the EU to ESFRI research infrastructures.

Research & Innovation Area	Technology Area
Scientific Domain: Energy	
Research & Innovation: on technologies, tools and methods required for creating a sustainable, secure, competitive and affordable energy system that is essential for reducing CO2 emissions and developing a New Circular Economy. It includes “Energy storage and efficiency”, “Resources efficiency”, “Renewable Energy systems”.	Technology Areas: hydrogen chain and fuel cell technologies, hydrogen production (PEM and alkaline electrolyzers), solar, geothermal and wind technologies, hydrogen-powered vehicles, Low carbon energy technologies, Net-Zero Buildings, Nuclear Fusion Power, Plug-in electric vehicles, High Temperature Superconductivity & Twist Electronics, Advanced Data Analytics & ML to increase grid flexibility, Thermal-hydrological-mechanical-chemical (THMC) modelling.

Scientific Domain: Environment	
<p>Research & Innovation: on technologies, tools and methods required for having a continuous improvement and a holistic insight on technological, environmental, economic and social aspects linked to the Sustainable Development Goals (SDGs) and to a responsible, affordable and sustainable supply of raw materials for the energy transition. As well as, a better management and response to natural and anthropic environmental changes, such as loss of biodiversity, depletion of natural resources, pollution, hazards, risks and climate change.</p>	<p>Technology Areas: Biodegradable Sensors, Energy Efficient Water Treatments, Ocean Wiring and Sensing, Zero-Power Sensors, Bioleaching, Biotechnologies, Radioactive Waste technologies, Clean technologies, WEEE & Battery recycling technologies, New Materials, Radiation and Capsulation technologies, Low carbon energy technologies, Underwater Infrared Video monitoring, Groundwater sensors, Scanning sonar, Underwater drones, AI & ML, Net zero GHG emissions technology, Geotechnical monitoring & safety, Rock-fracturing technologies, Seismic monitoring technologies, Hyperspectral Imaging, Data-mining, Machine and Computer vision technologies, Geo-Data Acquisition, Management, Visualization, Analysis and Modelling.</p>
Scientific Domain: Health & Food	
<p>Research & Innovation: on technologies, tools and methods required for 1) Food: creating a Sustainable, Affordable and Safe Food System which is vital for the European Green Deal ambitions, and 2) Health: creating a Safe & Healthy Society and Work Environment, minimizing physical stress, injury risk, and chronic diseases. Developing also innovative technologies for better managing the risks associated to radioactive materials, new virus-related challenges and to the climate-relevant health outcomes, poor water quality, dust & noise control, and air pollution.</p>	<p>Technology Areas: Hydroponic Farming technologies, Precision Farming technologies, Plants and animal health-diseases, Biodegradable Sensors, Biorobotics-Bionics, Bioinformatics, Sensor based monitoring systems, Biopharmaceutical, Firefighting technologies, Ergonomics and Machine safety, Electrical safety, Explosives safety, Antibiotic-Resistant Super Bacteria, Regenerative Medicine, Dust & Noise control technologies, Bioimaging technologies, Digital Imaging.</p>
Scientific Domain: Physical Science & Engineering	
<p>Research & Innovation: on technologies, tools and methods required in many of the areas of societal challenge. Including but not limited to a greener environment and cleaner energy, improved cities and communications, new underground spaces for human use, better transport systems, personal and national security, and safety issues associated to radioactive material. Study of rare phenomena in low radiation background environments such as dark matter, exotic nuclear interactions and neutrino interactions. Development and testing of novel engineering solution and advanced materials required in the raw materials value chain, the space industry, additive manufacturing and robust optical components.</p>	<p>Technology Areas: Underground construction technologies, Construction equipment technology, Drilling & Excavation technologies, Autonomously operating machinery, Advanced building information modelling (BIM), 4D Printing, Advanced & Intelligent Materials (Self-assembly and programmable material technologies, climate-active textiles, liquid printed metals,...), Zero-Power Sensors, Explosives detection and deactivation technologies (for aeronautics, defence, public safety, landmines), Mechatronics, Unmanned vehicles, Robotics, Drones, Efficiency of Solar Cells technologies, Scanning Tunnelling Microscopy, Nuclear Fusion Power, Technologies suitable for flooded and underwater spaces, Astrophysical Research.</p>
Scientific Domain: Social & Cultural Innovation	
<p>Research & Innovation: on technologies, tools policies and methods required basically in the following four areas. <u>RRI of Technology:</u> implementation and evaluation of responsible innovation within industrial context. <u>Preserving Cultural Heritage:</u> getting a better understanding of the socio-technical aspects for the conservation and valorisation of the Underground Built Heritage (UBH).</p>	<p>Technology Areas: Spatial-temporal data visualization, BIM, Data science, Machine learning, Big Data, Ethically Trustworthy Artificial intelligence, Geo-data, Zero-Power sensors, IoT.</p>

<p><u>Life under different & difficult condition:</u> health and social effects on humans of using social distancing measures, underground spaces, and living & working under isolation, poor visibility and/or lighting conditions, associated to remote locations on Earth and permanent colonies in the Space. <u>Social & Ethical AI:</u> multi-disciplinary research focus on the societal and ethical impact of AI, where social sciences and humanities synergistically work in combination with engineering research.</p>	
Scientific Domain: Digit	
<p>Research & Innovation: on technologies, tools and methods required for the development of: <u>New possibilities:</u> for sharing and collaboration between geographically distributed stakeholders where open access to data and scientific results will transform not only how research is conducted but its overall reach. <u>Advanced Technologies:</u> as the fusion of Digital + Key Enabling Technologies required to develop and manage (1) Intelligent City Ecosystems, (2) Industrial applications of BigData and AI for SMEs, and (3) Innovative technologies for Industry. <u>Cybersecurity:</u> cyber & digital threats and other hostile activities.</p>	<p>Technology Areas: Advanced building information modelling (BIM), AI, Machine Learning, Anonymous Analytics, Ethically trustworthy AI, Opendata, Cybersecurity, technologies for data interoperability in IoT, Blockchain, Technologies for continual assurance of 1) Learning-Enabled, 2) Cyber Physical Systems and 3) Autonomous Systems.</p>

Table 11: Research, Innovation and Technology Areas suggested to the EUL Network.

2. Best-practice-strategies to acquire and perform new projects

Tips and recommendations:

In addition to the recommendations and conclusions derived from the Exercises #7, #8 and #9 carried out during the Workshop #3 that took place in September 2021, the following tips and recommendations are suggested as essential elements of the best-practice-strategy, not only for acquiring and performing new projects, but also, for securing a long-lasting sustainability of the EUL network and a perfect symbiosis with other research infrastructures in Europe. They could be implemented gradually according to the EUL networks interests and needs.

- 1. Working together for a mutual benefit.** It is the cornerstone of any quality Research Institution. The accepted concept of the customer (Researcher/Colleague) and supplier (Research Institution/Professor/Director/Team Leader/Colleague) working together, at the same level, hand-in-hand for their mutual benefit.
- 2. Creation of research work groups among EUL partners.** For developing EUL Synergies and exploring new joint projects. Clearly articulating who would be the team leaders, what will be the scientific topic and objectives, defining tasks explicitly, clarifying expectations, setting KPIS's and quality standards, and communicating the performance criteria effectively.

3. **Preparation of Join Research Activities.** Exploring new ways of collaboration throughout the join preparation of research and innovation proposals to European calls, that can improve the research capacity and network of the EUL members and its researchers. As for instance, INFRAIA, IFs, ITNs, COST ACTIONS, etc.
4. **Development of a join E-Research Infrastructure.** To be developed as a first pilot project among the EUL partners. It could start by including for instance a map of the ULs, a 3D Virtual Tour of each UL, and a Repository of the main projects and publications developed by the EUL members. The scope of this join E-Infrastructure could be expanded gradually, according to the needs and strategy of the EUL Association.
5. **Fostering Collaboration and Integrity in Research.** Addressing mutual expectations, research misconduct and detrimental research practices. Identifying and promoting responsible research practices among researchers. Collaborating in the development of policies, mechanisms and procedures to improve inclusion, transparency, and to effectively respond to allegations of misconduct. Keeping open lines for bidirectional communication. Using education as the main channel and launching platform to acquire new customers who share EUL's values. Emphasizing in the need of a responsible conduct in research, and helping researchers to clarify that promoting good research practices is not only a moral imperative, but also, crucial to good science, for the sake of EUL network, and the society at large.
6. **Fostering collaboration Academia-Industry.** Developing a plan for enhancing multicultural cross-sector collaborations between Academy and Industry. Building trust and honesty with a fair, prompt and open communication plan. Being flexible and open-minded to seize chances, to understand and to accept different cultural backgrounds. Being inclusive, and exploiting multiculturalism and constructivism as key assets that will make the difference, improving innovation and increasing the research impact of the EUL network.
7. **Implementation of a PDCA Plan at the EUL's level.** Starting with a (P) Planning what is needed, (D) Doing it, (C) Checking that it works, (A) Acting to correct any problems or improving performance.
8. **Adjusting the PDCA Plan to the role/profile of each EUL member:** Developing one PDCA plan that can help each EUL member to define the strategy and actions to be carried out depending on its business model, role and profile. For instance, as Innovation Hub, Project initiator, Project Partner, Subcontractor, or as a Facility Provider.
9. **Implementation of a Benchmarking system.** As a continuous activity for identifying, understanding, and likely adapting what are the best practices and processes that could lead EUL network to a superior performance. It should measure EUL's processes and services in order to define targets, and to establish a list of priorities and potential improvements, leading the EUL network to enhance its competitive advantage and likely cost management efficiency.

- 10. Implementation of a Quality Management System (QMS).** A holistic management system in which main responsibilities (research & innovation quality, safety, health, and environmental) could be integrated according to the EFQM Model or ISO standard. It would help to build trust and recognition, rewarding success and showing how well EUL network is performing against a proven international framework.
- 11. Defining a QMS Plan for reviews, assessments and audits.** An essential task required to secure functioning and improvement of a good QMS. Ensuring that current methods adhere to the documented procedures, undertaking periodical system reviews systematically, to secure that QMS achieves the required effect.
- 12. A Processes Improvement Plan.** Defining and implementing a Plan that can help EUL partners to understand and improve their processes, using for instance a systematic approach, tools and technics (e.g. LEAN, DRIVE Methodology, Processes mapping, flowcharting, force field analysis, Cause and Effect Diagrams, Pareto Analysis, etc.).
- 13. Implementation of a Total Quality Management System (TQM).** By doing the right things right, first time. Managing Systems, Processes and People to ensure complete customer satisfaction, internally and externally, at every stage. To be implemented in a later stage, as the way of managing the EUL network for the future. Once the service quality of the EUL association is achieved and assured via its QMS.
- 14. Implementation of the Symbiosis Readiness Level (SRL) and its Matrix, instead of the traditional Technology Readiness Level (TRL).** “Industrial Symbiosis” understood as the system approach to obtain a “more sustainable and integrated industrial system, which identifies business opportunities that leverage underutilised resources (such as materials, energy, water, capacity, expertise, assets etc.)”. Using the “Matrix for defining the symbiosis readiness level” **Fig. 17**, in order to assess the status of any industrial symbiosis project comprehensively, which was extracted from the Independent Expert Report “Study and portfolio review of the cluster of projects on industrial symbiosis in the Directorate for Prosperity in DG Research and Innovation: Findings and recommendations” made by (Sommer, K.H., 2020).





Symbiosis readiness level	Technology 	Business 	Ecology 	Management 
SRL9	Commercialization	Business case continuously controlled, reported and shared	Sustainability benefits proven	Resilient partnership
SRL8	Extended operation	Finalize legal framework	Benefits routinely monitored and reported	Practical operation and management starts
SRL7	Demonstration	Partners committed	Monitoring and reporting begins	Senior management is involved and supports industrial symbiosis case
SRL6	Prototype demonstration 'looks like'	Business case with all details	Permits applied for	Concept for joint management is developed
SRL5	Breadboard demonstration 'acts like'	Evaluate competitiveness	Sustainability assessment finalized	Partners start joint evaluation of industrial symbiosis potential
SRL4	Proof of concept validation	Check resources and criteria	Sustainability assessment in progress	Partners indicate interest
SRL3	Proof of concept research (bench scale)	Check fit with strategies of partners	Thorough data collection	First contact with partners
SRL2	Academic research	Develop concept	Rough estimate	Potential partners identified (*)
SRL1	Initial ideas			

Fig. 17: Matrix for defining the symbiosis readiness level.

3. Quality Control, Assurance and Management

The Quality Control process in any research project is crucial since it makes the difference between bad and good science.

- It helps Researchers and Scientists to monitor and maintain quality standards while a research or innovative project is being conducted.
- It helps Research Institutions to meet customers' requirements. Providing a sense of confidence in the ability of the research institution to deliver the product and/or service expected by the researchers. Exceeding perhaps their expectations and needs.
- It helps Research Institutions to meet their own requirements. Not only internally, but also, externally. Making an efficient, cost effective and optimal use of their own resources, whatever the type might be (information, technology, infrastructures, human, materials, etc.).
- It enables a Research Institution to develop and implement its policy and strategy, achieving therefore its own goals and objectives.

It usually includes different mechanisms to detect, reduce, analyse and correct any issue that might happen in a research lab or research institution, helping researchers to make their experimental and methodological results more solid and consistent, increasing also researchers' confidence in their own results. Contributing to a more efficient management of Research Institutions as well.

As a result, a Quality Management System (QMS) at the EUL Network should include a set of coordinated activities, specifically defined to improve the steering and control of the research organization, while the efficiency and effectiveness of its processes and performance is also being enhanced. Therefore, the priority here should be the "production" of quality services that can help researchers to improve the impact of their research, rather than intensifying the efforts in detecting "defective" or "poor" services, after perhaps they could have been provided.

Recommendation: For improving the quality of the EUL's services and consequently the EUL's research impact, the implementation of a Quality Management System (QMS) is suggested, which simultaneously will contribute to achieve an efficient quality control, assurance and management of the EUL Association.

Annex

Test Case#1: Project Application from a Canadian University: Geophysical Detection of EDZ/HDZ Around Tunnels

1. Project description

When an excavation is constructed, redistribution of stress in the surrounding rock mass leads to unfavorable conditions near the excavation boundary causing damage on the micro scale as well as driving the development of macroscopic fractures. The areas in which micro scale fracturing and macro scale damage occur are referred to as the Excavation Damage Zone (EDZ) and Highly Damaged Zone (HDZ), respectively. Because the damage in these zones can increase rock mass permeability from background levels, understanding the nature of the EDZ/HDZ is of importance i.e. for the design and construction of deep geological repositories for the storage of nuclear waste and tunnel construction.

Geophysical methods have been considered as candidates for investigating the EDZ and HDZ, due to the non-invasive nature of the methods and the expected changes in the physical properties of rock masses with accumulated damage. Many of the investigations to date, however, have been borehole-based methods (cross-hole seismic tomography, cross-hole seismic velocity, cross-hole resistivity, etc.). The majority of investigations not using boreholes have focused on the principles of seismicity (i.e. active refraction surveys, or passive acoustic emission measurements). Other geophysical methods have the potential to be used without boreholes, although they have not been a focus in the literature. Some non-destructive resistivity & induced polarization (RES/IP) surveys have been performed in Opalinus Clay in Switzerland (Kruschwitz & Yaramanci, 2004; Nicollin et al., 2010), although they have not involved a calibration based on damage development during lab testing and have used limited survey configurations. Ground Penetrating Radar (GPR) surveys for fracture detection in repository host rocks using high and low frequencies have been performed previously. Although EDZ delineation using this technique has been performed, it requires more testing and validation (Silvast & Wiljanen, 2008; Heikkinen & Kantia, 2010). By collecting the RES/IP and GPR data together, along with additional calibration and verification information, the application of these methods can be tested and improved.

The ultimate goal, via a collaborative field experiment is to correlate the spatial distribution of damage around an excavation with geophysical properties and to recommend a methodology for damage monitoring and detection using geophysical methods. It is also hoped that the damage levels detected can be correlated with laboratory strength thresholds. This will allow for non-invasive detection of the EDZ and the HDZ which can be utilized in optimizing cut-off design.

This is a joint project of the university and the Norwegian Geotechnical Institute (NGI). By way of this proposal, we would like to encourage the collaboration of a new UL within the EUL network to participate in this research by allowing access to annul within the EUL network.

2. Project support needed from EUL

Access to an UL in the EUL network is requested for the investigation of the EDZ/HDZ using geophysical equipment in a crystalline bedrock. Access is required for 4 consecutive days (Oct 8-11) underground, with 1 flex day in the event of delays (Oct 12). The items which require support from the suggested UL is listed below in table 1.

Table 1: Items requiring support from an UL for the research project.

Item	Support Requirements
Onsite transportation	<ul style="list-style-type: none"> Personnel transport twice daily (morning / evening) Equipment transport (once underground, once to surface)
GPR Unit	<ul style="list-style-type: none"> Standard European electrical outlet 30 m extension cord
RES/IP Unit	N/A
Lidar	N/A
Hilti hand held drill with ½" & ¼" drill bit	<ul style="list-style-type: none"> Provided by the UL? OR bring from Canada (more difficult logistically)
Hilti core drill with ~50mm diameter bit	<ul style="list-style-type: none"> Provided by the UL? OR bring from Canada (more difficult logistically) <ul style="list-style-type: none"> 16 Amp breaker on power supply 30 m extension cord Cooling water supply with a standard faucet screw connection
Borehole camera	<ul style="list-style-type: none"> Standard European electrical outlet 30 m extension cord
Work lighting	<ul style="list-style-type: none"> Standard underground work lighting
Office space	<ul style="list-style-type: none"> 1 standard office for processing if onsite accommodation are available

Test Case#2: Application from a German University: Unravelling the cryptic microfossil *Frutexites* – a biosignature for microbial Fe-cycling through Earth history?

1. Project description

Stromatolitic iron-rich structures have been reported from many ancient environments and are often interpreted as *Frutexites*, a cryptic microfossil first described by Maslov in 1960. Although a microbial formation is likely, a detailed chemical comparison of recent and ancient forms is lacking so far. Therefore, the major task of this project will be the investigation of recent microbial structures which are quite similar to the fossil *Frutexites* and the identification of characteristic biosignatures. These biosignatures help to determine similarities of recent and ancient *Frutexites* structures.

For this study recent (living) *Frutexites* samples from the Äspö Hard Rock Laboratory and from 4 other mining museums and former ore mines in Germany will be microscopically and geochemically investigated and compared among each other. Furthermore, a selection of these mats will be subjected to an artificial diagenesis. These samples will be compared to natural fossilized *Frutexites* samples from different localities and different time points of the earth history.

The research findings of the proposed project will not only be relevant for those interested in biosignatures, and *Frutexites*, but are expected to yield important implications for studies on life in extreme environments and the microbial Fe-Cycle.

2. Project support needed from EUL

Access to an UL in the EUL network is requested for the investigation. For the sampling of living *Frutexites* bearing samples it is necessary to enter the UL by car. Immediate cooling and sample /preparation and conservation for the different analysis will be necessary and performed directly at the sampling site. Three working days in the UL are estimated for the sampling campaign.

Adjacent water samples will be taken and a request to a nearby chemistry lab to analyse 4 water samples for : 1. anions (Cl^- ; SO_4^{2-} ; Br^- ; F^-), 2. pH, conductivity, alkalinity; 3. Ammonia; 4 Fe(II) is required.

Test Case#3: Application from an Australian University: Tracing the precipitation of calcite by a multiproxy approach – In situ experiments in an UL

1. Project description

Calcium carbonate minerals such as calcite (CaCO_3) are highly frequent in natural and applied environments. The formation of carbonate minerals are most likely referred to aquatic systems, like for carbonate skeleton, shell, ooid, speleothem, scaling, and mortar. Tracing the formation of CaCO_3 in such environments is a highly interesting issue in geosciences and material sciences to discover the environmental conditions during growth. Tracing can be done by measuring elemental and isotopic signals of the precipitated CaCO_3 , most promising by using a multi-proxy approach. In the present project calcite-precipitation experiments will be conducted to follow the incorporation behaviour of elements and isotopes during the formation of calcite by using naturally occurring fracture groundwater within an EUL underground laboratory. This is an excellent and extraordinary possibility to provide pristine natural anoxic fluids, which are directly draining from the rocks, at a given flow rate. Fulfilled pre-requirements for the present study are rather constant temperatures and chemical compositions of the solutions as well as continuous fluid flow. These technical issues have to be discussed with a site-geochemist.

Moreover, the groundwaters of interest should be already slightly saturated with calcite, which is an advantage, and its elemental content is suitable for studying the behaviour of proxies e.g. with the systems of Ba, Sr, Fe, Mn, and Mg.

For calcite precipitated on the walls of water-conducting deep fractures in the crystalline rocks, very few studies of trace-element uptake exist. The complex timing relationship between the minerals (possible age of up to tens of millions of years) and the present groundwaters (residence times of decades up to one million year) inhibits any certain constrains of how calcite incorporate trace metals at ambient temperature in this scarcely studied but globally widespread environment. There is therefore a need to further investigate trace-element incorporation into calcite *in situ* during natural conditions in deep bedrock fractures. The overall goal of the present case study is to get an advanced understanding of the coupled incorporation of trace elements and isotopes by using an experimental *in situ* multiproxy approach. Accordingly, an UL or several UL's within the EUL network is an excellent site for the study.

Shortly, pre-experiments in the tunnel (batch) will document the calcite-precipitation behavior with and without seed. Based on information from this initial step, pre-installation of the experimental set up (using pumps, reactors etc.) will be done in the laboratory of our own the University. After this, equipment will be transferred from the University to the selected UL or UL's; where the equipment will be installed in two to four boreholes.

2. Project support needed from EUL

Access to existing database of the selected UL or UL's.

Access to 1 or several UL's

Test Case#4: Application from a Swedish University: Developing and implementation of Real Time Grouting Control Method (RTGCM) for rational tunneling with focus on grout penetration ability and real spread

1. Project description

Real Time Grouting Control Method (RTGCM) is a grouting concept developed at the university. The method is an active tool for governing of grout spread in rock and a tool for control of jacking. Using this method, it is possible to reduce both grouting time and consumption of grout compared with present-methods.

Calculation of grout penetration in time is central in the method. The calculation is based on estimation of hydraulic aperture, geometric aperture and minimum aperture that a grout can penetrate. There are large uncertainties in estimation of these parameters and the aim of the project is to reduce these uncertainties. Further the method is new and there is a need to verify the method in field which is also an aim of the project.

The project consists of two subprojects, a PhD project and a senior research project. Penetration ability of grouts, hydraulic aperture and geometric aperture are studied in PhD subproject. Mainly the study in this sub-project will be performed by model tests in lab with long slot with varied aperture. The latest research showed that this method is more appropriate than others. In the other subproject, senior research project, RTGC method will be verified in field. The calculated penetration in time will be compared by the measured in field.

This application is related to senior research project and the aim of this subproject is verification of RTGC method in field. A number of suitable conductive fractures in an UL should be selected, investigated and grouted. The grout spread in these fractures will be measured and also calculated by RTGCM. The measured grout spread will be compared by the calculated and in this way RTGCM will be verified.

In an UL part of the EUL three or four suitable test places with conductive fracture will be selected. A “grouting” bore hole and two or three “observation” bore holes will be drilled to cross the selected fracture at each selected place. The fracture will be grouted and time the grout needs to reach observation holes and tunnel walls will be measured.

This project is also a subproject of the umbrella GROUT project. The GROUT project brings together scientists from the Baltic Sea area and a number of private companies with the aim to improve tools for planning, design and construction of underground facilities.

2. Project support needed from EUL

In an UL-tunnel three or four suitable test places with conductive fracture will be selected.

Principal field test procedure:

1. Selection of suitable fractures
2. Drilling of “grouting” bore holes
3. Transmissivity test of the fractures
4. Drilling of “observation” bore holes for conductive fractures
5. Grouting

The main support needed from EUL in this project is access to an UL. The project needs also access to tunnel excavation data to inspect if selected fractures are grouted before or not.

Grouting unit will be provided by international company and the drilling of the bore holes will be arranged by some local company.

Test Case#5: Application from a Finnish University: Fe(II) biomineralisation and La enrichment during oxidation of fracture groundwater

1. Project description

Two kind of materials from an UL included in the EUL network will be investigated: (1) the microbial mat from two installed flow reactors, and (2) bacteriogenic iron oxide layers, which cover the tunnel wall at a depth of about 500m and are investigated concerning La enrichment. The investigation of these materials will build on two advanced X-ray techniques. For the microbial mat, Scanning X-ray Transmission Microscopy (SXTM) and Near Edge X-ray Absorption Fine Structure (NEXAFS) of C, Fe and metals will be utilized. These analyses will provide information on chemical interaction between metals, microbes, iron species such as Fe (hydr-)oxides, phosphate, and carbonates. For the La-enriched oxide layers, micro-Extended X-ray Absorption Fine Structure (EXAFS) will be utilized and provide information on local coordination environment and chemical phases of both Fe and La at the same spots.

The study requires access to synchrotron laboratories, which will have to be applied for in a competitive process. The analysis will be performed at:

- MAX-lab for bulk Fe NEXAFS and EXAFS.
- The Advanced Light Source in USA, the Canadian Synchrotron Radiation Facility, and the Swiss Light Source for STXM. Allocation of beamline time at any of these laboratories will be enough for project success.
- Two of several among the Advanced Light Source in USA, Stanford Synchrotron Radiation Facility, Advanced Photon Source in USA, European Synchrotron Radiation Facility and Swiss Light Source for Micro- Fe and La EXAFS. Allocation of beamline time at any of these laboratories will be enough for project success.

2. Project support needed from EUL

Access to an UL with a data base, and possibly of sampling at an UL.

A co-funding of 10 000 € is applied through the EUL network.

Test Case#6: Application from a Swiss University: Microbial community structures and activities in deep sub-surface fracture waters

1. Project description

The continental subsurface is estimated to contain 2 to 19% of the earth's total biomass. The microbes inhabiting this biome profoundly influence global nutrient and energy cycles. However, due to the difficulty of sampling in the deep subsurface, this environment is one of the least understood ecosystems on earth.

Several important questions for the deep biosphere microbiology remain unanswered. For example, if the microorganisms are active or dormant; whether or not specific populations are viable or non-viable; if the deep biosphere microorganisms use special adaptations to this specific oligotrophic environment; and how the fundamental processes are carried out in this ecosystem. To address this lacuna, the proposed project will investigate diversity, viability and metabolic activity of microorganisms from at least twenty groundwaters with different depth and origins.

This study will help to understand the microbial populations, viability, activity, processes and adaptations to the sub-surface. The biology data will be linked to the chemistry, geology, and hydrology of the environment to create a comprehensive model for understanding natural groundwater and the microbial implications in landscape scale deep subsurface granitoid fracture waters.

Use of the UL's associated with the EUL is vital for the success of the project as it provides the necessary infrastructure to carry out the experiments such as access to the deep subsurface.

2. Project support needed from EUL

1. Use of the EUL research database. To link the produced data to previous studies (e.g. geochemistry and hydrology) carried out within the EUL network, it is requested to have access to the EUL research database.

2. Access to UL tunnels. To obtain samples for study we request access to the UL tunnels for the project leader and co-workers. A list of suitable boreholes to be sampled should be provided by the UL's. Technical assistance for sampling might be requested by on-site personnel at the start of the project.

3. Use of the UL's facilities. It is requested to use the UL's dedicated area for on-site sample preparation before cells are sent for analysis and continued experiments. Physiochemical data collection is also required so the identified biological transformations can be related to the environment.

Test Case#7: 3D underground mine surveying with drone mounted laser scan sensors

1. Project description

Laser scanning is widely used in the mining industry, as a new and better way of making work easier and safer. Different laser scanners (for example the hand-held scanner during this project) and drones could be used for underground mine surveys. The development of mine surveys and the technology used in them has been very rapid and has created a number of new methods. These methods allow object measurement with less time and more accuracy. Measurements can be performed more safely and more economically. Measurement work with drones and lasers has been introduced. Laser scanning and using the drones allows measuring many points from a safe distance, it can be a more accurate image for using it during volume calculation, design, quality control, and follow-up of mine operations analysis. Mobile laser scanners are lighter (a hand-held scanner) and more compact. Similarly, it is possible to use drones for underground mine survey. During the project is the need to carry out experiments to make underground mine surveys more rapid, efficient, and safer. One of the interests is to use a hand-held scanner for the underground mine survey (to obtain a three-dimensional plan). During the project the need for testing and comparing the underground measurements made with a hand-held scanner with measurements made with the drone. After mine survey the need to obtain a three-dimensional drawing. The mine surveyor should walk with a lightweight hand-held scanner through the surveyed and excavated area, so that both the excavated volumes and the sizes of the excavated areas as a whole, should be available. And another survey test with the drone in the same area (mine passages). The purpose of the applied research is to find out whether performing the work with a drone or hand-held scanner facilitates the performance of the work, which one is faster and more accurate.

The project could carry out applied research in order to get further ideas on how to improve the quantity and volume measurements in the underground mine (new surveying measurement and safety for the specialists, with using the hand-held scanner and a drone). Need to find a way to simplify the underground measurements of mineral resources. Usually have to use at least three employees (mine surveyors) for that, the work has to be done at least once a month and it takes a whole day with two other employees. Need the experiment with the drone and a hand-held scanner to understand which one would speed up the work and how much human resources should be involved in the measurement method.

2. Project support needed from EUL

- Access to an UL in the EUL network is requested for the investigation.
- Two working days (one with the hand-held scanner and another day with the drone) in the UL are estimated for the project.
- Access to an UL and access to the tunnel which imitates as a complex of mine passages (at least 2 passages)
- measuring equipment for mine survey (a hand-held scanner and a drone).

- 1) **Selected organization where the required keyword was found from:** CNR-IRPI, via Amendola 122/1, 70126, Bari, Italy

Research keywords associated with the research organisations:

['INTERFEROMETRY', 'SAR INTERFEROMETRY (DINSAR)', 'SPATIAL PATTERNING', 'MINING', 'MINES', 'RADAR TARGETS', 'LANDSLIDES', 'INTERNATIONAL (CO)', 'PERSISTENT SCATTERERS INTERFEROMETRY', 'GEODETIC SATELLITES', 'SUBSIDENCE', 'TARGET DRONES', 'SATELLITE INTERFEROMETRY', 'INTERFEROMETERS', 'ENVISAT', 'ALL OVER THE WORLD', 'SYNTHETIC APERTURES', 'MININGINDUCED SUBSIDENCE', 'SALT MINES', 'PERSISTENT SCATTERERS', 'BEAM PLASMA INTERACTIONS']

- 2) **Selected organization where the required keyword was found from:** Polish Geological Institute, Rakowiecka, 4, 00-975 Warszawa, Poland

Research keywords associated with the research organisations:

['INTERFEROMETRY', 'SAR INTERFEROMETRY (DINSAR)', 'SPATIAL PATTERNING', 'MINING', 'MINES', 'RADAR TARGETS', 'LANDSLIDES', 'INTERNATIONAL (CO)', 'PERSISTENT SCATTERERS INTERFEROMETRY', 'GEODETIC SATELLITES', 'SUBSIDENCE', 'TARGET DRONES', 'SATELLITE INTERFEROMETRY', 'INTERFEROMETERS', 'ENVISAT', 'ALL OVER THE WORLD', 'SYNTHETIC APERTURES', 'MININGINDUCED SUBSIDENCE', 'SALT MINES', 'PERSISTENT SCATTERERS', 'BEAM PLASMA INTERACTIONS']

3) Selected organization where the required keyword was found from: Roadscanners Oy, Finland

Research keywords associated with the research organisations:

['ANTENNAS', 'ASSESSMENT TECHNIQUE', 'BLASTING', 'BLASTING EXCAVATION', 'CONTROLLED CONDITIONS', 'CRYSTALLINE BEDROCKS', 'CRYSTALLINE ROCKS', 'DRILL AND BLAST METHOD', 'DRILLS', 'EXCAVATION DAMAGE ZONES', 'GEOLOGICAL DISPOSALS', 'GEOLOGY', 'GEOPHYSICAL METHODS', 'GEOPHYSICAL PROSPECTING', 'GEOPHYSICAL TECHNIQUES', 'GEOPHYSICS', 'HIGH FREQUENCY HF', 'INFILL DRILLING', 'MAPPING', 'METHOD DEVELOPMENT', 'NUCLEAR FUELS', 'PROCESSING TECHNIQUE', 'QUALITY CONTROL', 'SEISMOLOGY', 'SPENT NUCLEAR FUELS', 'VOLUME VISUALISATION']