



WP4 INTERLINK Platform

D4.4- Second release of INTERLINK platform and community portal



*The INTERLINK project is co-funded by the European Union.
Horizon 2020 - DT-GOVERNANCE-05-2020 - Grant Agreement No 959201*



Project acronym	INTERLINK
Project full title	Innovating goverNment and ciTizen co-dEliveRy for the digital sINgle marKet
Call identifier	DT-GOVERNANCE-05-2020
Type of action	RIA
Start date	01/01/2021
End date	31/12/2023
Grant agreement no	959201

WP	4. INTERLINK Platform
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Version	V1.0
Deliverable Type	OTHER
Dissemination Level	PU
Date of Delivery	2023-04-30 (M28)
Submission Date	2023-05-15 (M29)



VERSION HISTORY

Version	Issue Date	Status	Changes	Contributor
0.1	14/03/2023	Draft	Initial structure	TREE
0.2	05/04/2023	Draft	1 st version	TREE, DEUSTO, FBK
0.3	21/04/2023	Draft	Full version internally reviewed	TREE, DEUSTO, FBK
0.4	03/05/2023	Pre-final	Version with reviewers' inputs	FBK, CNS
1.0	12/05/2023	Final	Submitted version	TREE



Glossary

ENTRY	DEFINITION
INTERLINKERs	Common building blocks, provided as software tools or in the form of knowledge offered digitally, that represent interoperable, re-usable, EU-compliant, standardized functionality for the co-production of public services
Public Service	Services that are publicly available and are provided by the government or on behalf of the government's residence in the interest of its citizens. In INTERLINK we focus not only on the software services (i.e., the services delivered digitally) but also the services that rely on digital technologies.
Software Platform	<p>A platform is a group of technologies that are used as a base upon which other applications, processes or technologies are developed.</p> <p>In other words, a platform is the basic hardware (computer) and software (operating system) on which software applications can be run. This environment constitutes the basic foundation upon which any application or software is supported and/or developed.</p> <p>Within the context of the INTERLINK project, we define a Software Platform as a set of data storage, backend services and APIs which serve as a basis for the business logic and frontend applications to develop, integrate and function. It also includes SW deployment and operational infrastructure.</p>
Software Backend	Is part of software services and/or applications running on server side within the client-server paradigm. It mostly dedicates to data storage, business logic, process workflow and utility functions
Software Frontend	Is part of the software services and/or applications running on the client side within the client-server paradigm. It mostly focuses on graphical user interface (GUI), workflow navigations and supporting business logic
SW API	API means Application Programming Interface, a type of software interface, offering a service to other pieces of software.



ACRONYMS

ABBREVIATED	EXTENDED
API	Application Programming Interface
CD	Continuous Deployment
CE	INTERLINK Collaborative Environment
CEF	Connecting Europe Facility
CI	Continuous Integration
CRUD	Create, read, update and delete
CSV	Comma-separated values
DEMO	Staging Environment
DEV	Development Environment
eIDAS	electronic IDentification, Authentication and trust Services
eTOPIA	City of Zaragoza's Centre for Art and Technology
EU	Europe / European
GDPR	General Data Protection Regulation
GUI	Graphical user interface
ICT	Information and communications technology
I/O	Input / Output
FAQ	Frequently Asked Questions
MEF	Italian Ministry of Economy and Finance
KPI	Key Performance Indicator
OSS	Open-Source Software
PA	Public Administration
PS	Public Services
PSPM	Participatory Strategic Planning Module
RP	Reporting Period
SaaS	Software as a Service
SME	Small and medium-sized enterprises
SOC	Service Offering Canvas
SW	Software
VARAM	Latvian Ministry of Regional Development
WP	Work Package
ZGZ	City of Zaragoza



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Executive summary

This deliverable represents the second release of INTERLINK platform, including the community web portal and the instantiations in the three use-case sites after the first iteration. The document also provides an update of the socio-technical requirements and the architecture of the platform.

The initial socio-technical requirements as detailed in D4.1 and the refinement process to provide guidelines for the redesign and development of system v2 is detailed in **Chapter 2**.

In **Chapter 3**, the modifications done to the architecture, in relation to deliverable D4.2, as a result of the first pilot results and optimization of the platform are described. This chapter also includes the addition of information on the data model of Interlink, as well as a mention of the Gamification engine component, which further enhances the platform's capabilities.

Modifications done to the platform and infrastructure compared to the first release of the platform (described in deliverable D4.3) are detailed in **Chapter 4**.

Updates to the implemented INTERLINK Community Web Portal are reported in a separate **Chapter 5** as it corresponds to Task T4.4 of the WP4 of the Project.

Finally, **Chapter 6** describes the software installation and preparations for the second iteration of the three pilot use cases of the Project. The results of the demonstration and testing correspond to the tasks under Work Package 5 and their results will be reported in a separate deliverable document.

1 Introduction

1.1 Introduction

INTERLINK is designed as a collaborative software system, which consists of numerous software components.

This deliverable describes the second release of the integration including the community portal and the instantiations in the three use-case sites. The document builds upon D4.3, first release of INTERLINK platform, and it also includes an updated version of the socio technical requirements (defined in D4.1) and of the reference architecture (described in D4.2) refined following the outcomes of the first use-case validation phase.

1.2 Related documents and contents

During the project, many conceptual and architectural deliverables have been created, which build the basis for the INTERLINK platform. The following enumeration lists the most relevant of them. Each of them describes aspects, which apply to a single component or idea in much greater detail. We will refer to those documents where necessary, notably:

- D4.1 (FBK, R, M6) - List and description of the socio-technical requirements. The initial list and description of the socio-technical requirements defined in T4.1.
- D3.1 (FBK, R, M10) - Identification and specifications of INTERLINKERS. Specifications of common building blocks for INTERLINK inclusive public services and their specification.
- D4.2 (TREE, OTHER, M12) - Reference architecture model and specification. The reference architecture model and specifications as defined in T4.1.
- D5.1 (DEUSTO, R, M12) - Use-case plans and guidelines v1. Result of T5.2, this document contains the specification of the use-case plan, including purpose and background, objectives and evaluation criteria, strategy, prerequisites, assumptions, risks, personnel and responsibilities, organisation, site description, methodology, schedule and test result collection. It also describes the associated trial evaluation plan and KPIs. Two releases are planned, one for each phase.
- D5.2 (VARAM, R, M12) - Community building and preliminary use-cases activities. Result of T5.3, this document contains the plan for building a community for the users and stakeholders in all the use-case sites, including details about the communication channels and contents.
- D2.1 (RU, R, M16) - Preliminary governance model. This report will include a literature review and a preliminary governance model identifying relevant variables and conditions. The model will also take into account the comparative analysis of successful and unsuccessful cases of co-production.
- D2.3 (RU, R, M16) - Governance performance indicators. This document will be a list of operationalized, non-technical performance indicators, to be used in T5.2 to develop KPI for the evaluation of the platform.



- D2.4 (CNS, R, M16) – Co-business model specification and analysis. This report will briefly describe the alternative co-business models considered for INTERLINK, present analysis results identifying the strengths and weaknesses of each candidate model and specify the best co-business model to be supported by the INTERLINK platform.
- D3.2 (FBK, OTHER, M16) – Initial repository of INTERLINKERs and partnership tools. This deliverable will provide an initial repository of common core INTERLINK enablers (INTERLINKERs) to foster Government as Platform model, and of public-private partnership governing tools such as partnership models, templates, and guidelines. The initial repository will cover a subset of the enablers targeted at the first use-case validation.
- D4.3 (TREE, OTHER, M18) – First release of INTERLINK platform and community portal. Description of the first release of INTERLINK platform, including the community portal, guidelines for instantiation and specific instantiations in the three use-cases ready for the first validation phase.
- D5.3 (DEUSTO, R, M21) – Use-case deployment and operation report v1. Details on the result of T5.4 and contains INTERLINK platform evaluation results obtained after each of the two phases of use-cases. It will report on the effort and strategy use for the deployment and the running of use-case operations.
- D5.4 (DEUSTO, R, 24) – Use-case plans and guidelines v2. Result of T5.2, this document contains the specification of the use-case plan, including purpose and background, objectives and evaluation criteria, strategy, prerequisites, assumptions, risks, personnel and responsibilities, organization, site description, methodology, schedule and test result collection. It also describes the associated trial evaluation plan and KPIs. Two releases are planned, one for each phase.

2 Refinement of socio-technical requirements

The main objective of the INTERLINK project is to design and implement a platform that can be adopted by heterogeneous networks of stakeholders – which include public governments, companies and citizens – to set-up and orchestrate collaborative initiatives for the co-production of public services. The design task is very complex, as the digital tools should support collaboration aspects (e.g. establishing interaction, motivating the people involved, bringing resources, and shared decision-making), but also meet the specificities of potentially different governance models, and comply with requirements that ensure quality of and trust in the produced services. In addition, EU regulations impose specific restrictions and recommendations on the digital services adopted by PAs (European Commission 2016¹; 2017²).

¹ European Commission. (2016). EU eGovernment Action Plan 2016-2020: accelerating the digital transformation of government. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016DC0179> (accessed on 21st February 2023).

² European Commission. (2017). European Interoperability Framework – Implementation Strategy. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:134:FIN> (accessed on 21st February 2023).

During the first 6 months of project development, task T4.1 concentrated on the collection of an initial set of socio-technical requirements by integrating different perspectives and input coming from the different work packages of the INTERLINK project, namely:

1. Top-down requirements, i.e. principles and guidelines of the new collaborative governance model defined in WP2 which is essential to understand the steps required to co-produce new public services and how technology should be customised to the specific problem to solve.
2. Bottom-up requirements from WP5 incorporating stakeholders' perspectives and empirically elicited through the involvement of the three PA partners of INTERLINK: the Italian Ministry of Economy and Finance (MEF), the Latvian Ministry of Regional Development (VARAM) and the City of Zaragoza (ZGZ).
3. Transversal user requirements that refer to the characteristics that a digital solution should satisfy in order to be useful, acceptable and accessible by end-users, considering different types of users, such as PAs, private entities, citizens.
4. Transversal technical requirements, i.e., those features that the INTERLINK platform should implement and the constraints it should satisfy to be interoperable and compliant with EU-regulations (WP4).

Deliverable D4.1 - "List and Description of Socio-technical requirements", prepared at M6, provided a detailed account of the context and the rationale for the high-level requirements for the INTERLINK platform and collected a preliminary list of descriptive tables for the requirements. The deliverable provided guidelines for the platform design and development, for the functional specification of INTERLINKERs described in D3.1. and provided a reference for the INTERLINK architecture model documented in D4.2. This preliminary list of socio-technical requirements was consulted and discussed on an ongoing basis during the process of platform and INTERLINKERs development. During a post-pilot reflection phase, carried out in M22-M24, further usability, functional, legal and system requirements were identified, as necessary for the system iterative redesign and extension to be implemented in Y3 of the project.

This chapter briefly summarises the initial socio-technical requirements as detailed in D4.1 and the refinement process that has brought to their extension and refinement at a finer grain level, to provide guidelines for the redesign and development of system v2.

2.1 Initial socio-technical requirements

The list of socio-technical requirements described in Deliverable D4.1 aimed at: (i) identifying desired (high-level) functionalities that the INTERLINK platform needs to expose to effectively guide the co-production process and the collaborative work of a network of stakeholders; (ii) collecting functional needs that pertain to concrete examples of co-production projects, as emerged from the three INTERLINK case studies; (iii) identify the common technical requirements to be satisfied by INTERLINKERs and the overall platform architecture. The requirements are succinctly recalled here for the sake of completeness. All the details can be consulted in D4.1.

2.1.1. Requirements for co-production guidance

GUID.REQ.1 - Raise awareness on co-production models: The INTERLINK platform should raise awareness and provide easy to understand information about the existing different types of co-production models and co-business models, considering that INTERLINK users have different expertise and heterogeneous levels of knowledge on co-production processes.

GUID.REQ.2 - Step-by-step guided co-production flow: A step-by-step guided co-production flow should be integrated in the INTERLINK platform to support actors in coping with the different challenges of a co-production process and in using the most appropriate resources at the different stages of the process.

GUID.REQ.3 - Go-no-go strategy: The system should actively suggest the co-production team to iteratively evaluate whether the service is feasible and viable in the longer run (sustainable) or not, and hence decide if it is worth continuing the co-production effort.

GUID.REQ.4 - Catalogue of INTERLINKERS: A catalogue of enablers (in the form of reusable knowledge and software resources) should be made available to facilitate the sequence of steps to design and produce a public service.

GUID.REQ.5 - Catalogue of Public Services: It would be useful to provide a range of exemplary public services which might be adopted, refined and extended by third PAs and their corresponding stakeholders.

GUID.REQ.6 - Catalogue of success stories: A catalogue of success stories should support end-users in understanding the value of using the INTERLINK approach (its associated governance model and collaborative environment) and the INTERLINKERS provided through the platform.

GUID.REQ.7 - Custom views for stakeholders (PA, citizens, SME) and Users: The INTERLINK platform should provide customised views to the different stakeholders and end-users of the platform. Tailored information about the co-production process and about how to engage with the INTERLINK platform should be provided in order to meet end-users' expectation and to guarantee users accessibility to the available resources.

GUID.REQ.8 - Support the co-production team in overcoming barriers related to government and PAs adoption of ICT for co-production: The INTERLINK platform should provide guidance on how to cope with challenges related to the adoption of ICT for co-production, e.g. through the availability of guidelines and checklists to aid co-production teams to overcome financial, technical, legal and cultural obstacles associated with sustainable co-production of services and assess whether such obstacles have been overcome in each co-production process.

2.1.2. Requirements for ICT support to collaboration projects

COLL.REQ.1 - Project creation and management. INTERLINK should allow registered users to create a "project", that is a new co-production initiative described by a set of



metadata fields. Administrators should be able to invite new members, monitor progress, cancel a project, provide visibility on who is the coordinator of the stakeholders' network.

COLL.REQ.2 - Team management and coordination. INTERLINK should support group activities through different features: possibility to send invitations to external users to join the project (e.g. email), visualisation of the members/participants of the project and their role within the project, workplan management, information and data sharing, tasks distribution among team members, tracking of project progress, ideation and decision making, coordination tools (e.g. calendars and Doodle like functionalities).

COLL.REQ.3 - Registration / Authentication. INTERLINK should ensure controlled access to the co-production projects, support secure login to the platform, ensure that users who register into the INTERLINK platform are able to use the same credentials for authenticating themselves into all components of the platform, manage individual accounts or corporate accounts, support the use of existing accounts (e.g. Google, Facebook) to facilitate registration and authentication.

COLL.REQ.4 - User profile. Registered users can create a personal profile that will be visible by other members of the co-production team.

COLL.REQ.5 - Collaboration environment. The collaboration environment should support the team members to carry out different types of tasks: to share files and information, to communicate with each other regardless of their physical location, to jointly work on a project or a task seamlessly on a real-time basis.

COLL.REQ.6 - Building blocks for service implementation. The catalogue of INTERLINKERS should include all the building blocks that are required to build the public services involved in the three pilot case studies, to demonstrate the potential of the INTERLINK platform.

2.1.3. Common requirements for INTERLINKERS

INTER.REQ.1 - INTERLINKER specification model compatible with Service Offering Canvas. The INTERLINKERS specification model should be compliant with the Service Offering Canvas (SOC)³ - a tool for the standardised description and definition of important digital solutions (themes), providing a comprehensive vision of the purpose of a solution, for whom it is intended, and how it is realised.

INTER.REQ.2 - Compatibility with the CEF Building Blocks. When applicable, the INTERLINKERS should be compatible at the level of standards, interfaces, and protocols with the specifications and implementations of the common capabilities promoted by EU CEF⁴.

INTER.REQ.3 - Interoperability and composability. The INTERLINKERS should satisfy the interoperability requirements at different levels to facilitate the integration with

³ <https://ec.europa.eu/digital-building-blocks/wikis/display/DIGITAL/Service+Offering+Canvas+Playbook>.

⁴ <https://ec.europa.eu/digital-building-blocks/wikis/display/DIGITAL/About+us>.



the platform and composability with other components and INTERLINKERs according to the type of the INTERLINKERs and their role in the co-production process.

INTER.REQ.4 - Openness of catalogue of INTERLINKERs for extension with new INTERLINKERs in the future. The catalogue of INTERLINKERs should support continuous addition of new INTERLINKERs to match emerging needs and new INTERLINKERs produced during the different public service co-production processes.

INTER.REQ.5 - Configurability of INTERLINKERs. (Some of the) INTERLINKERs need to expose a configuration interface that allows users of the INTERLINK platform to set different configuration/customization options supported by the module.

INTER.REQ.6 - Traceability by design. Prefer the solutions that allow for tracing their use in order to ensure the transparency and to enable monitoring of the INTERLINKERs within the INTERLINK platform.

INTER.REQ.7 - Open-Source Licensing when possible. Prefer the solutions based on the Open-Source licences as also suggested by the EU and national regulations. This requirement does not necessarily mean free software; the way the software is provided, hosted, and managed, as well as the support, may be regulated by additional commercial agreements including the aforementioned long-term support agreements or master service agreements.

2.1.4. General technical requirements

TECH.REQ.1 - FAIR principles for data and metadata management. The INTERLINK platform should adopt open standards for data exchange and management. In general, the whole data and metadata management within the INTERLINK platform should comply with the FAIR standard principles⁵.

TECH.REQ.2 - Protocol Interoperability. In general, REST API-based exchange following the Open API 3.0 Specification is preferred. Depending on the type of INTERLINKER software (freeware which runs locally or external SaaS) and availability of API, integration into platform may be: deep as a platform plugin for platform tools; medium level for microservices integrated via REST API or app-specific API; weak or manual (at level of human processes) for external SaaS which do not provide any API.

TECH.REQ.3 - Infrastructure Interoperability. Market standard-based solutions are preferred for the self-hosted solutions, adhering to the Cloud-Native Computing Foundation (CNCF) initiative.

TECH.REQ.4 - Security Interoperability. Use standard solutions recommended by EU and national level practices for accessing the applications, both at the user level and application-level integration (e.g., OAuth2.0 / OpenID Connect, eIDAS compliant solutions, Single Sign-On).

⁵ Wilkinson, M., Dumontier, M., Aalbersberg, I. et al. The FAIR Guiding Principles for scientific data management and stewardship. Sci Data 3, 160018 (2016). <https://doi.org/10.1038/sdata.2016.18>



TECH.REQ.5 - Secure storage of data and GDPR-compatibility. The INTERLINK platform has to provide secure storage functionalities for the data collected for the legitimate needs of the platform. When using data subject to GDPR, the platform must also provide the required GDPR processes.

TECH.REQ.6 - Platform usage statistics. The INTERLINK platform should log the usage of the system front end, the number of registered users, and the types of used services. The collected data should be scrutable in a user-friendly way and should support periodic data analysis to generate reports on system performance, size of the engaged community, and most popular INTERLINKERS.

TECH.REQ.7 - Separation between service co-production platform and service operation platform. Potential for offering an operation environment to manage execution and monitoring of co-produced services, as part of the co-delivery stage. This functionality will be offered only for INTERLINKERS and PSs used in the pilots.

TECH.REQ.8 - Service composition. The INTERLINK platform must support users in the creation of bundles of INTERLINKERS that compose a new public service.

TECH.REQ.9 - Storage of a new bundled service in the Service Catalogue. After a user has created a bundle of INTERLINKERS that compose a new public service, the new service is stored in a dedicated catalogue for its potential reuse by other PAs. Each public service publication needs to come with instructions for deployment and execution.

TECH.REQ.10 - Configuration of an item in the Service Catalogue for its reuse by other PAs. A bundled service in the Service Catalogue conceived to be potentially reused by a PA needs to expose possible configuration settings.

TECH.REQ.11 - Platform Front-End responsive on different devices, operating systems, and browsers. Every functionality of the INTERLINK platform should be able to work with most web-browsers, operating systems, devices or with minimal configuration.

2.1.5. General user requirements

USER.REQ.1 - Usability. Usability of the INTERLINK front-end and INTERLINKERS should be guaranteed following usability principles⁶: visibility of system status, match between system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic, and minimalist design, help and documentation.

USER.REQ.2 - User help. Users should be supported in discovering and using the platform functionalities and the related INTERLINKERS. Relevant information on the platform should be easy to find as well as the value of the platform should be easy to understand. A set of features should be integrated in the platform to help users: user manual, in-line help, FAQs, video-tutorials.

⁶ <https://www.nngroup.com/articles/ten-usability-heuristics/>.



USER.REQ.3 - Acceptability and usefulness. INTERLINK platform should be designed considering the following features: *pragmatic*, that is, the usability and usefulness which is the match between user needs and functionality; *accuracy*, how well the platform addresses the co-production process needs; *hedonic*, i.e. likeability and physical appearance, affective evaluation; *costs*, both the financial costs and the social and organisational consequences of buying a product.

USER.REQ.4 - Trust and privacy. INTERLINK platform should be designed considering the following privacy-preserving *features*: awareness (users should be aware of personal data stored and managed by the platform); data quality (completeness and accuracy); security (data transmission, cookies); information movements should be communicated to users; user identification should be communicated to users; choice (users should decide if they agree to collect and store personal data).

USER.REQ.5 - Accessibility, inclusiveness, and internationalisation. In case multiple existing software solutions comply with the core profile specification of an INTERLINKER, prefer the solution with *certified* accessibility according to the EU and national recommendations for the user interfaces of the solutions. Guarantee multilingual interfaces and ensure a low technological entry barrier. The same general requirement should be satisfied by the INTERLINK platform front-end.

2.1.6. Implementation of initial socio-technical requirements

Following the initial socio-technical requirements listed above, integrated with a technical specification of the system architecture (as documented in deliverable D4.2), and a specification model for INTERLINKERS (deliverable D3.1), the first version of the INTERLINK Collaborative Environment (CE) was designed and implemented to be ready for the first major milestone of project development at M16 (as detailed in deliverable D4.3). Table 1 briefly summarizes how the initial socio-technical requirements were considered during the design and implementation of the first version of the INTERLINK platform.

Table 1. Initial socio-technical requirements and their implementation in the 1st version of INTERLINK platform

INITIAL SOCIO-TECHNICAL REQUIREMENTS	HOW THEY WERE IMPLEMENTED
Requirements for co-production guidance	
GUID.REQ.1 - Raise awareness on co-production models	In prototype v1, content was provided that explains general co-production concepts and the availability of alternative schemas for co-production models.
GUID.REQ.2 - Step-by-step guided co-production flow	An "Overview" section was implemented in the system that suggests a list of steps to perform to create a new co-production process.
GUID.REQ.3 - Go-no-go strategy	The co-production schemas available in prototype v1 included reflection tasks in which co-production coordinators are invited to stop and reflect on how to proceed in their co-production process.
GUID.REQ.4 - Catalogue of INTERLINKERS	An initial version of this functionality was implemented in prototype v1.
GUID.REQ.5 - Catalogue of Public Services	The design of this functionality was delayed to v2 to enable further considerations.



INITIAL SOCIO-TECHNICAL REQUIREMENTS	HOW THEY WERE IMPLEMENTED
GUID.REQ.6 - Catalogue of success stories	The design of this functionality was delayed to v2.
GUID.REQ.7 - Customized views for stakeholders (PA, citizens, SME) and Users	An “administrator” role was implemented that allows the visualization of functionalities normally hidden to other users. Users can be grouped into teams that are assigned a type (citizens, public administration, non profit organization, for profit organization) and different access rights to the co-production resources, so to implement customized views.
GUID.REQ.8 - Support the co-production team in overcoming barriers related to government and PAs adoption of ICT for co-production	Specific content and knowledge INERLINKERs were included in the platform to build capacity in co-production and in the use of digital tools for collaborative work.
Requirements for ICT support to collaboration projects	
COLL.REQ.1 - Project creation and management	This functionality, with a range of possible interactions, was implemented in prototype v1.
COLL.REQ.2 - Team management and coordination	This functionality, with a range of possible interactions, was implemented in prototype v1.
COLL.REQ.3 - Registration / Authentication	This functionality was implemented through the integration of the AAC INTERLINKER.
COLL.REQ.4 - User profile	In prototype v1 a minimal user profile stores users’ email addresses, their role and access rights.
COLL.REQ.5 - Collaboration environment	A platform including several digital functionalities to support collaborative work was implemented in prototype v1.
COLL.REQ.6 - Building blocks for service implementation	Some software INTERLINKERs were made available in the catalogue to experiment with service implementation from building blocks.
Common requirements for INTERLINKERs	
INTER.REQ.1 - INTERLINKER specification model compatible with Service Offering Canvas	The specification model for INTERLINKERs was built upon the Service Offering Canvas, as explained in deliverable “D3.1 - Identification and specifications of INTERLINKERs”.
INTER.REQ.2 - Compatibility with the CEF Building Blocks	The specification model for INTERLINKERs explicitly considers compatibility with CEF Building Blocks, as explained in deliverable “D3.1 - Identification and specifications of INTERLINKERs”.
INTER.REQ.3 - Interoperability and composability	The overall platform architecture as well as the specification model of INTERLINKERs is based upon principles of interoperability and composability as explained in deliverables “D3.1 - Identification and specifications of INTERLINKERs” and “D4.2 - Reference architecture model and specification”.
INTER.REQ.4 - Openness of catalogue of INTERLINKERs for extension with new INTERLINKERs in the future	The catalogue of INTERLINKERs is extendable.
INTER.REQ.5 - Configurability of INTERLINKERs	Whenever appropriate, some INTERLINKERs can be configured to adapt their reuse to different application contexts.



INITIAL SOCIO-TECHNICAL REQUIREMENTS	HOW THEY WERE IMPLEMENTED
INTER.REQ.6 - Traceability by design	An articulated method for tracing the system functioning has been implemented at different levels: at platform level (with low level logging of system usage), at interface level (with user action logging) and at INTERLINKERS level (with user action logging).
INTER.REQ.7 - Open-Source Licensing when possible	Open-Source Licensing has been preferred whenever possible, both at the level of system architecture implementation and system components implementation.
General technical requirements	
TECH.REQ.1 - FAIR principles for data and metadata management	This requirement was incorporated by design in the system architecture.
TECH.REQ.2 - Protocol Interoperability	This requirement was incorporated by design in the system architecture.
TECH.REQ.3 - Infrastructure Interoperability	This requirement was incorporated by design in the system architecture.
TECH.REQ.4 - Security Interoperability	This requirement was incorporated by design in the system architecture.
TECH.REQ.5 - Secure storage of data and GDPR-compatibility	This requirement was incorporated by design in the system architecture. Further monitoring and refinement of data management protocols have been continuously carried out in WP6.
TECH.REQ.6 - Platform usage statistics	A specific dashboard was implemented to meet this requirement, as described in deliverable "D5.3 - Use-case deployment and operation report v1" (see section 3.5.1).
TECH.REQ.7 - Separation between service co-production platform and service operation platform	This requirement was incorporated by design in the system architecture.
TECH.REQ.8 - Service composition	The experimentation of this functionality was delayed to v2.
TECH.REQ.9 - Storage of a new bundled service in the Service Catalogue	The design of this functionality was delayed to v2 to enable further considerations.
TECH.REQ.10 - Configuration of an item in the Service Catalogue for its reuse by other PAs	The design of this functionality was delayed to v2 to enable further considerations.
TECH.REQ.11 - Platform Front-End responsive on different devices, operating systems and browsers	This requirement was incorporated by design in platform front end interface.
General user requirements	
USER.REQ.1 - Usability	This requirement was satisfied through iterative cycles of user-centred design, implementation, evaluation, and revision.
USER.REQ.2 - User help	This requirement was satisfied through iterative cycles of user-centred design, implementation, evaluation, and revision.



INITIAL SOCIO-TECHNICAL REQUIREMENTS	HOW THEY WERE IMPLEMENTED
USER.REQ.3 - Acceptability and usefulness	This requirement was satisfied through iterative cycles of user-centred design, implementation, evaluation, and revision.
USER.REQ.4 - Trust and privacy	This requirement was satisfied through iterative cycles of user-centred design, implementation, evaluation, and revision.
USER.REQ.5 - Accessibility, inclusiveness, and internationalization	The user interface was internationalized and tested for accessibility.

2.2 Additional requirements distilled after Pilot Iteration I

One of the main goals of the Pilot Iteration I was to evaluate the effectiveness of the first system release and to collect information to improve the system for the second release, which will be tested in Pilot 2.

For the redesign of the first release of the CE, a collaborative approach has been followed in which all Project Partners and in particular Pilot Owners, have been engaged in an iterative discussion in order to define priorities to be tackled for the Second release as well as to co-design new functionalities to be integrated in the CE. Specifically, after the analysis of the results gathered through Iteration I, two workshops have been conducted to define the refined requirements to be implemented, the new functionalities to be designed, and priorities for Pilot 2. According to the technical plan emerged from this collaborative work, mock-ups and prototypes have been developed to guide the implementation of the second Release of the platform (See Figure 1).

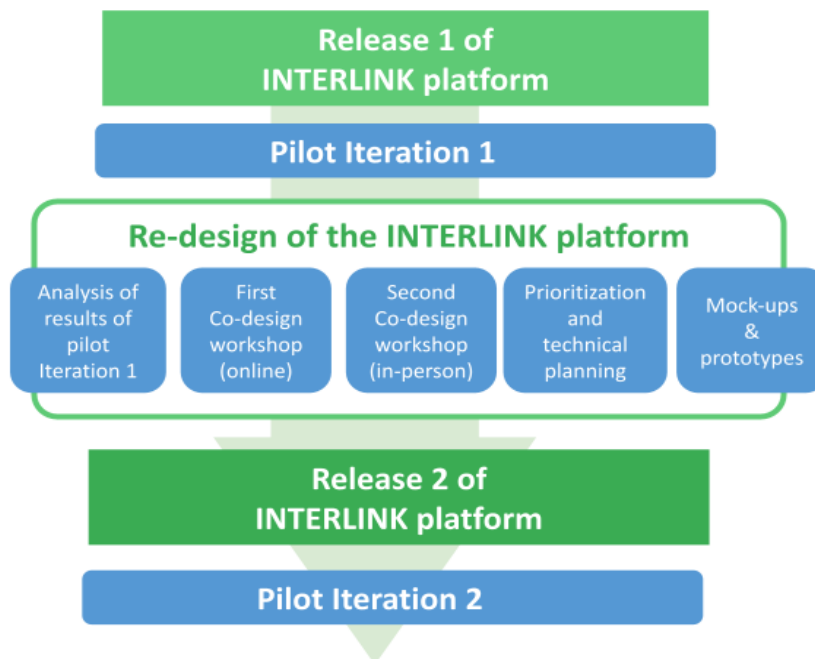


Figure 1. The process followed for the redesign of the Collaborative Environment



The overall re-design process has been structured as a collaborative activity involving all INTERLINK partners and case Study Owners. We decided to exploit the Collaborative Environment itself and other INTERLINKERs (like Loomio) to manage collaboration and to take advantage of the collaborative resources helpful to share the different perspectives on the first pilot iteration, take decisions together and document the whole process (Figure 2). This activity allowed project partners to engage in a concrete exercise of collaborative process mediated by INTERLINK vision and tools, thus offering evaluation opportunities of project results beyond the testing sessions of the use cases.

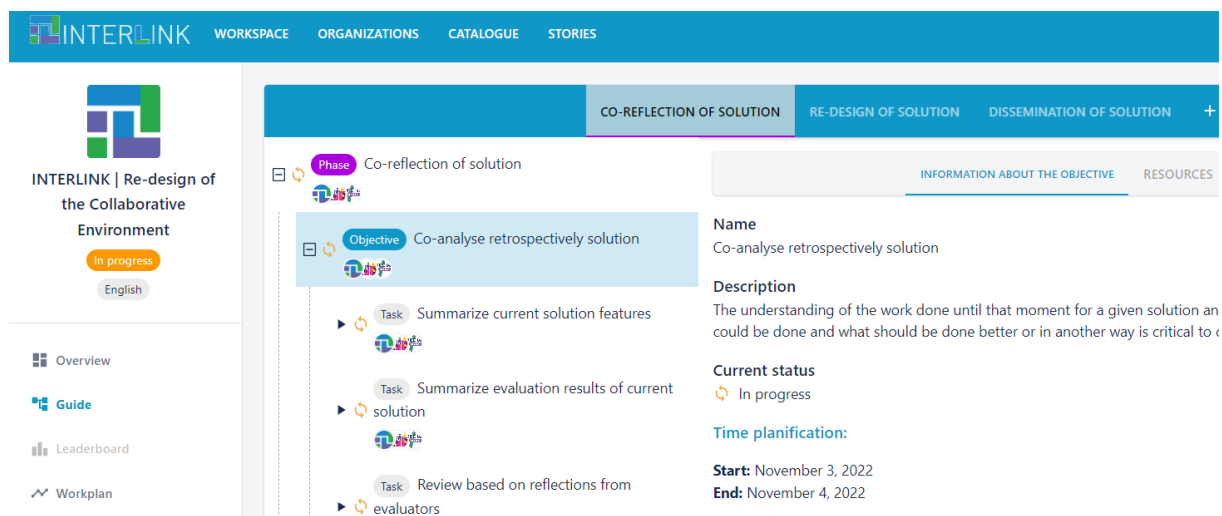


Figure 2. Snapshot of the process in the Collaborative Environment to manage the redesign phase.

2.2.1. Requirements from the results of the First pilot evaluation

A detailed description of results of the first pilot is described in D5.3. We report here a summary of the main outcomes emerged especially in relation to User Experience and Usability as expressed by case studies owners in the Post-pilot reflection questionnaire. These findings represent fine-grained user requirements that refine and integrate the initial socio-technical requirements and have been used as the basis to start the collective reflection on the redesign of the Collaborative Environment described in the next subsections of this Section.

REFINED.REQ.1 - Accountability and awareness of the process

- Team members entering in a co-production process should be aware of what other team members and themselves have performed over a co-production process. There is a need to follow the timeline of the project.
- A progress dashboard is considered very important.

REFINED.REQ.2 - Long-term involvement and motivation

- Long-term engagement in co-production processes requires that individual team member contributions are measured and valued. Only by reinforcing



accountability it will be possible to consider the future adoption of exploitation plans for co-produced artefacts. A Digital dashboard showing statistics and insights on the collaborative process would foster self-reflection and co-evaluation for an internal assessment of the co-production initiative.

REFINED.REQ.3 - Improve usability of the GUI of the Collaborative Environment

Better contextual information and guidance are needed to reinforce acceptance.

- Easier and more effective team member management is needed, e.g. allow the creation of teams from CSVs with contact details rather than inputting members one by one.
- The structure of co-production schemas is difficult to grasp. More graphical elements are required, more plain English for terminology, better link between INTERLINKERS, resources and tasks.
- Access rights management is not easy to understand but seems highly important from a governance point of view.
- Notification mechanisms should be provided.

REFINED.REQ.4 - Replicability of co-production processes

- Importance of success stories: learning by example is considered helpful. Consolidated successful co-production processes should be made available and allow third parties to instantiate new co-production processes based on those successful experiences.

REFINED.REQ.5 - Customization of co-production model and schemas

- They have been positively evaluated, but further enhancements are needed to adapt existing ones into new co-production schemas.

REFINED.REQ.6 - Improved navigation of INTERLINKERS

- Navigation of INTERLINKERS through the catalogue should be improved, with a more to the point recommendation of INTERLINKERS with respect to the task to perform.

2.2.2. First collaborative re-design workshop (4th November 2022, Online)

Once the feedback from the 3 pilots was collected and analysed, the re-design phase of the Collaborative Environment started. The main goal of this phase was to define the improvements to incorporate into the system that will be deployed in Iteration 2 and define a clear work planning for the system implementation. The first workshop had two main objectives:

- to perform a collaborative retrospective analysis of the first release of the Collaborative Environment starting from the results gathered during Pilot 1;
- to make a collaborative reflection about possible new desirable features for the second release of the Collaborative Environment to be tested during Pilot 2.

In the following we report the main activities carried out during the workshop and the results gathered.



- **Perceived usefulness and usability of current functionalities of the Collaborative Environment**

As a first step for discussing improvement and enrichment of the platform, a voting session was launched through Loomio - an INTERLINKER integrated into the Collaborative Environment. Pilots' owners of the 3 different use cases were asked to vote on both usability and usefulness of the current functionalities. Usability was measured asking participants to vote on a 1 to 10 scale (see Figure 3 below) while usefulness was measured asking participants to rank the functionalities from the most useful to the less useful.

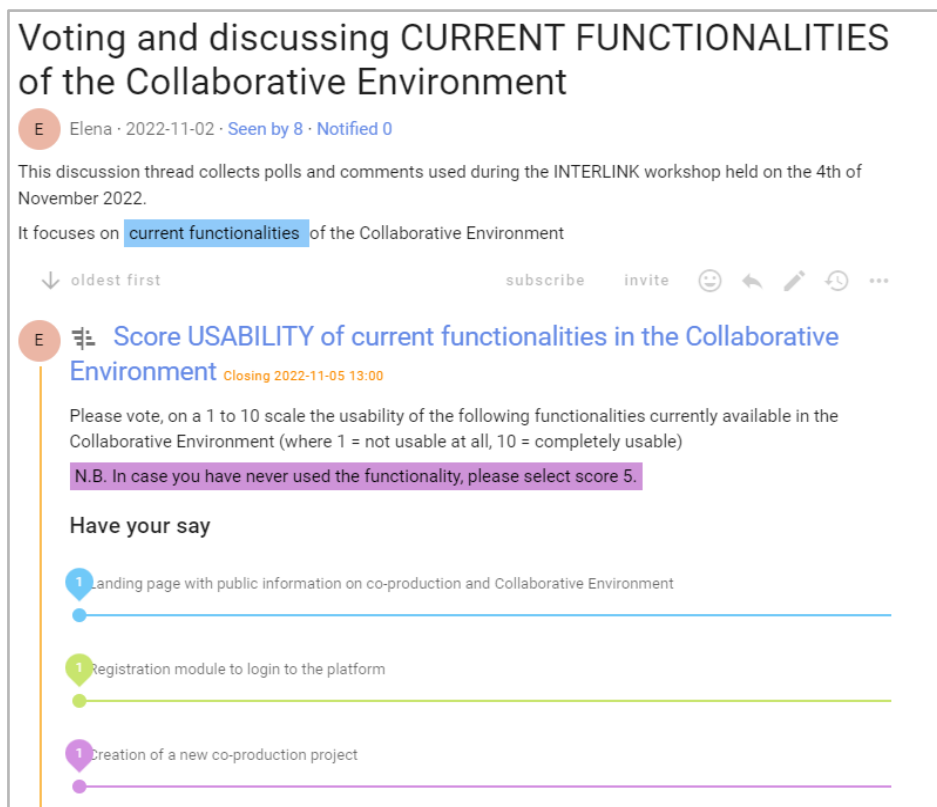


Figure 3. Snapshot of the voting session in Loomio

Collecting insights on both usability and usefulness was crucial to identify which are the most interesting and useful functionalities according to pilot owners and the perceived degree of usability of these functionalities (Table 1).

Table 2. Usefulness and usability scored

Current functionalities of the Collaborative Environment	USABILITY (scale 1 least usable - 10 most usable)			USEFULNESS (1 least useful - 15 most useful)		
	total points	average	% of points	total points	average	% of points
Generic Interlinkers for collaboration (E.g.: Google doc, Google form, Loomio)	54	9.00	8.59%	30	5.00	4.17%



Current functionalities of the Collaborative Environment	USABILITY (scale 1 least usable - 10 most usable)			USEFULNESS (1 least useful - 15 most useful)		
	total points	average	% of points	total points	average	% of points
Possibility to upload and share documents	49	8.17	7.79%	64	10.67	8.89%
Knowledge Interlinkers for co-production (E.g.: Template for focus group / interviews; Consent forms)	49	8.17	7.79%	25	4.17	3.47%
Possibility to link external resources	48	8.00	7.63%	54	9.00	7.50%
Software Interlinkers for co-production (E.g Augmenter)	46	7.67	7.31%	34	5.67	4.72%
Catalogue of INTERLINKERS	44	7.33	7.00%	29	4.83	4.03%
Edit of project description	43	7.17	6.84%	44	7.33	6.11%
Registration module to login to the platform	40	6.67	6.36%	71	11.83	9.86%
Co-production process overview	40	6.67	6.36%	46	7.67	6.39%
Coproduction Tree navigation (Phase, Objectives, Tasks)	40	6.67	6.36%	58	9.67	8.06%
Landing page with public information on co-production and Collaborative Environment	39	6.50	6.20%	56	9.33	7.78%
Workplan	38	6.33	6.04%	66	11.00	9.17%
Creation of organisation and teams	37	6.17	5.88%	46	7.67	6.39%
Creation of a new co-production project	33	5.50	5.25%	53	8.83	7.36%
Schema selection	29	4.83	4.61%	44	7.33	6.11%
	RED MEANS CRITICAL USABILITY			RED MEANS CRUCIAL FOR USEFULNESS		

Results showed that the functionalities perceived as most crucial and useful for pilot owners are on average usable (e.g., Possibility to upload and share documents, Possibility to link external resources, Registration module to login to the platform). The results also clearly showed which are the functionalities perceived as useful that received low usability values, such as:

- Co-production Tree navigation (Phase, Objectives, Tasks)
- Landing page with public information on co-production and Collaborative Environment



- Workplan
- Creation of a new co-production project
- Schema selection

In Annex 1 a detailed overview of the results gathered through the Loomio voting session is provided.

• **Reflection on future extensions of the Collaborative Environment**

After having analysed the current functionalities, participants were asked to provide their feedback on future extensions of the system. They were asked to reorder a list of possible future extensions of the Collaborative Environment based on their perceived usefulness. Results are summarised in Table 2, where the "average" column indicates the average position in a 1 to 10 priority of each potential future functionality.

Table 3. Future extensions of the Collaborative Environment in order of preference

Potential future functionalities of the CE	total	average	% of points
Notification about latest updates, important changes, etc	54	9	16.36%
Visualisation of stakeholders’ network activity and liveliness	42	7	12.73%
Workplan with Progress awareness functionalities	41	6.83	12.42%
New co-production schemas	36	6	10.91%
Instant group chat	36	6	10.91%
Forum integrated within a co-production process	32	5.33	9.70%
Catalogue of re-usable public services	25	4.17	7.58%
More advanced design thinking tools (like Miro/Mural boards)	25	4.17	7.58%
Incentives & rewards component	23	3.83	6.97%
Catalogue of success stories	16	2.67	4.85%

Results showed that the most crucial functionalities to be implemented are related visibility, awareness and transparency of the collaborative work conducted within the CE. Specifically, functionalities that are expected are (i) notification about updates (ii) visualisation of the network activity and (iii) awareness about the progress in the workplan. As a participant wrote in the comments: “These could be new functionalities that could enhance the usefulness of the platform allowing a more shared awareness and communication about project progress.”

Besides, participants asked to implement the possibility to add new co-production schemas and to customise those offered by the CE. This would improve the flexibility of the CE and adapt it to diverse collaborative initiatives.

The top four functionalities were directly included by technical partners in the list of improvements foreseen for the second phase of the project. Others like instant group chat, forums, and design thinking tools (certainly useful from the end-user point of view) were considered less interesting from the research and innovation perspective as they may be “easily” integrated using standard solutions.



The last two positions in Table 2 above deserve a special reflection. Very likely, pilot owners assigned higher scores to those functionalities that would have been particularly useful during their activities in iteration 1. The catalogue of success stories is particularly useful during the initial orientation phase, when PA stakeholders still look for inspiration and information on whether to adopt a co-production approach or not. For the three pilot case studies, during iteration 1, the need for inspiration was not strong (as the co-production scenario had already been decided well in advance) and this was reflected in their evaluation. Similarly, some preconceptions about incentives and rewards in public administrations hindered the complete understanding of the feasibility and potential benefit of this functionality. For this reason, the opportunities related to incentives and rewards and to the catalogue of success stories were further investigated with pilot owners in specific brainstorming activities that let better emerge their salience for INTERLINK.

- **Requirements for incentives and rewards to support co-production**

Co-production processes may span over months, sometimes even years. The engagement of heterogeneous networks of stakeholders for long periods of time requires proper strategies to foster participation and active contribution. To investigate the issue and collect requirements for a potential extension of the INTERLINK Collaborative Environment in this direction, during the first re-design workshop we organised a targeted focus group, facilitated through the collaborative filling of an online Jamboard and articulated in the following phases:

1. introduction clarifying the definition of the terms “incentives” and “rewards”;
2. reflection on past experience of all partners with incentives and rewards for collaboration activities; elaboration on what was used, why, whether it proved to be effective, general constraints related to the usage of incentives and rewards;
3. discussion about what needs to be incentivised (which actions, people, when);
4. a more open brainstorming on types of incentives and rewards beyond those that were already experimented to come up with an expanded categorization along the two dimensions Material/Immaterial and Internal/External;
5. a reflection on how this may impact on gamification techniques and on the potential integration of a gamification engine to digitally manage incentives and rewards within the Collaborative Environment;
6. envisaging potential scenarios of use of incentives and rewards in the three pilot case studies.

The following general requirements have emerged to inform the design and implementation activities for the second version of the INTERLINK Collaborative Environment:

REFINED.REQ.7 – Usage of incentives and rewards

- A Knowledge Interlinker would be desirable with guidelines and best practices on how to increase personal motivation of public servants and, in general, participants to co-production processes.



- There are different types of activities and aspects to be incentivized/rewarded:
 - (i) commitment and involvement of participants;
 - (ii) execution of co-production tasks (e.g., collaboration on public service description creation as in VARAM's scenario);
 - (iii) dedication, execution of extra task / take up of responsibilities and administrator's role;
 - (iv) quality and creativity of ideas or proposals (like in hackathons envisaged in ZGZ's scenarios).
- The evaluation of quality and creativity implies that we are not simply rewarding participation and commitment of people, but we introduce a notion of competition where some contributions may be better than others.
- If a software INTERLINKER is used to support the measurement of activities, still a human supervision is necessary to evaluate the quality of the actual engagement and decide when a task has been completed.
- The system has to be very flexible/configurable to accommodate different types of stakeholder's networks, participant types, material and immaterial incentives and rewards.

Further details on the ongoing work for the design and integration of an incentives system in the Collaborative Environment and of a separate Loyalty System to be tested in ZGZ use case will be described in detail in deliverable D3.3 ("Final catalogue of Interlinkers and partnership tools", M32), as various knowledge and software INTERLINKERs are at stake.

2.2.3. Second collaborative re-design workshop in Rome (13th-14th December 2022, In-person)

Starting from the results of the first workshop, a second workshop was organised during the in-presence Consortium Meeting in Rome (13-14 December 2022). The main goal of this second workshop was to focus on the redesign of the functionalities that have been rated as most crucial and useful and to start co-designing the new functionalities to be developed in the second release of the platform.

Although the workshop was held in presence, we decided to use a digital jamboard to allow the participants of the Zaragoza pilot, who were collected remotely, to be involved as well. The collaborative work was structured in the following way: the different functionalities were first presented by showing a short demo of the functionalities (if available) or by presenting the general idea for a new functionality through slides, then feedback was collected both verbally through a structured discussion and with written contributions through the jamboard (see Figure 4).

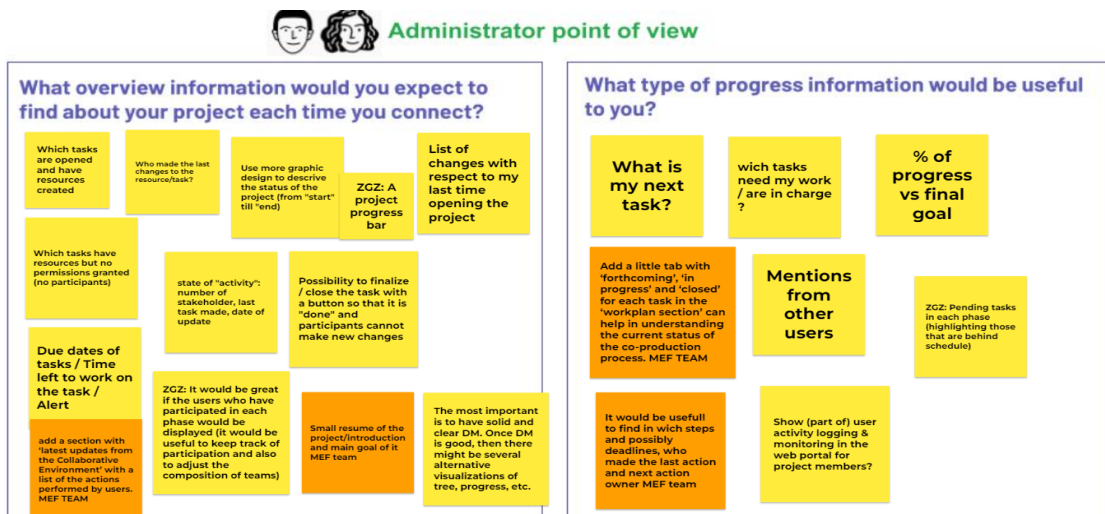


Figure 4. Snapshot of the jamboard used to collect feedback from participants on the Overview page of the Collaborative Environment

We report in the following the main results gathered on the specific functionalities discussed and analysed.

- **Requirements for revision of existing functionalities**

In the first part of the workshop, the focus was on the re-design of functionalities that participants could try and test during Iteration 1.

REFINED.REQ.8 - Clearer guidance for the creation of a new co-production project

As it emerged during the first workshop, launching a new co-production initiative can be a daunting task especially when there is a lack of information and guidance on the necessary steps to take.

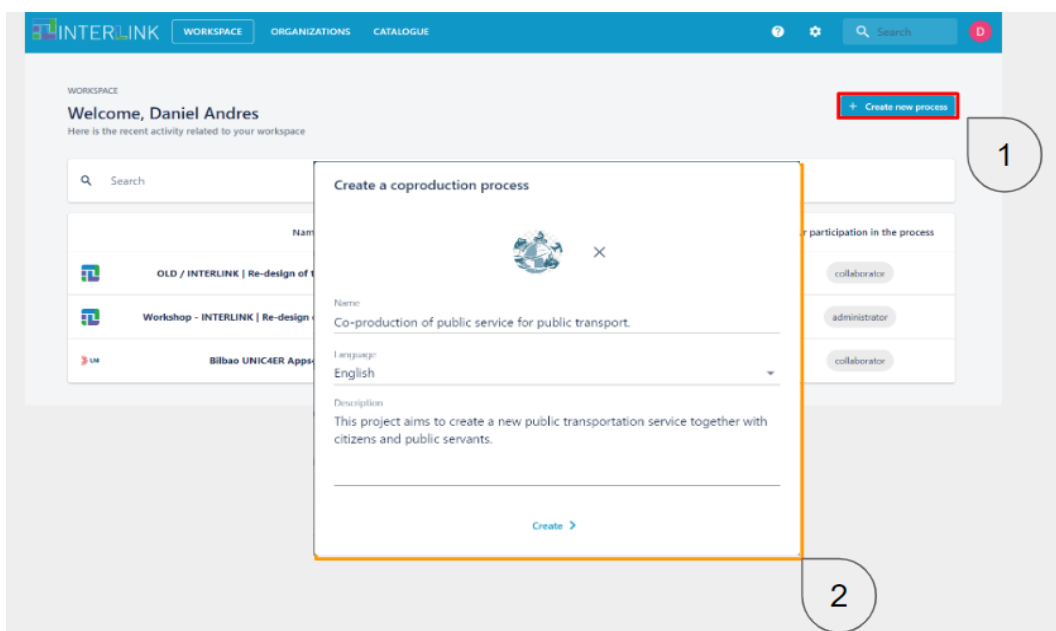


Figure 5. Snapshot of the functionality in which the user can create a new co-production process



Participants were asked to reflect on the following aspects:

- What step of the co-production process creation is the most difficult?
- What type of additional guidance do you feel would be needed at this point?
- What type of additional content do you think should be shown before the project creation flow?

Participants agreed that it is crucial to provide users with richer descriptions about the digital environment in which they are working. This can include:

- clear explanations of how to start a new project;
- guidance through a step-by-step approach, highlighting which are the mandatory tasks (vs non-mandatory tasks).

These requirements might be addressed through a static page (tutorial) that summarises what comes next or through a page that pops up the first time a user logs in. Visual material and graphics should be preferred over text descriptions.

REFINED.REQ.9 - Email notifications

Guidance should be improved also through detailed material targeting the administrator of the process. In particular, participants suggested that once the project is launched, an email to the administrator might be sent where all the procedure is clearly explained. Also, co-producers, that is the participants to a co-production process that are invited to join a process, should be notified through email and receive detailed information about what is expected from them.

REFINED.REQ.10 - Project overview and progress: in-platform notifications and resource history

Another important part of the Collaborative Environment that participants asked to improve is the project overview page and the progress view. For these functionalities, we asked participants to reason, first, from the administrator perspective and, second, from the participants perspective. Questions were:

- What overview information would you expect to find about your project each time you connect?
- What type of progress information would be useful for you?

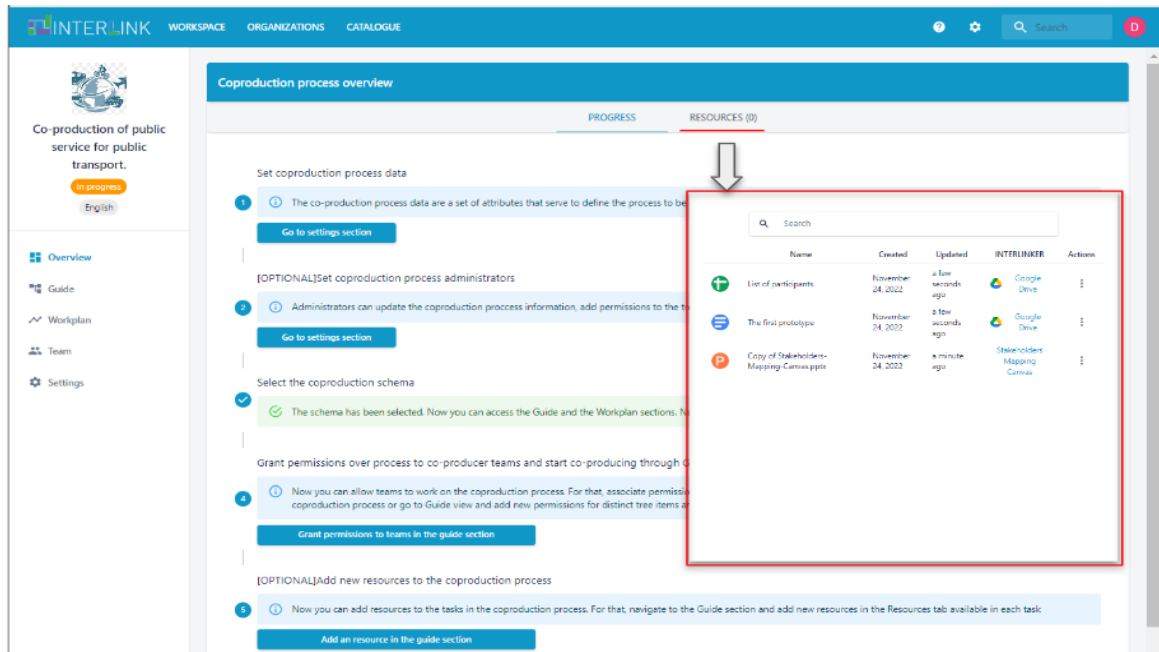


Figure 6. Snapshot of the overview page evaluated by participants

The following tables summarise the input that was collected from participants during this discussion session.

Administrator perspective

Table 4. Desiderata for information on project progress, from the Administrator perspective

What overview information would you expect to find about your project each time you connect?	
Type of information required	Example of expected information
Information about tasks status	<ul style="list-style-type: none"> • Which tasks have associated resources? • Which tasks have resources, but no permissions granted (no participants) • Due dates of tasks / Time left to work on the task / Alerts • Possibility to finalise / close the task with a button so that it is "done" and participants cannot make new changes • Which tasks are open
Information about the project	<ul style="list-style-type: none"> • Use more graphic design to describe the status of the project (from "start" till "end") • Small resume of the project/introduction and main goal of it
Information about participants activities on the platform	<ul style="list-style-type: none"> • Who made the last changes to the resource/task? • It would be great if the users who have participated in each phase would be displayed (it would be useful to keep track of participation and to adjust the composition of teams) • Show (part of) user activity logging & monitoring in the web portal for project members



<i>Information about changes and updates</i>	<ul style="list-style-type: none"> List of changes with respect to my last time opening the project 'Latest updates from the Collaborative Environment' with a list of the actions performed by users.
<i>Information about activities</i>	<ul style="list-style-type: none"> State of "activity": number of stakeholders, last task made, date of update
What type of progress information would be useful to you?	
<i>Information about tasks</i>	<ul style="list-style-type: none"> What is my next task? Which tasks need my work / are in charge? % of progress vs final goal pending tasks in each phase (highlighting those that are behind schedule) suggestion: add a little tab with 'forthcoming', 'in progress' and 'closed' for each task in the 'workplan section' can help in understanding the current status of the co-production process.
<i>Information about steps and possibly deadlines</i>	<ul style="list-style-type: none"> It would be useful to find in which steps were made recent actions and which are the deadlines, who made the last action and what will be the next action

Participant perspective

Table 5. Desiderata for information on project progress, from the Participant perspective

What overview information would you expect to find about your project each time you connect?	
Type of information required	Example of expected information
<i>Information about tasks and contribution</i>	<ul style="list-style-type: none"> Which processes and tasks are open to you to participate
<i>Information about effort</i>	<ul style="list-style-type: none"> How much time is required for a single task. Which skills are required.
<i>Latest updates</i>	<ul style="list-style-type: none"> Who from your team made the last changes in the task/resource
<i>Role of participants</i>	<ul style="list-style-type: none"> What is the role of new stakeholders and what are they able to do and how
What type of progress information would be useful to you?	
<i>Deadlines and alerts of tasks</i>	<ul style="list-style-type: none"> Deadlines and main milestones on the project List of tasks in which participants are asked to contribute
<i>Steps</i>	<ul style="list-style-type: none"> what's next --> why they have to collaborate to this task and the impact to final goal
<i>Output and results</i>	<ul style="list-style-type: none"> Results of the tasks/process in very clear language

The type of expected information mentioned by participants was carefully examined to inform the design of new functionalities that visually render project progress, like



the visualisation of notifications about latest events in the platform and the history of resource modifications.

REFINED.REQ.11 – Guidance for schema selection

The selection of a proper co-production schema was also identified as challenging by participants in the first workshop. We asked participants to reflect on the following aspects:

- How would you make schema selection more visible inside the platform?
- What type of additional information about governance models and co-production do you think would be useful here?
- If you had to imagine a step-by-step guidance on schema selection, what would you like to find?

Selection of the co-production schema			
<input type="text" value="Search"/>			
Name	Description	Creation date	Actions
#1 Hackathon creation process ☆☆☆☆☆ (0)	The INTERLINK project allows for the definition of purpose-specific co-production processes. In this case, this co-production process is designed to guide ideation, preparation, launch and exploitation of a Hackathon devised to address some societal challenges in cooperation between public administrations, citizenry and other PA's stakeholders, namely, SMEs, academia or non-profit organizations. It is composed of 4 main phases: a) ENGAGE – understanding, approaching and engaging the right stakeholders; b) DESIGN – follow the guidelines to discuss together, in a balanced and inclusive way, issues, beneficiaries, and priorities for the hackathon to be designed; c) RUN – browse the catalogue of INTERLINKERS to find reusable building blocks for the implementation of the hackathon and its launch; and d) EXPLOIT – realize the results of the hackathons by reaching agreements to bring the proposed service ideas and mock-ups into reality.	3 months ago	Preview
#2 Default schema ☆☆☆☆☆ (0)	The INTERLINK project has defined a generic co-production process which can accommodate any co-production endeavour. It is composed of two main phases to be followed by co-producers: a) Co-design phase. It concerns activities that incorporate 'the experience of users and their communities' into the creation, planning, or arrangements of public services. In it, the co-production team is created and starts working together to define the service to be co-produced. This phase entails two sub-phases: Engagement and Design; and b) Co-delivery phase. It is a joint effort by public authorities and stakeholders to provide and improve public services where the service is implemented and delivered in a sustainable manner. The co-delivery phase entails two sub-phases: Build and Sustain.	3 months ago	Preview

Figure 7. Snapshot of the functionality to select the co-production schema

Suggestions in this sense have been the following:

- More guidance is needed to select an appropriate schema. Participants stated that it is challenging to select the right schema that fits a given goal and context. Prompts and questions might be provided to users in order to guide the selection of a specific schema and help to identify the proper co-production process. Besides, the system should provide guidance on the steps/activities expected after the selection of a given schema and the consequences of the selection of a given schema (e.g. relation to the work plan and to specific INTERLINKERS).
- The description of the schemas should be improved in order to help the user select the most appropriate one for a specific initiative. Actually, different schemas have been developed in the CE and every schema has specific features: each model fits goals, values, and types of networks.
- A schema should be simpler, flexible and customizable: users should be able to easily remove/add tasks in the schema.

REFINED.REQ.12 – Revised catalogue of Interlinkers

The catalogue to browse INTERLINKERS is a central feature of the CE and participants in this part of the workshop were asked to provide feedback on how the catalogue



might be improved. In the Table below, we list the questions and the answers of participants:

Table 6. Desiderata for improved Catalogue of INTERLINKERS

Question	Answer / suggestion
What information would you like to find in the catalogue?	<ul style="list-style-type: none"> • clear contact info to the "owner" of the INTERLINKER
How would you filter the catalogue?	<ul style="list-style-type: none"> • multiple filters to search INTERLINKERS are needed • search by topic: mobility, air quality, welfare... • aim/goal of the co-production process • filtered search based on user needs • clear contact info to the "owner"
Would there be constraints to publish an Interlinker you created?	<ul style="list-style-type: none"> • it could be solved highlighting the type of licence

• **Requirements for new functionalities**

In the second part of the workshop, the goal was to collect information to co-design new functionalities for the CE to be implemented in the second version of the platform.

REFINED.REQ.13 - Catalogue of success stories

Public administrations who are new to cross organisational collaboration may benefit from learning how similar public bodies have successfully applied co-production. A digital catalogue of "co-production stories" could be used to draw inspiration, to understand if a past process is transferable to a similar contest by carefully considering whether there is technological, organisational, and institutional fit. We asked PA representatives what they would look for in such a catalogue.

Table 7. Desiderata for Catalogue of Success Stories

Question	Answer / suggestion
What information would you like to find in the catalogue?	<ul style="list-style-type: none"> • objective of the process • who started the process? • approach followed by the network • what was the impact of the co-production process, the BENEFIT. • starting with "why" the process started (the need, the problem) • not only "success" but also "failed" stories of co-production • important to know what worked and also what did not work • in general, it is not easy to track the success of a story • solutions developed within a co-production process • how the problem was defined for the different user groups involved



How would you use it?	<ul style="list-style-type: none"> • to draw inspiration • to copy it adapting it to our particular circumstances (maybe we would contact the original owners of the idea) using a "success story" template of formal structure" • to make an analysis to know if the process is replicable in a similar contest
How would you filter the catalogue?	<ul style="list-style-type: none"> • problem domain • year • country • "aim of the co-production process" • reviews of participants/beneficiaries as social proof
Are there constraints to publish your own story?	<ul style="list-style-type: none"> • visual material (photo, video) would require some consent • licensing if original content was produced

REFINED.REQ.14 - Instant messaging/ forum in the CE

As reported in previous Table 2, a functionality for instant messaging was scored high on the usefulness scale. To better understand how potential users of the platform envisage such functionality and whether a tight integration within the Collaborative Environment would be appropriate and feasible, a discussion was facilitated that highlighted the aspects shown in the following table.

Table 8. Desiderata for instant communication

Question	Answer / suggestion
Do you normally use instant messaging for your work? Which tools?	<ul style="list-style-type: none"> • teams, zoom chat • MS Teams • Whatsapp • Slack or similar systems can maintain the history • technical considerations • difficult to maintain a chat service 24/7 or 8-18x5: it could be useful to schedule a time slot • we have to consider GDPR issues (i.e. phone number for whatsapp)
Why having a chat inside the CE?	<ul style="list-style-type: none"> • Smoother teamwork • Synchronous and asynchronous work sessions mixing • Addressing issues faster • To make communication smoother and immediate. • Notifying participants • To reach out easily and quickly actors involved in the co-production process and tackle main problems



<p>What types of messages would you like to exchange inside the CE?</p>	<ul style="list-style-type: none"> • Request for help for users lost in the process, in the environment • Free form: formal, informal, no restrictions • Only regarding the thematic of the Collaborative Environment to be sure the communication is about a specific project • Call to actions • contextual help and for "easy" problems (for critical or big issues, the chat it's not the right tool) • To notify that a survey has been opened or that stakeholders have to start an activity. • To notify progresses about the co-production process • In case of violations, administrators can be informed and granted access to the chat to remove participants (hate speech cases, inappropriate content, etc.)
<p>Who would you address messages to?</p>	<ul style="list-style-type: none"> • to a single participant or team as a whole • it's important to clarify with whom you can or you're chatting • to task/resource - the message reaches those who are permitted to work on it • I think we have to clarify: chat during a workshop/task and similar vs. chat for help/support in the process • to a single partner, a small group or to the whole Consortium

2.2.4. Summary list of refined socio-technical requirements

The following table briefly summarizes how the refined socio-technical requirements emerged after the evaluation of the first prototype were considered during the design and implementation of the second version of the INTERLINK platform.

Table 9. Refined socio-technical requirements and their implementation in the 1st version of INTERLINK platform

REFINED SOCIO-TECHNICAL REQUIREMENTS	HOW THEY WERE IMPLEMENTED
<p>REFINED.REQ.1 - Accountability and awareness of the process</p>	<p>This requirement was implemented with in-app notifications that allow co-producers to easily see what has happened inside the platform since their last login.</p> <p>Administrators can also see in the Overview section a progress bar for the suggested steps in the co-production process management.</p>
<p>REFINED.REQ.2 - Long-term involvement and motivation</p>	<p>A gamification engine was tightly integrated inside the Collaborative Environment to support the management of incentives and rewards for co-producers. A digital dashboard (leaderboard) can be activated to increase awareness in co-producers about participants' personal and collective contribution.</p> <p>A new Loyalty Module INTERLINKER was also implemented to offer reusable similar functionalities in other application contexts.</p>
<p>REFINED.REQ.3 - Improve usability of the GUI of the Collaborative Environment</p>	<p>Several ameliorations and extensions were implemented along the lines of the feedback collected from users during pilot iteration 1, like: easy import and export of contacts of team members,</p>



REFINED SOCIO-TECHNICAL REQUIREMENTS	HOW THEY WERE IMPLEMENTED
	more graphical elements and explanations, simplified access rights management.
REFINED.REQ.4 - Replicability of co-production processes	Functionalities were added to clone previous co-production processes.
REFINED.REQ.5 - Customization of co-production model and schemas	Functionalities to customize co-production trees (add, remove, reorder nodes) were added and/or ameliorated.
REFINED.REQ.6 - Improved navigation of INTERLINKERS	The search and re-order functionalities in the INTERLINKERS catalogue were improved.
REFINED.REQ.7 - Usage of incentives and rewards	<p>This requirement overlaps with REFINED.REQ.2. Extensions mentioned above apply also here.</p> <p>Additional knowledge INTERLINKERS (guidelines and user manual) will be added to the catalogue to build capacity in co-production coordinators to manage incentives and rewards.</p>
REFINED.REQ.8 - Clearer guidance for the creation of a new co-production project	The Welcome page and the Overview section were redesigned to improve contents, graphical layout, and feedback on process status. (See Annex 2)
REFINED.REQ.9 - Email notifications	An email notification system was integrated to alert users of various events happening in the platform that may be of their interest (like being invited to join a co-production process, being added to a team).
REFINED.REQ.10 - Project overview and progress: in-platform notifications and resource history	This requirement overlaps with REFINED.REQ.1. Extensions mentioned above apply also here.
REFINED.REQ.11 - Guidance for schema selection	The process of schema selection was redesigned to improve usability. (See Annex 2).
REFINED.REQ.12 - Revised catalogue of INTERLINKERS	This requirement overlaps with REFINED.REQ.6. Extensions mentioned above apply also here.
REFINED.REQ.13 - Catalogue of success stories	A new functionality for publishing finished co-production processes was implemented. The functionality allows the reuse of previous co-production trees and associated resources (including published software components). The Catalogue of Success Story absorbs functionalities also for GUID.REQ.5 - Catalogue of Public Services.
REFINED.REQ.14 - Instant messaging/ forum in the CE	A feasibility study was conducted to understand how instant messaging and discussion forums could be integrated inside the Collaborative Environment. The implementation was not actually performed as deemed not crucial from a research and innovation point of view.



2.2.5. Technical workplan

Building on the evaluation findings of iteration 1 with the emerged additional fine-grained requirements and the input generated during the two collaborative re-design workshops, a technical workplan was devised to proceed with the implementation of the required revisions/extensions towards the second version of the INTERLINK platform which represents the major project milestone at M28.

The technical workplan needed to find a good compromise while considering:

- emerged usability issues;
- perceived usefulness of current functionalities and potential extensions;
- effort that would be required for revisions and new developments;
- what was included in the original project objectives that calls for a generalisation of the devised technological solutions beyond the immediate needs of the three pilot use cases (like in the case of the catalogue of success stories useful during the inspiration phase);
- the research nature of the project that calls for investigations beyond the state of the art on open research topics (like in the case of incentives and rewards to support co-production and co-delivery in particular).

Decisions included what has to be redesigned, what new aspects are worth implementing, what needs to be demonstrated/pilot tested and what can stay at a more research level (Table 8). It was also decided to start activities from the (re-)design of what takes more time and effort. Another significant decision was related to the merging of the concept of the catalogue of Success Stories with the catalogue of Public Services, as the idea of reusing (through cloning) experiences and resources tested by other Public Administrations at the bases of the two catalogues is the same and it would be difficult for users to understand the reuse of a public service without the description of the context in which it was generated and used, i.e. without its co-production story.

Table 10. Activities planned towards INTERLINK platform version 2

Fix known usability issues (which are easily fixable)	Re-design interaction flows that impact severely on UX	Co-design new functionalities that were promised in the GA	Co-design new functionalities that may contribute to the co-delivery and co-business vision	Revise / create improved contents on governance / co-production inside the platform
<ul style="list-style-type: none"> • identified list of issues (according to specific plan) 	<ul style="list-style-type: none"> • project overview • project progress • initial guidance • schema selection <p>new views over existing data model</p>	<ul style="list-style-type: none"> • catalogue of success stories • improved catalogue of Interlikers • (catalogue of public services merged into catalogue of success stories) <p>extension of data model</p>	<ul style="list-style-type: none"> • functionalities for incentives and rewards <p>extension of data model</p>	<ul style="list-style-type: none"> • information in landing pages • specific content to guide project creation/participation (for non-admins) • bespoke knowledge Interlinkers



A specific timeline was also prepared (in December 2022, at M24) to coordinate the re-design and development efforts of the involved partners, as illustrated in Figure 8.

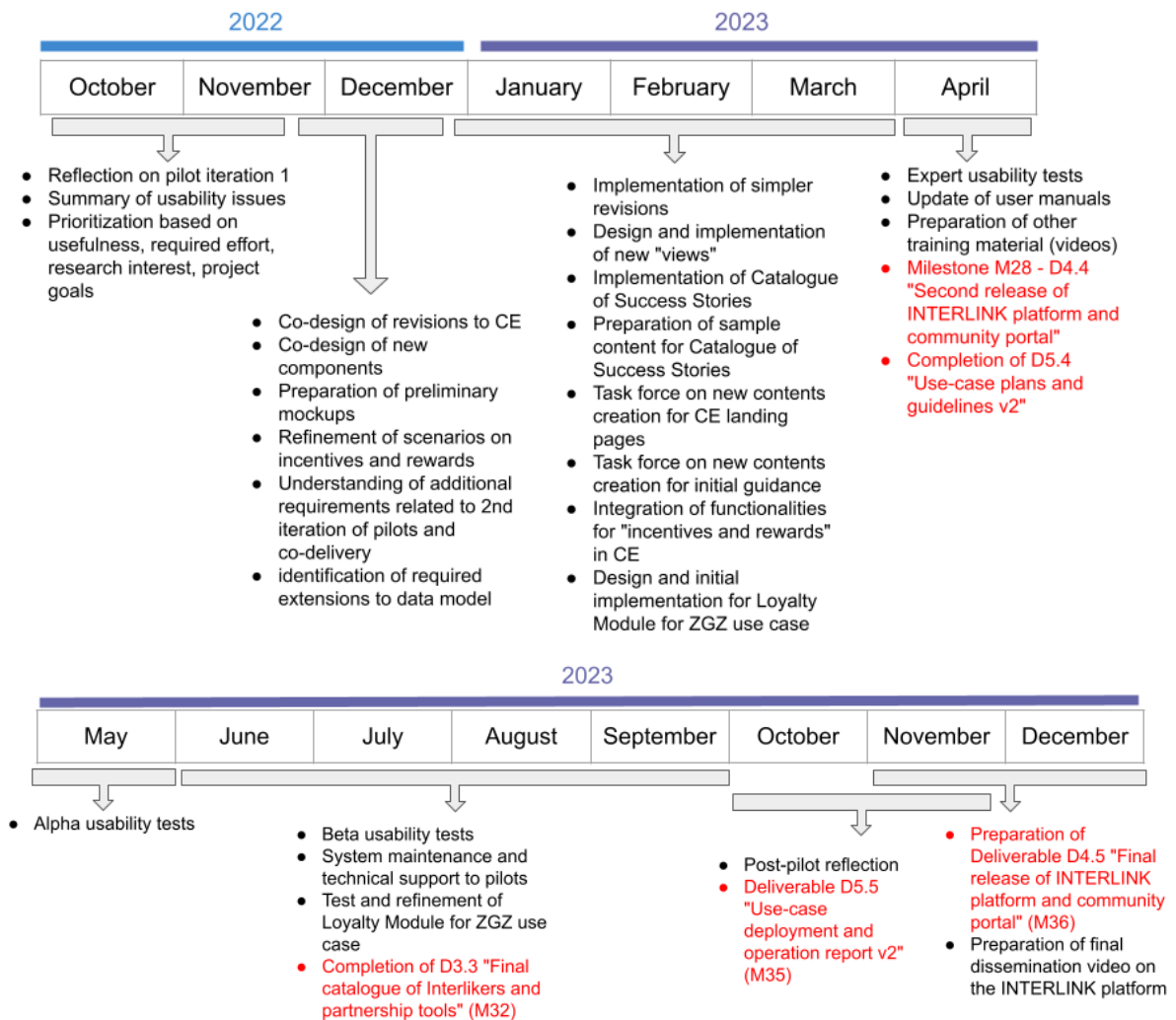


Figure 8. Timeline for the redesign activities towards the second release of INTERLINK platform

2.2.6. Mock-ups and prototypes

Starting from the refined requirements emerged from the analysis of pilots' iteration 1 (Section 2.2.1) and from the two co-design workshops that followed (Section 2.2.2 and Section 2.2.3), a process of redesign of the Collaborative Environment front end interface was initiated. An extended set of modifications was proposed and passed to the development team by means of commented mock-ups and Figma prototypes, which covered the following user interface elements:

- (new) Welcome page to be shown when users access their own workspace; black screen tutorial explaining personal workspace contents;



- (revised) Overview section for administrators featuring extended content, more graphical elements and a clearer indication of the sequence of steps required to manage a co-production process;
- Proposal for creating a separate Resources section, always accessible from the left drawer, to make the list of project resources easily accessible at any time; proposal of search filters on resources;
- (revised) Guided procedure for annotating a new co-production process with governance concepts;
- (revised) Clearer procedure for schema selection with black screen tutorial explaining schema structure and use;
- (revised) Placement of notification centre in the left drawer to make it visible and easily accessible at any time;
- (new) Interaction elements to be integrated in the Collaborative Environment interface that allow administrators to activate and manage incentives and rewards; interaction elements visible to all users relative to the management of incentives and rewards; interaction elements implementing leaderboards and personal views on accumulated points and corresponding rewards;
- (new) Catalogue of Co-production Stories.

Annex 2 presents a selection of commented mock-ups which exemplify the process of redesign of the Collaborative Environment front end interface.

3 Update of the reference architecture model and specification

The initial architecture was described in deliverable D4.2 – Reference architecture model and specification (TREE, M12). Overall, the “High-level architecture of the INTERLINK software” and the “Development, Deployment and Operational Environments described in sections 3 and 6 respectively in D4.2 remain the same as.

However, there were some minor modifications in the “Interlink Data Model” and “Public Service co-production platform architecture”, described in sections 4 and 5 in D4.2. The detailed explanation on the modifications with respect to D4.2 can be found below.

3.1 Interlink Data Model

The data models have been updated in the latest version to meet the requirements of the pilots and incorporate new functionalities for improving the platform. Figure 9 displays the current database model of the co-production component, which includes new entities, such as Notifications, UserNotifications, and CoproductionProcessNotifications. The Notifications entity stores notification templates created using the platform's notification system. UserNotifications stores personal messages that administrators and collaborators receive during a co-production process. CoproductionProcessNotifications entity stores information



about notifications made during a specific co-production process, including events of claims made by a user for a specific resource.

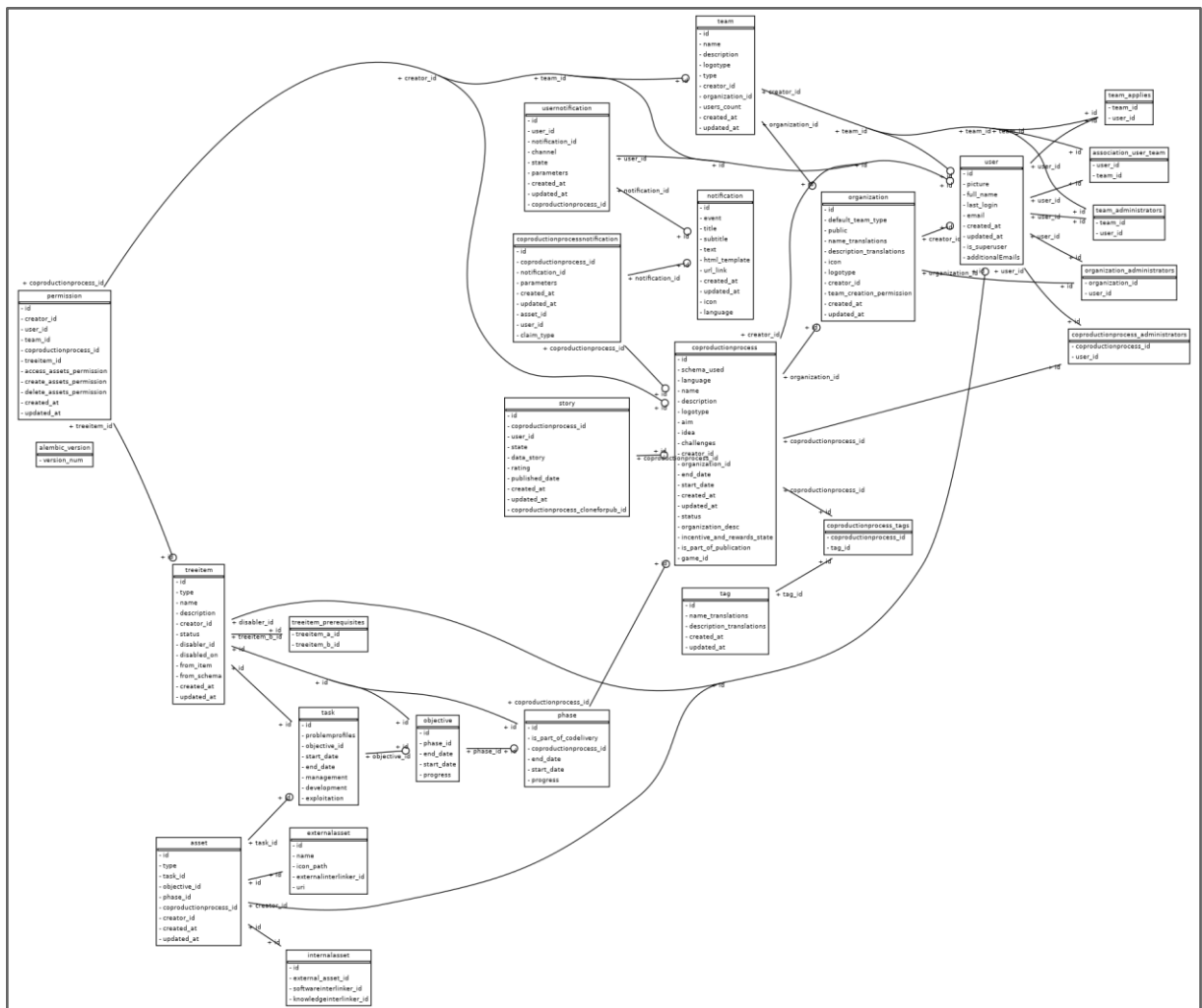


Figure 9. Updated co-production service data model

In addition to the previously mentioned entities, this model introduces a novel entity called "Story". The Story entity plays a crucial role in storing all the relevant information about the publication of a success story. This information includes various details such as the date of publication, the description of publication, and the key information associated with the success story. With the addition of this new entity, the model provides a comprehensive framework for capturing and analysing the complete lifecycle of a success story.

The Coproduction Process_tags and Tag entity serve as a means of storing keywords that are relevant to a particular process. By utilizing these entities, it becomes easier to filter and make recommendations within the catalogue of success cases. This functionality can greatly enhance the search experience, enabling users to quickly find the most relevant content and facilitating more efficient knowledge sharing across different use cases.



Figure 10 shows the catalogue service data model, which includes information on Interlinkers, problem profiles, and other details that enable navigation through the Interlinkers' catalogue.

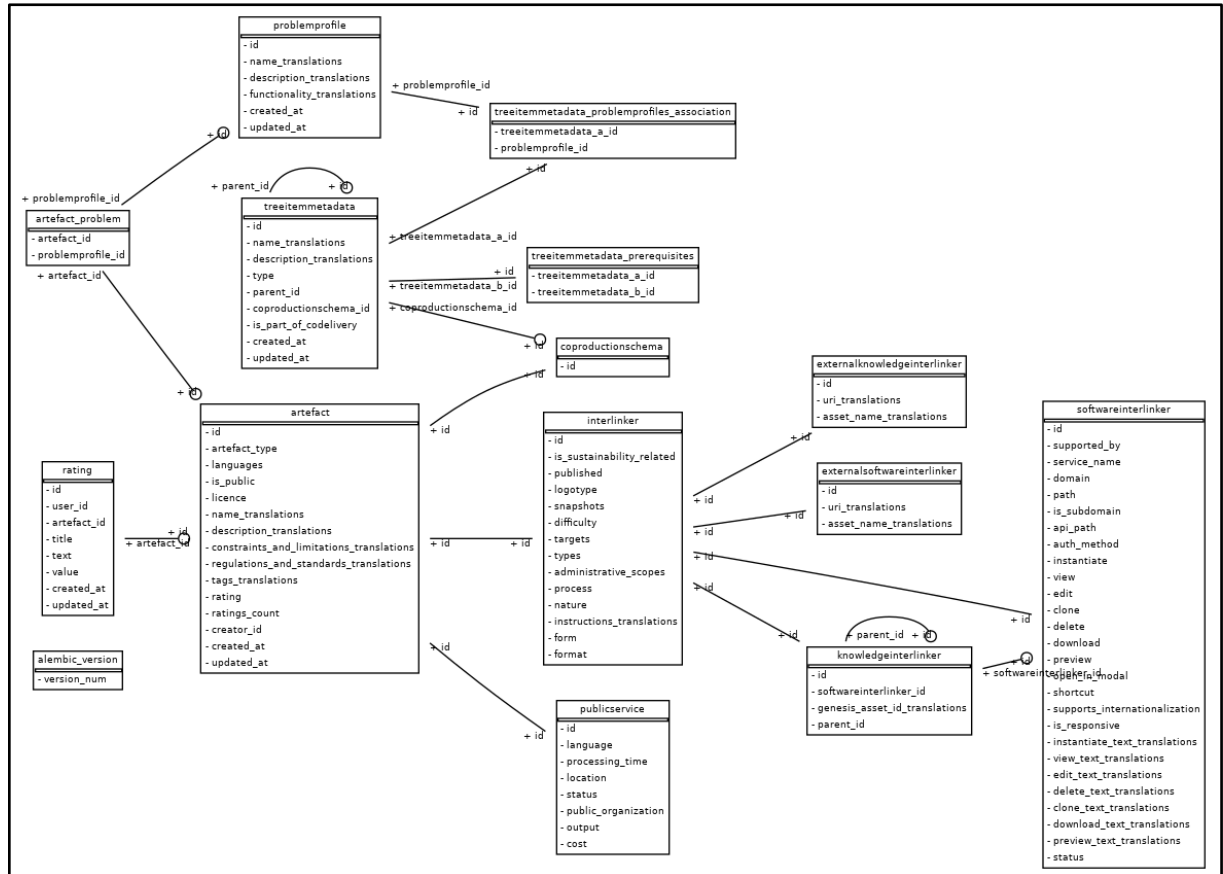


Figure 10. Updated catalogue service data model

3.2 Public Service co-production platform architecture

Section 5 of D4.2 described the Public Service co-production platform architecture. The following modifications have been done from the initial architecture:

3.2.1. General design considerations

Within subsection 5.1 of D4.2 the general design considerations were described, to which gamification features have been included.

Gamification

The gamification engine was included as a new module of the Interlink architecture in this version. This module included the database regarding the information on the games conducted in the collaborative processes and the business logic to create, alter, retrieve, and delete them. The gamification engine included a RESTful HTTP API to conduct CRUD operations for the data regarding the games.



We employed an intermediate authentication layer between the API provided by the gamification engine and the presentation layer (frontend) to connect with the gamification engine. This was implemented as a security measure to ensure that the users conducting changes in the games were authenticated users with permissions over the coproduction process being altered.

3.2.2. Platform SW modules

The Platform SW modules described in subsection 5.3.1 in D4.2 have been updated. Figure 11 shows the updated architecture (from Figure 7 in D4.2), where:

- Beats is the component that is responsible for sending container logs to Elasticsearch for the monitoring platform.
- The authentication service affects all platform services.

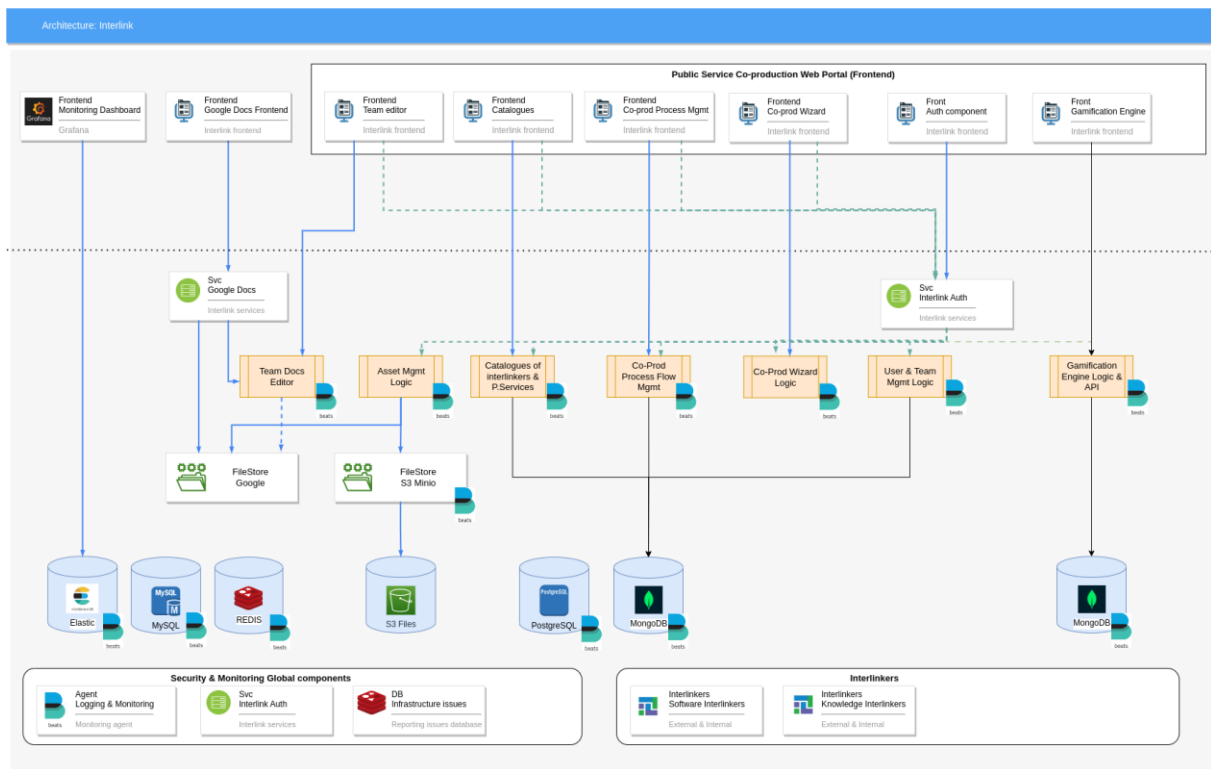


Figure 11. Updated architecture for PS co-production platform (bottom part of the diagram)

3.2.3. Logging & Monitoring Service

The logging and monitoring service, subsection 5.3.6 in D4.2, was modified by replacing Kibana and Logstash by Grafana and Filebeat. Below there is more detail on the changes carried in the context of the overall system:

Functionality Overview

The PS co-production platform uses logging and monitoring functionality for two primary goals: infrastructure logging & monitoring and application/business level



monitoring. The same software module will be used for both monitoring levels. Infrastructure logging and monitoring will collect logs from all Docker containers deployed with the software system, storing them in a common logging area for post-processing and visualization. For application-level KPIs, each software module should implement additional logging functionality to log specific data to the common platform logging service. This data will be saved in the logging area and can be processed and visualized using additional algorithms, scripts, or configurations.

Technologies Used

The original logging and monitoring system used the ELK stack, consisting of Elasticsearch, Logstash, and Kibana, as the golden standard for Docker and Kubernetes runtime environments. However, alternative tools can be used to achieve the same overall log collection, processing, and visualisation workflow. In this case, Grafana will replace Kibana, and Filebeat will replace Logstash.

Grafana is an open-source visualisation and analytics platform that will be used to create and display dashboards for the indexed data. It offers similar capabilities to Kibana but provides more flexibility and additional features for data visualisation.

Filebeat is a lightweight log shipper that will be used instead of Logstash to collect logs from Docker containers and forward them to the Elasticsearch engine. Filebeat is more resource-efficient than Logstash and can provide similar log collection and processing capabilities.

The preferred way for software components to send their data to logging is by sending both standard output and standard error I/O streams to the syslog service. Docker-compose or Kubernetes can be configured to send logs from all Docker containers to the new monitoring stack consisting of Elasticsearch, Filebeat, and Grafana. If a specific software module doesn't send logging data to syslog service as standard I/O streams, additional log-collector daemon can be set up to transmit logs to the master host.

Once log data is received by Filebeat, it is parsed and streamed to the Elasticsearch engine, which stores and indexes the data according to pre-configured patterns. The indexed data is then streamed to Grafana for visualisation in a dashboard, based on corresponding configurations.

Additional third-party open-source or custom-made software modules can be created and used to add more functionalities to the application/business logging level. Examples of such functionalities include logging and monitoring of user navigation at the web frontend using cookies, GUI event logging, etc.

4 INTERLINK Platform and Infrastructure

As explained in D4.3, firstly, the software repository for the INTERLINK Project was established on GitHub.com server. This satisfied the requirement for the project software to be free of commercial licensing and open source.



The project's GitHub repository was then structured according to the structure and types of the software in the project. Next, the software development and software deployment policies were elaborated. Finally, the software hosting environment was defined, and first deployments started.

For the release of the second version of the platform, looking at D4.3 where the first release of the platform was described, subsections 2.1.1 "Software Repository", 2.3 "Task and Incident management", and 2.4 "The Servers Deployed", have not undergone any changes, while sections 2.2.1 "Software Development and Deployment procedures" and 2.2 "Infrastructure Platform Components" have experienced modifications, which are detailed below.

4.1 Software Development and Deployment Procedures

Subsection 2.1.2 in D4.3 described the software development and software release management that was established for the project software.

The following components described are kept the same. Unit Tests (UT), Software Releases, Integration Tests (IT), Building of Docker Software images, Continuous Deployment (CD) & Environments, Local Environment, Development Environment (DEV), Staging Environment (DEMO), Pilot Servers (ZGZ, MEF, VARAM), Software Updates, Software Refactoring, Data persistency, Current Situation and Separation of Platform Software Services.

The components that have been modified are described below.

Continuous Integration (CI)

CI tools (Jenkins & Github actions)

In the Interlink platform, Jenkins is being utilized as the Continuous Integration (CI) solution for deployments and platform services. Jenkins plays a vital role in streamlining the development process by automating the build, testing, and deployment stages. To ensure the secure management of secrets and credentials within the pipelines, Jenkins is integrated with Vault, a trusted solution for handling sensitive information.

This combination of Jenkins and Vault enables the project to guarantee seamless third-party integrations and ensures the encryption of logs using the managed secrets. As a result, the project maintains a high level of security and reliability throughout its development lifecycle.

In addition to Jenkins, the Interlink project also employs GitHub Actions for software deployments. GitHub Actions is a popular choice due to its simplicity and the existing developments made within the project. This approach allows the team to leverage the benefits of both Jenkins and GitHub Actions, creating a flexible and efficient CI/CD pipeline that caters to the specific needs of the Interlink project.



Secrets Management

In the Interlink platform, HashiCorp's Vault is being employed for secret management, providing a secure and reliable solution for handling sensitive information. Vault offers several key advantages that make it an ideal choice for the project, ensuring that the team can maintain high levels of security and efficiency throughout the development process.

One of the most notable benefits of using Vault in the platform is its compatibility with Docker. Vault can be seamlessly deployed within Docker containers, enabling easy integration with the project's existing infrastructure. This compatibility allows the team to take advantage of the containerization benefits offered by Docker, such as simplified deployment, better resource management, and enhanced scalability.

Furthermore, Vault offers robust access control mechanisms, allowing the project team to granularly manage permissions for accessing secrets. This ensures that sensitive information is only accessible to authorized personnel and services, thereby reducing the risk of unauthorized access or security breaches.

In summary, the utilization of HashiCorp's Vault for secret management provides significant advantages in terms of security, ease of deployment, and seamless integration with Docker. This decision helps the platform maintain a robust and efficient development environment, ensuring that sensitive information is managed safely and effectively.

Docker-compose profiling

The profiling feature in Docker Compose has been discontinued after thorough testing revealed that it does not fulfil the requirements of the platform.

Data backups

Data Backups are currently working. The existing configuration allows for daily backups uploaded to Azure Blob Storage, with the flexibility to be customized as needed.

4.2 Infrastructure Platform Components

Section 2.2 in D4.3 described the platform components that had been deployed in the v1 of the three pilot demonstration cases.

For the second release of the platform, the deployment of the "Data Storage Layer", the "User Authentication" and the "Infrastructure Logging". Below the modifications done to the "User Activity Logging" are described.

4.2.1. User Activity Logging

The backend logs are currently implemented with the structure proposed in the previous version of the document.



We are currently working on the analysis of user behaviour monitoring whilst interacting with the Collaborative Environment, by integrating the tool [Matomo](#). “D5.5 Use-case deployment and operation report v2” will report on the front-end activity logging and analysis that will be carried out to understand user behaviour whilst partaking in collaborative processes.

5 Community Web Portal

The developments in relation to the community web portal from a platform perspective was described in detail in section 3 of deliverable D4.3. As explained there, the INTERLINK collaborative environment offers the following core functionalities:

- a) co-producer organisation, team, and process management
- b) guide for co-production process, a “how to” guide, based on a given co-production process schema, to take these partnerships towards a successful deployment of new co-delivered public services.
- c) recommendation of INTERLINKERs most suitable to the problem profiles represented by the chosen co-production task
- d) selection, instantiation, and registry of usage (registering the result of using the enabler, e.g., instantiation of a Business Plan template) of a given INTERLINKER. The instantiation of an INTERLINKER, no matter if it is a software or knowledge one, usually gives place to a new resource which contributes to the completion of a co-production process task.
- e) INTERLINKER catalogue where imported INTERLINKERs and co-produced ones are published.

With respect to v1, the following additional functionalities have also been added to the Collaborative Environment in v2:

- 1) Modification of the co-production tree by process admins, so that a chosen co-production schema can be adapted to the specifics of the collaborative process being managed by the Collaborative Environment.
- 2) Add teams to a whole process, apart from having the capability to add different permissions to branches of the co-production schema.
- 3) Ease the creation of teams, allowing contact details import from CSV file and export of contact details of a given team. This has been done to streamline and speed up the configuration of teams or the creation of complementary communication channels among team members.
- 4) Notification functionality (in-app & by email) to allow updates in each co-production process to be seen by different team members. Now, users can see WHO has done WHAT, and WHEN within a co-production process. Besides, now the environment sends emails every time that a user is added to a team and every time that a team is assigned to a process.



- 5) Allow users to claim contributions over a task and to be granted points according to their relative contribution by a Gamification Engine. This new feature enhances the accounting and valorisation of individuals' contributions to co-production processes.
- 6) Cloning of processes to promote internal replication and reuse of previously created co-production processes.
- 7) Publication of success stories from cloned and pruned successful co-production trees, promoting third party replication. Hence, those approaching the Collaborative Environment may review previous success stories and ground them in setting up their own collaborative processes.

5.1 INTERLINKERs as *Enablers of the Co-production Process*

INTERLINKERs, as already specified in D3.2, are common building blocks, provided as software tools or in the form of knowledge offered digitally, that offer interoperable, re-usable, EU-compliant, standardised functionality for public service co-production management. These enablers are designed to support the co-production of effective, participatory, and sustainable public services. They can be applied to the following purposes:

- *To guide co-production*: Co-production enablers that guide and support teams in the collaborative execution of the co-production initiatives.
- *To build capacity*: Partnership tools and knowledge resources, which tackle the legal, social, and business aspects to make co-delivered public services viable and feasible in time.
- *To aid service development*: Technical enablers for co-delivered services, aligned with other existing EU-wide initiatives to foster interoperable and sustainable public services.

Some examples of *software INTERLINKERs for co-production* are: a) Tools for ideas crowdsourcing and collaborative decision making; b) Tools for surveys; c) Tools for team management; d) Document sharing & File management tool. On the other hand, some exemplary *knowledge INTERLINKERs for co-production* are: a) Guidelines and canvas to perform stakeholders analysis; b) Templates for stakeholders' engagement plan; c) Templates for surveys for problem refinement; d) Guidelines and materials for workshops for service design or e) Templates for Business Plans. Some exemplary *knowledge INTERLINKERs to build capacity* are: a) Guidelines on GDPR for Data Protection; b) Information sheets and consent forms; c) Guidelines on the acquisition and reuse of software for public administrations. Some exemplary *software INTERLINKERs supporting service building* are: a) Registration and authentication component; b) Collaborative Editor for public service descriptions; c) Loyalty, incentives, and rewards component.

In order to support the continuous growth of a catalogue of INTERLINKERs to empower the co-production process, a *Specification Model for INTERLINKERs* has been defined.



The INTERLINKER specification model aims at classifying INTERLINKERs across different dimensions to guide and support the co-production process activities, comply with standards, and foster reuse. Each INTERLINKER must supply a set of metadata in the form of several categories. Regarding *usage*: a) problems it addresses; or b) Service offering type in EU CEF SOC model. Regarding *licensing*: Software and Data licences. Regarding *context*: a) Administrative: local, national, EU; b) Regulatory: standards, regulations it complies to; c) Organisational: PA, Business, Individuals as beneficiaries and d) Domain: application domains, cross-cutting concerns. Regarding *software*: a) Provisioning: SaaS, OSS; b) Interoperability; c) Security: protocols and d) Integration within the platform.

Following a design pattern similar as the one defined in Research Object Crates (RO-CRATE)⁷, INTERLINK has defined an extensible declarative model, based on JSON Schemas, to easily define new either knowledge or software INTERLINKERs. The way to add new INTERLINKERs is to create a new directory per INTERLINKER that contains:

- A "metadata.json" file in the root of the directory.
- Optionally, a "snapshots" directory to store the images corresponding to the INTERLINKER.

Knowledge INTERLINKERs usually contain several representations of the template, e.g. document (docx), spreadsheet (xlsx), presentation (pptx) and so on, from which it will be instantiated so that users may view what capability they offer before instantiating them. Besides, they often include an *instructions.md* file which explains its usage.

INTERLINKERs include, on one hand, common metadata to all enablers (e.g., problem profiles targeted, difficulty, licence, name, description, logo, etc.) to allow for their exploration and searching, and, on the other hand, they also include aspects to enable its integration with the collaborative environment. Particularly, this annotation is particularly important whenever they are of co-production type, e.g., through the "capabilities" dictionary which includes elements such "instantiate", "clone", "view", "edit", "delete" or "download" among others. Figure 12 illustrates the corresponding API methods to be provided by every software INTERLINKER to be neatly integrated with the collaborative environment. On the other hand, Figure 13 shows the GitHub repository where all INTERLINKERs that populate the Collaborative Environment, and more concretely its Catalogue, are published, following the mentioned Specification Model.

⁷ «Research Object Crate (RO-Crate)», Research Object Crate (RO-Crate).
<https://www.researchobject.org/ro-crate/>

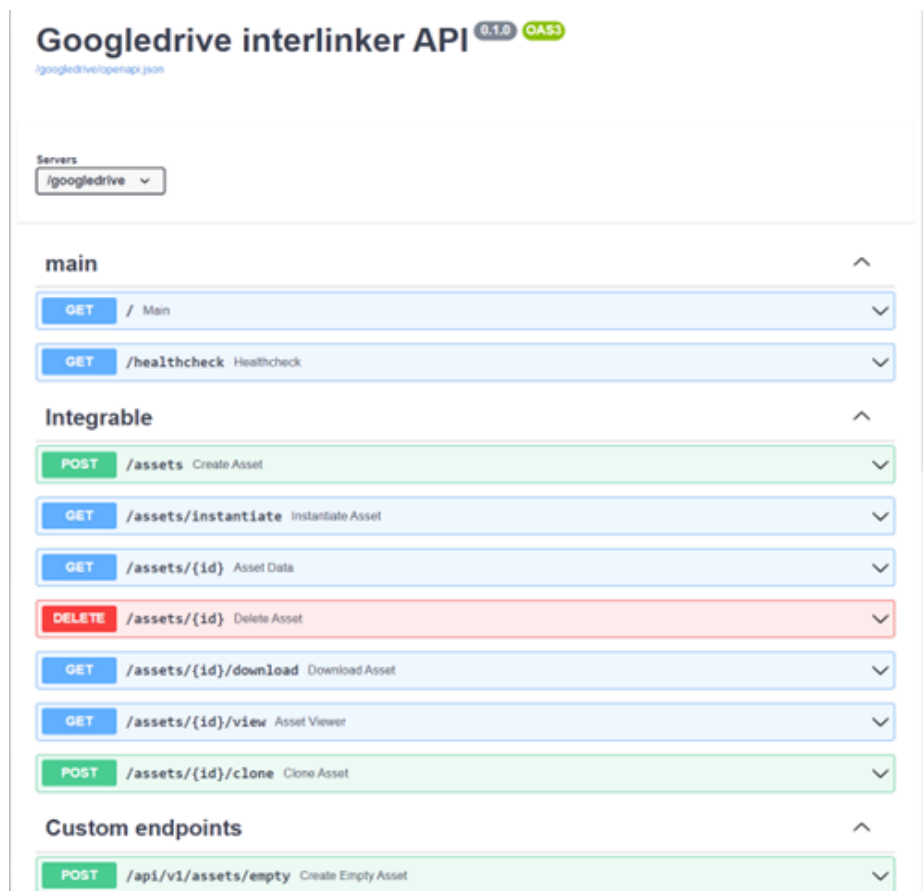


Figure 12. INTERLINK API to be integratable in collaborative environment.

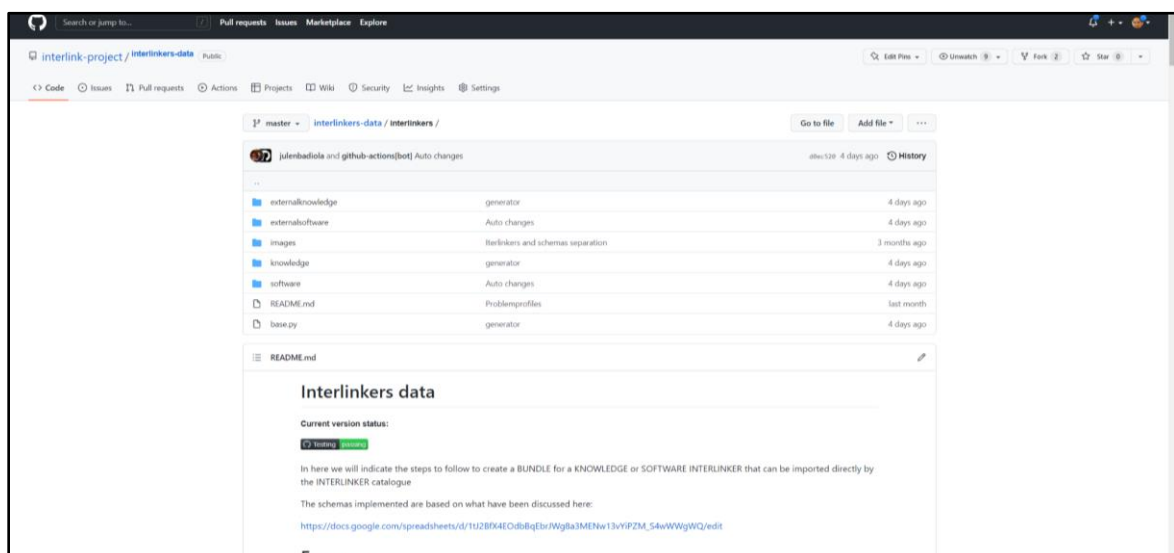


Figure 13. INTERLINKERS Catalogue data in GitHub repository.



5.2 Catalogue of INTERLINKERS

The INTERLINKER catalogue provides a one-stop-shop for know-how enabling co-production. It has been populated with knowledge and software INTERLINKERS leveraging resources generated in previous EU projects, social innovation initiatives, and service design best practices like: WeLive, Silearning.eu, servicedesigntools.org, DesignersItalia, IDEO or Engage2020. Some resources have been adapted to the specific needs of co-production; others are being created from scratch based on project research results. Figure 14 shows the INTERLINK catalogue where items can be filtered according to strings associated to their metadata, to their nature (software or knowledge), who created them and their ranking.

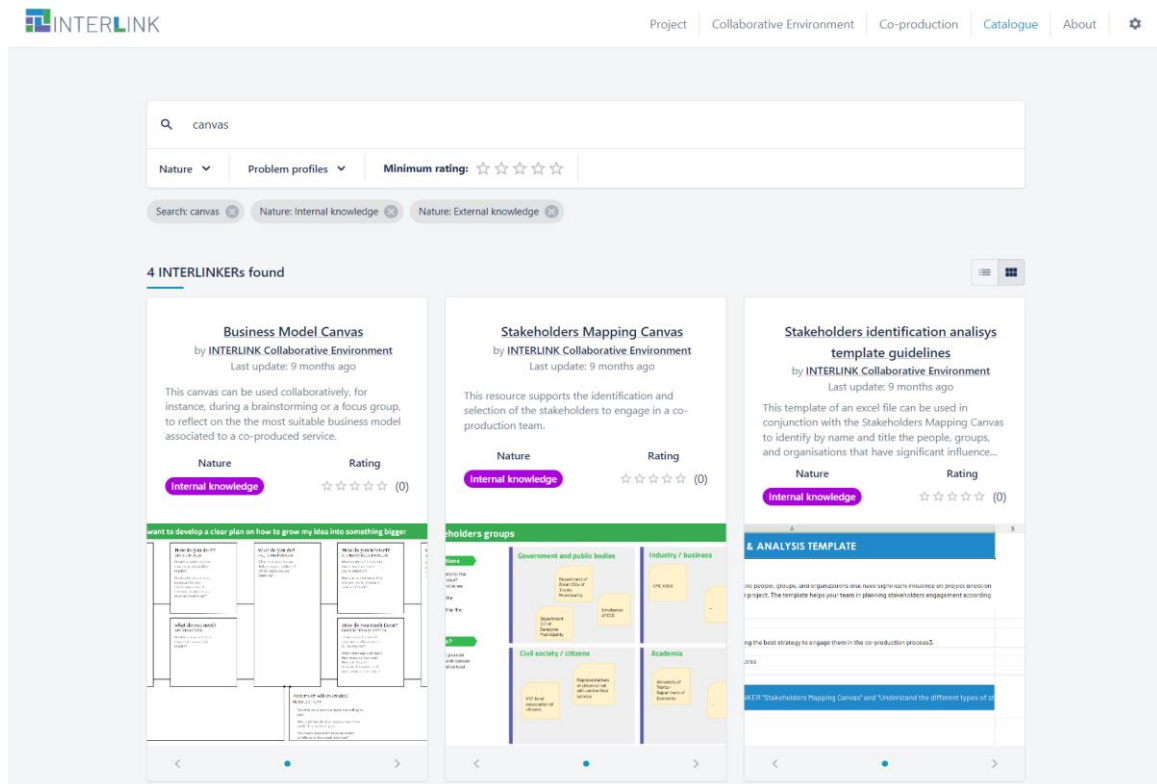


Figure 14. INTERLINKER catalogue.

5.3 INTERLINK Collaborative Environment

The INTERLINK collaborative environment has been designed to support the co-production methodology of INTERLINK (see Figure 15) and facilitate its adoption and application in the co-production of novel public services. As previously mentioned, it offers the following core functionalities: a) co-producer organization, team and process management; b) guide for co-production process; c) recommendation of INTERLINKERS most suitable to the problem profiles represented by the chosen co-production task; d) selection, instantiation, and registry of use (displaying result of



using the enabler, e.g. instantiation of a Business Plan) and e) INTERLINKER catalogue already showcased in Figure 14.

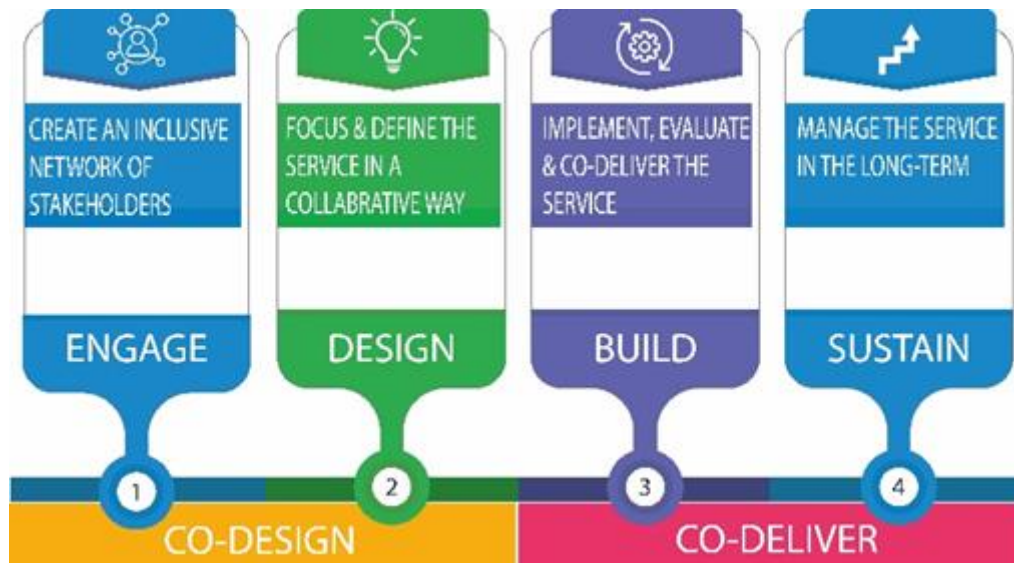


Figure 15. Generic co-production model in INTERLINK.

Notice that apart from methods required to integrate a co-production INTERLINKER with the collaborative environment, see Table 9, custom endpoints are defined by each INTERLINKER, e.g. for GoogleDrive the endpoint shown as /api/v1/assets/empty (see Figure 12).

Table 11. Co-production INTERLINKER API

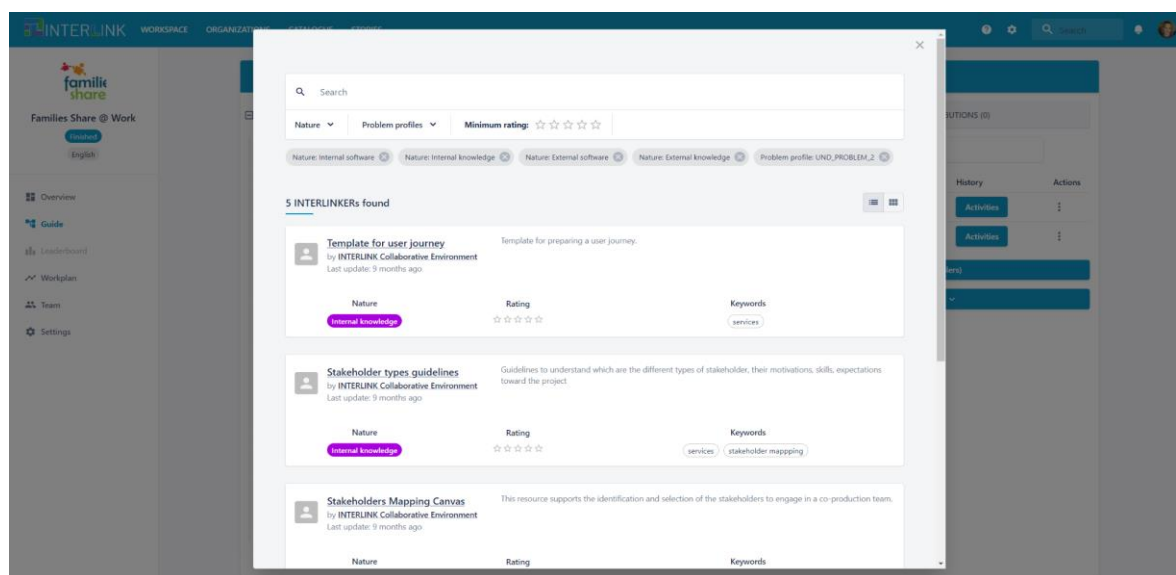
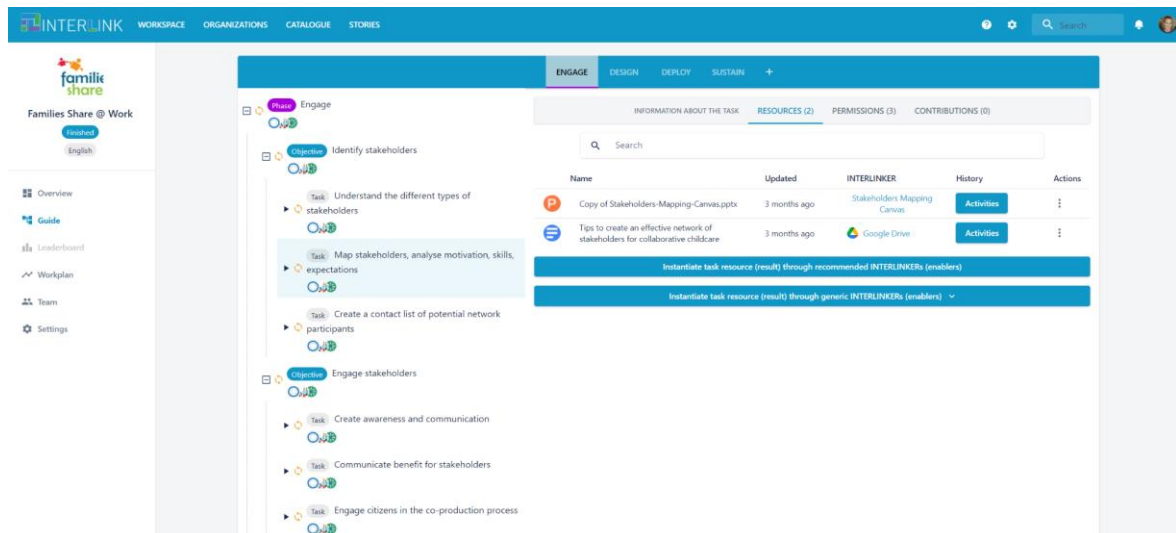
URI	Method	Description
/	GET	redirects to swagger / redoc DOCS
/assets	POST	[OPTIONAL] Posts data for asset creation and return JSON of asset
/assets/instantiate	GET	GUI for asset creation
/assets/{ASSET_ID}	GET	JSON data of asset
/assets/{ASSET_ID}	DELETE	Deletes asset and returns No content
/assets/{ASSET_ID}/download	GET	Download a representation of asset
/assets/{ASSET_ID}/view	GET	GUI for the interaction with the asset
/assets/{ASSET_ID}/clone	POST	[OPTIONAL] Clones the asset and returns JSON data

An assortment of co-production INTERLINKERs has been created to provide useful functionality to the collaborative environment, e.g.: a) interlinker-google drive to deal with office like documents; b) interlinker-survey to design and host answers for



surveys; c) interlinker-editor to collaboratively edit documents or d) description augmenter to annotate web pages.

As already mentioned, JSON Schemas have been defined to declaratively define Software and Knowledge INTERLINKERS. Likewise, co-production models can be defined which are tuned to the specifics of a co-production process, e.g. a Hackathon organisation and celebration. Indeed, although the collaborative environment is pre-loaded by default with the generic INTERLINK co-production tree, applicable in any co-production process, see Fig. 10, purpose specific co-production trees can be defined as shown in Fig. 11 and Fig. 12. Notice that Fig. 13 shows the INTERLINKERs recommendation capability of the collaborative environment, where the same task in two different co-production trees has been selected, recommending the same INTERLINKERs plus additional specific ones for the second co-production tree. Fig. 14. shows how the generic build sub-phase is replaced in the custom hackathon's co-production tree by a run sub-phase, with very different composing objectives and tasks.



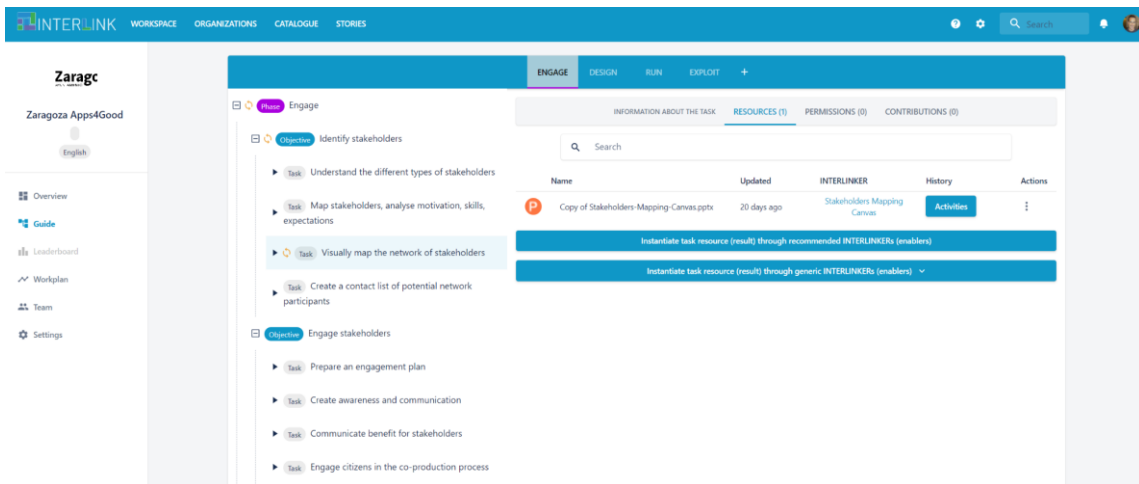
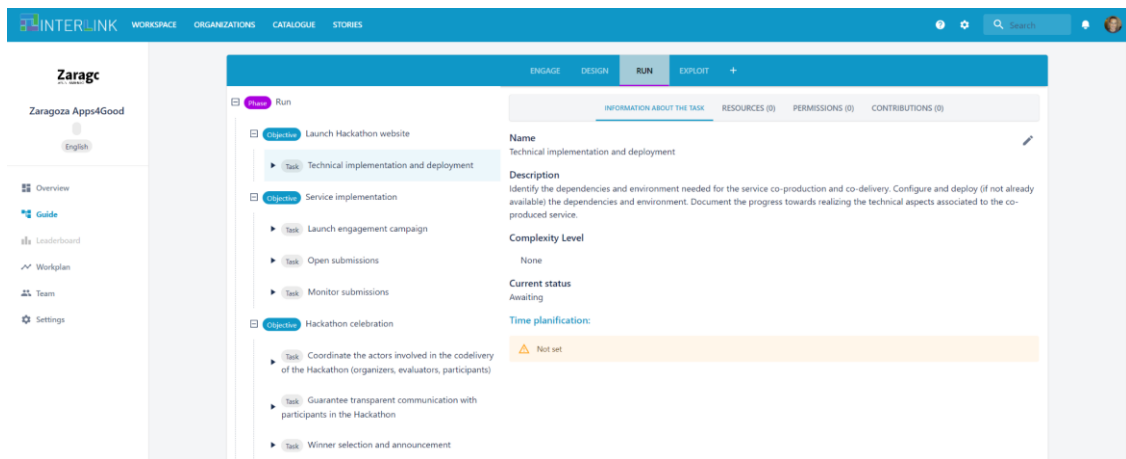


Figure 16. Comparison of INTERLINK ENGAGE in 2 co-production processes (top - family share; bottom - ZGZ apps4good) and INTERLINKER recommendation in the first co-production process (in the middle).

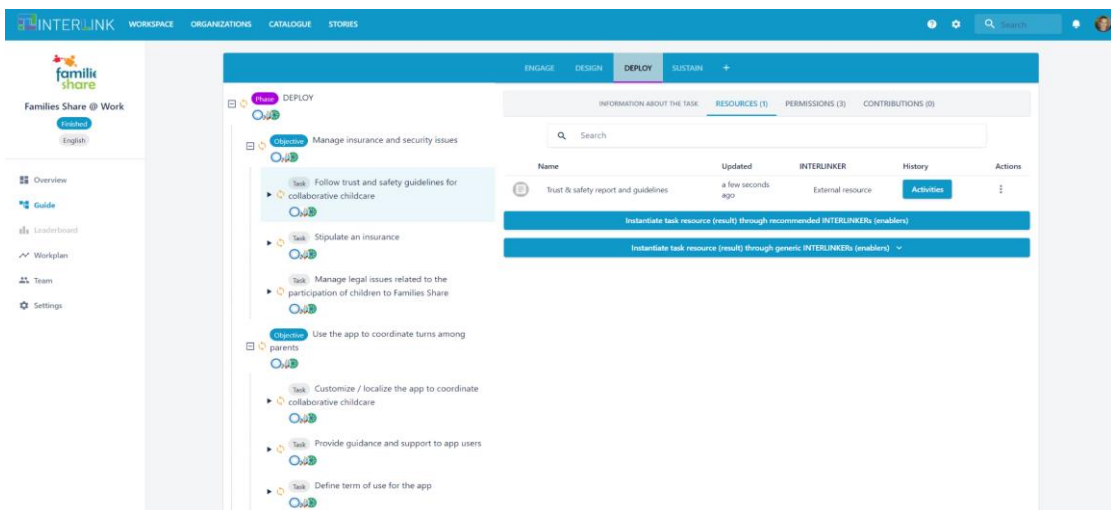


Figure 17. Comparison of INTERLINK RUN (from hackathon creation process model) vs. equivalent RUN (custom) stages in 2 different co-production processes.

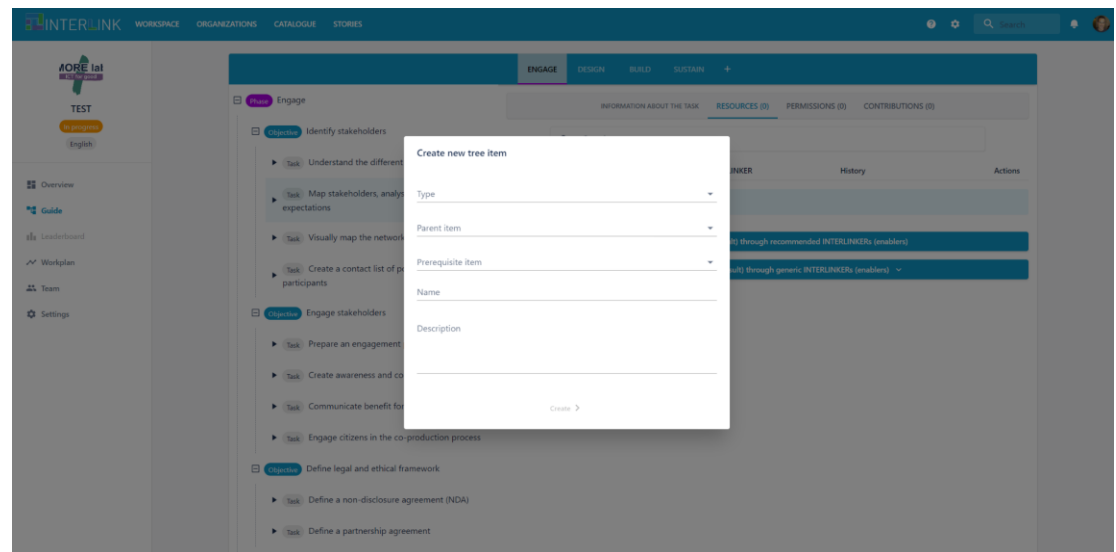
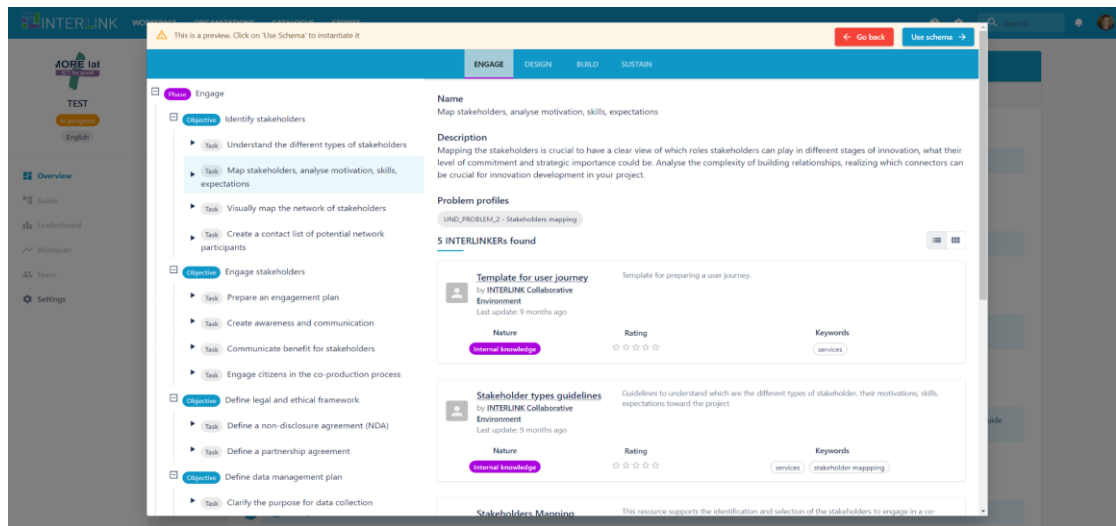
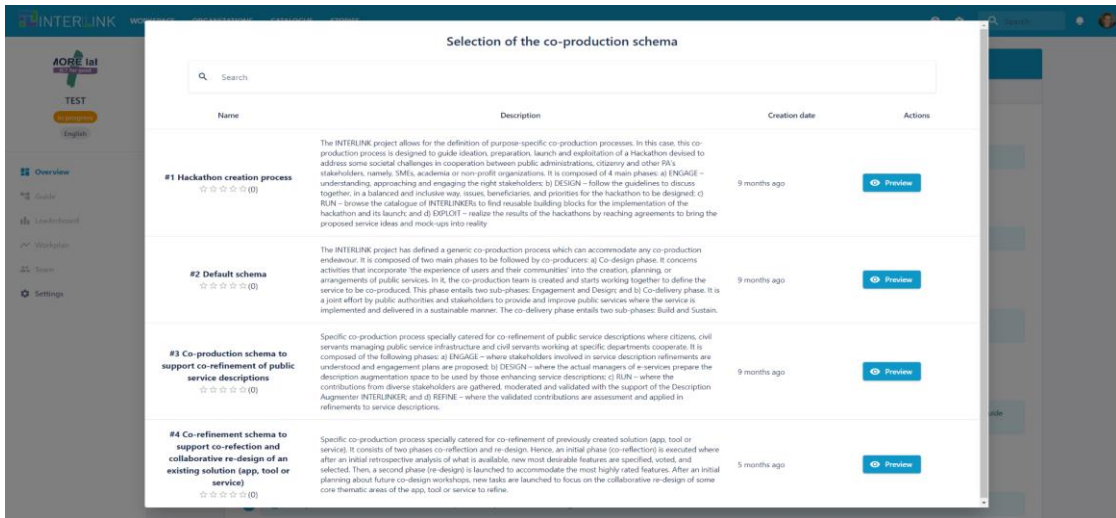
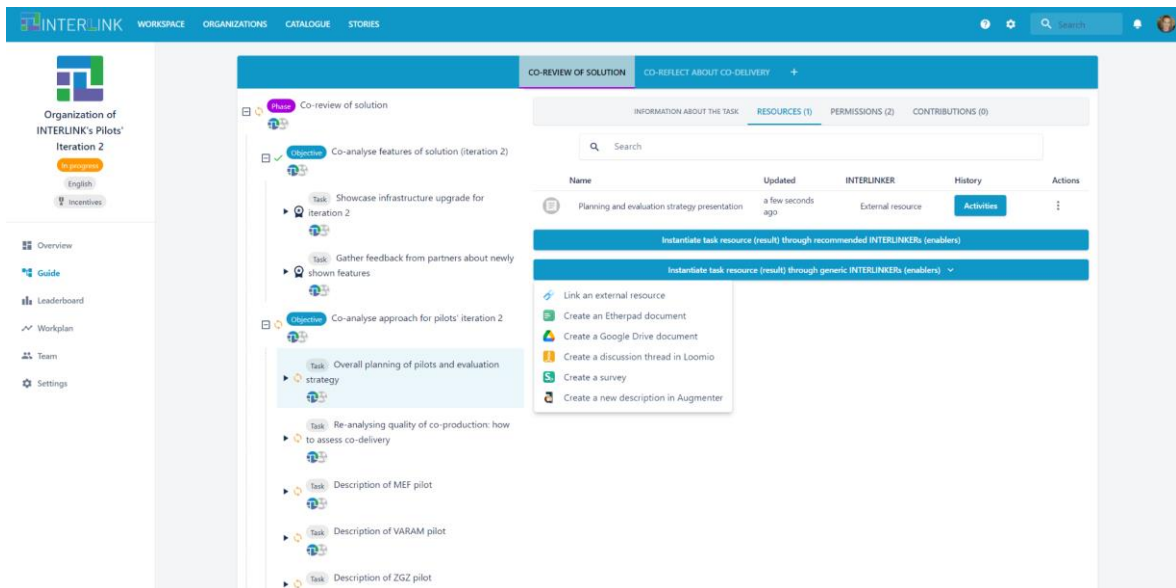
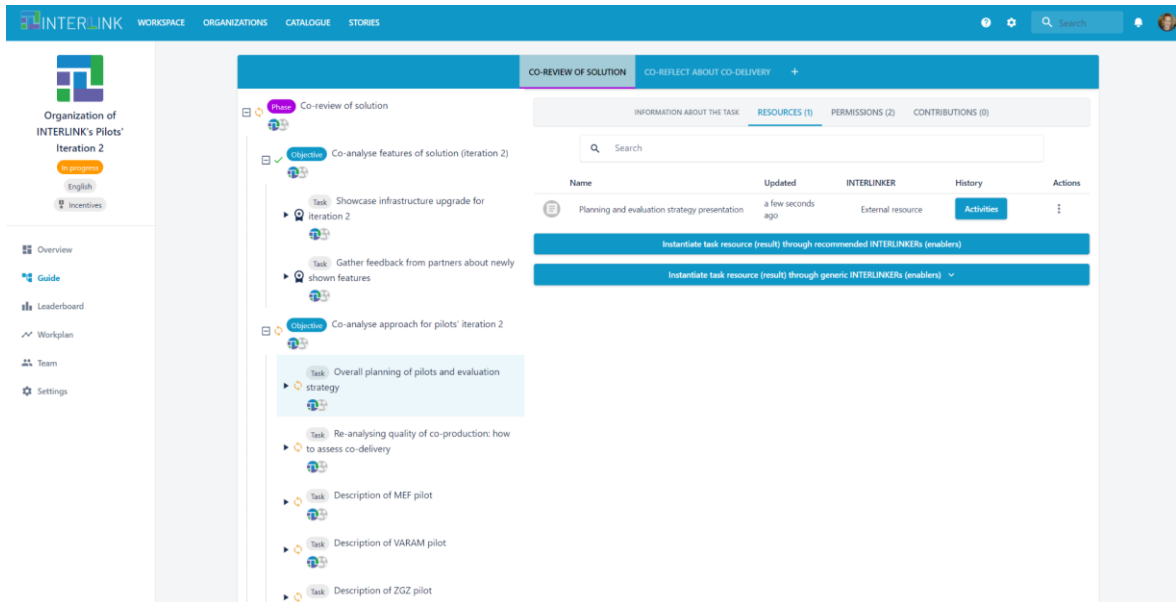


Figure 18. Selection of co-production process from 4 available models/schemas and customization of existing co-production process by clicking on "+" next to SUSTAIN phase (top menu).



5.3.1. INTERLINK Collaborative Environment Views

The Collaborative Environment offers different views to focus the co-production process in different aspects: a) guide; b) workplan; c) overview.



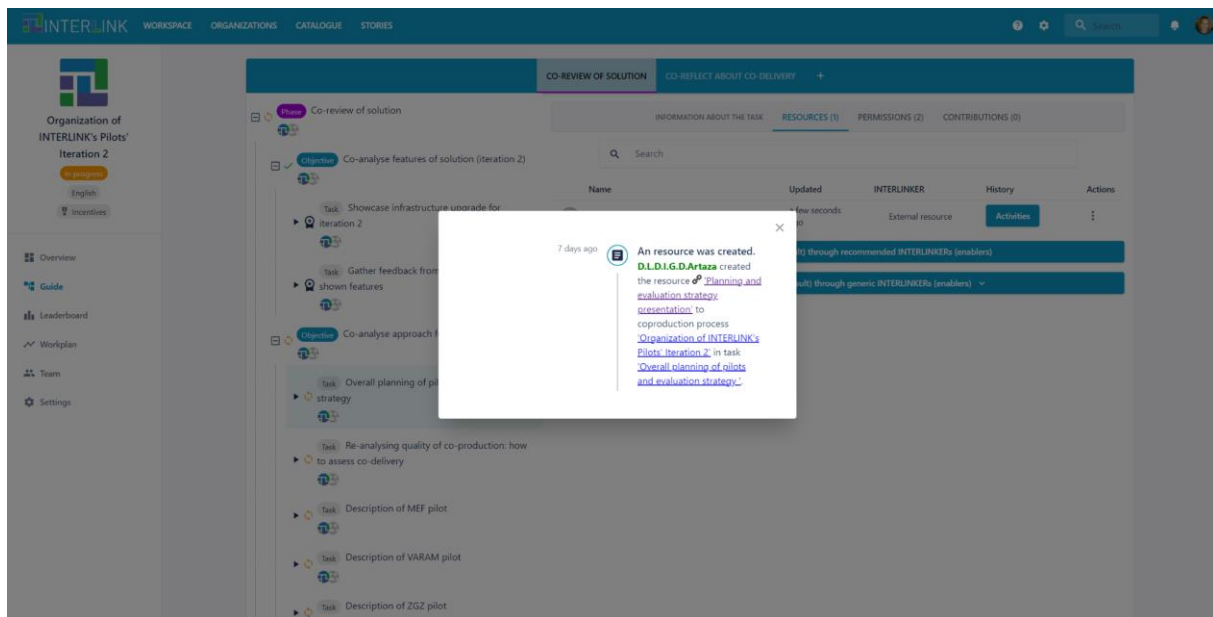


Figure 19. Guide section of the collaborative environment frontend.

The **guide view** showed in the Figure 19 shows how a co-production team can be guided in the co-production process, by being able to navigate through the co-production process phases, and for each phase, select a co-production objective, realise the tasks associated to that objective and get recommended relevant INTERLINKERs which may support accomplishing the objective of the currently selected task. Observe in the figure the selection of the task “Overall planning of pilots and evaluation” with the corresponding suggestion of generic INTERLINKERs which may be instantiated to give place to resources with which to make progress on the given task, e.g., “Create a Google Drive document”, “Create a discussion thread in Loomio” and so on.

Figure 20 shows the **Workplan view** which allows stakeholders to establish and review durations of the tasks accomplished within a co-production process. Figure 15 shows how the progress made in a co-production process can be reviewed easily by accessing the **“Overview” view**. Notice that navigation between a generated resource as result of having selected and used an INTERLINKER within a task is possible by means of the “See task” button. Also notice that navigation between the “Workplan” and “Guide” views is possible by clicking on the corresponding task name in the Workplan view (see Figure 20) or clicking on “Time planification” link within a given task view in “Guide” view (see Figure 21).

In the Guide view, during RP2, the new tabs PROGRESS and NOTIFICATIONS have been added. Whilst the first one allows an admin to see what steps have been carried out in the management of a co-production process and which ones are missing, the second one allows the teams involved in a co-production process to see the evolution of the process in time. That way team members collaborating to a process can see the progress and what concrete activities were carried out by each team member.



The Catalogue View was illustrated in Figure 14 earlier. Such snapshots showcased how users may browse through the existing set of knowledge and software INTERLINKERS and search for them according to distinct criteria: a) type of INTERLINKER, b) problem profile that they address; c) contents in the title or description of such INTERLINKERS.

In RP2 the Catalogue has been enriched with the creation of a “Success cases” catalogue (see Figure 22). Such catalogue allows users to see what success cases in the form of co-production processes have been realized thanks to INTERLINK Collaborative Environment. For each success case, the following metadata is published: objectives, lessons learnt, materials generated or license, apart from the co-production process in which it is based. Notice that the view of success story provides a “Clone process” button to be able to create a brand-new co-production process from the associated process to such success story.

Likewise, in the Settings view, amendments have been performed to allow a given co-production process to clone it or to publish a success story from it. Figure 23 shows the new appearance of this screen, allowing cloning of processes and publication of success stories from it.

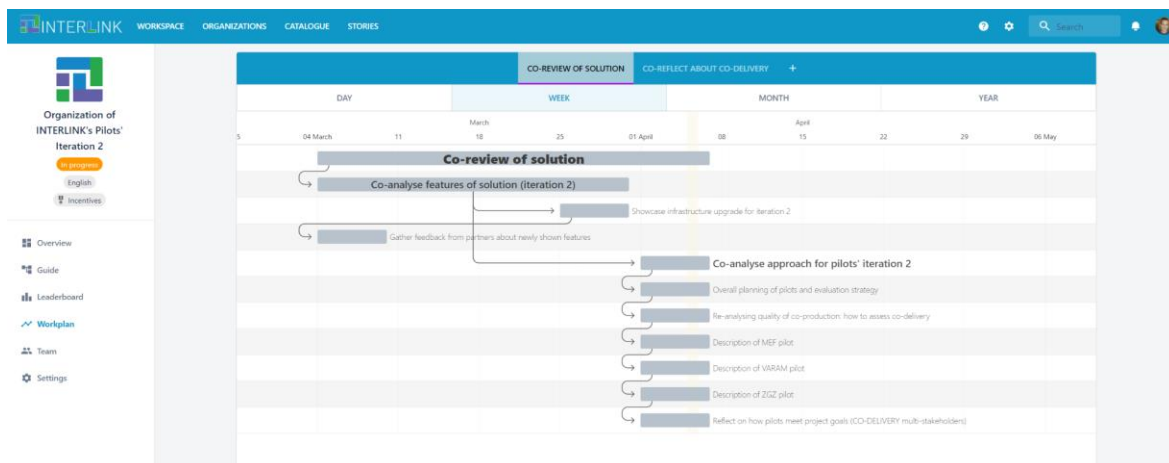
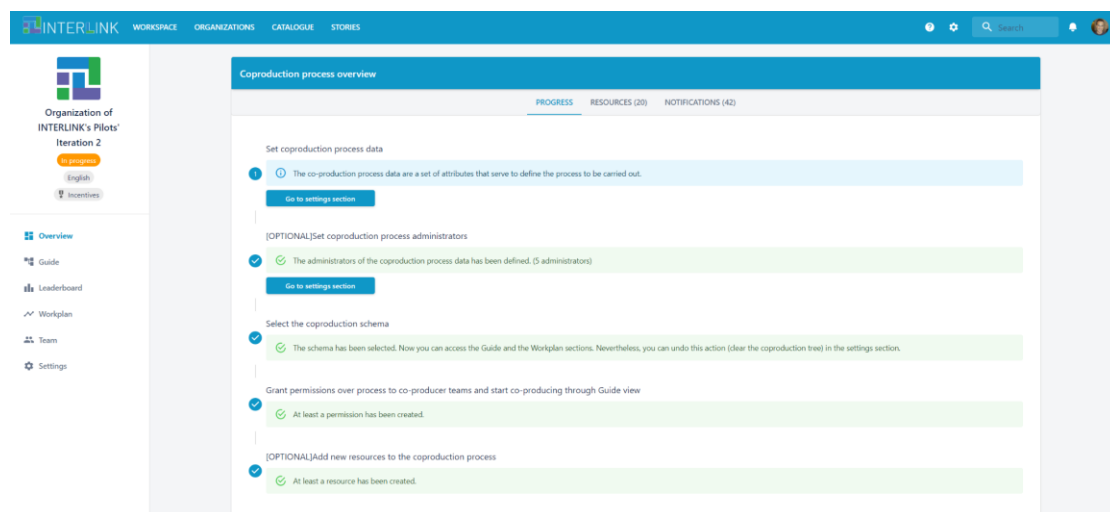


Figure 20. Workplan section of the collaborative environment frontend.



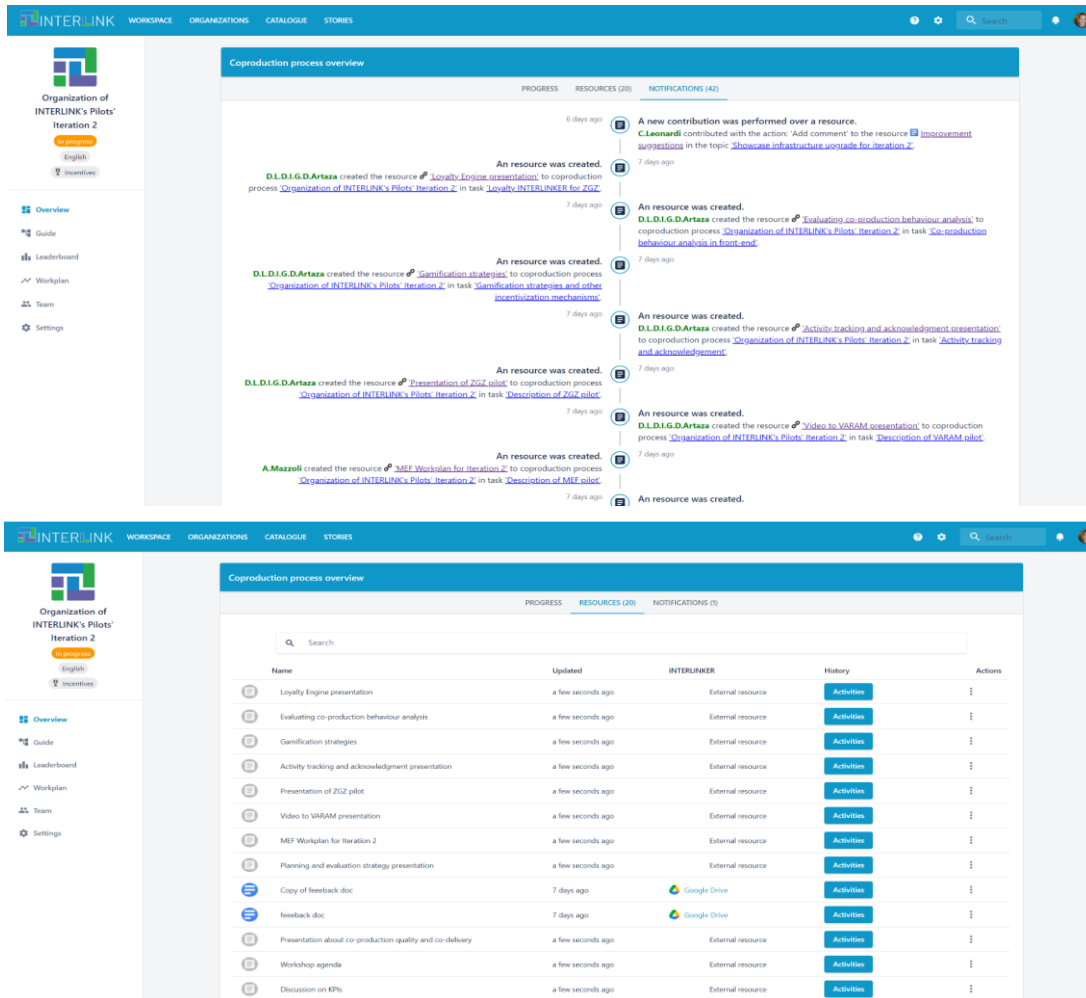
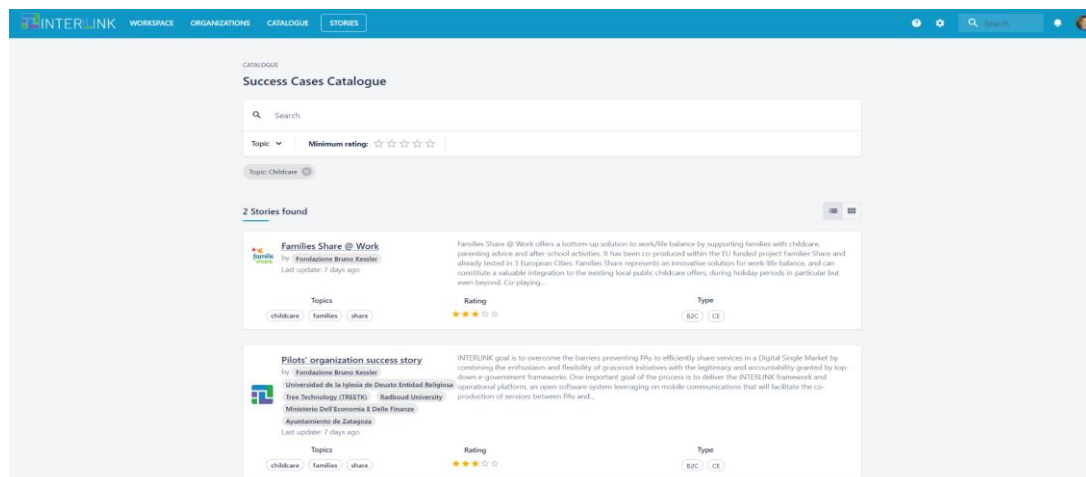


Figure 21. Overview view of the Collaborative Environment, where PROGRESS tab, RESOURCES tab and NOTIFICATION tab are show to process admins. Standard team members only see RESOURCES and NOTIFICATIONs tab.

These features are provided through a web and mobile accessible responsive portal for all stakeholders involved in the INTERLINK community (PA, citizens, and private actors). Such a portal is freely accessible at <https://demo.interlink-project.eu/>.



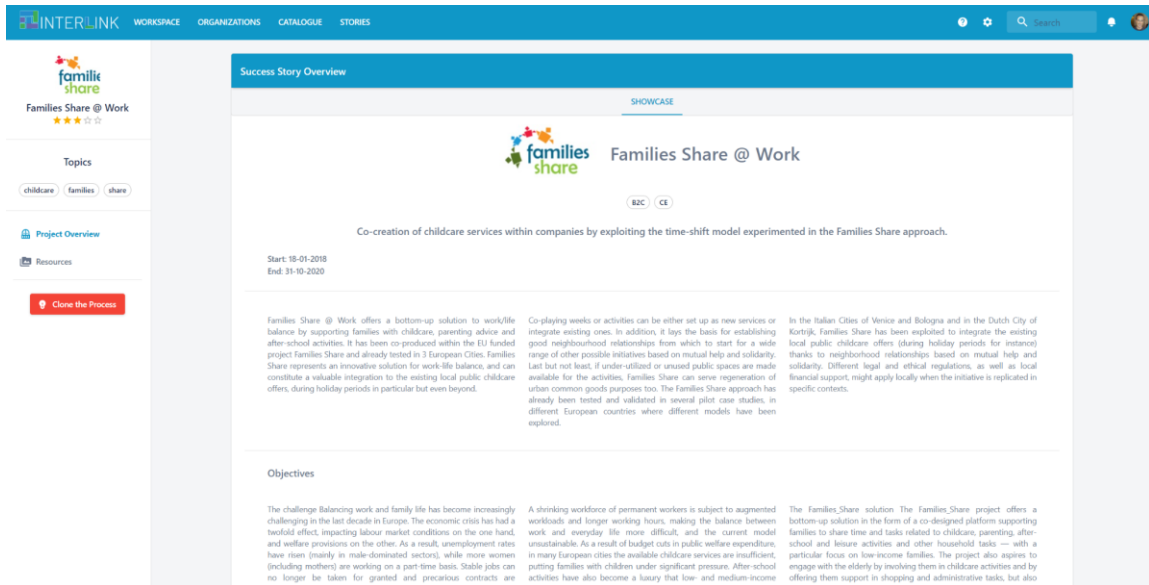


Figure 22. Success stories' view.

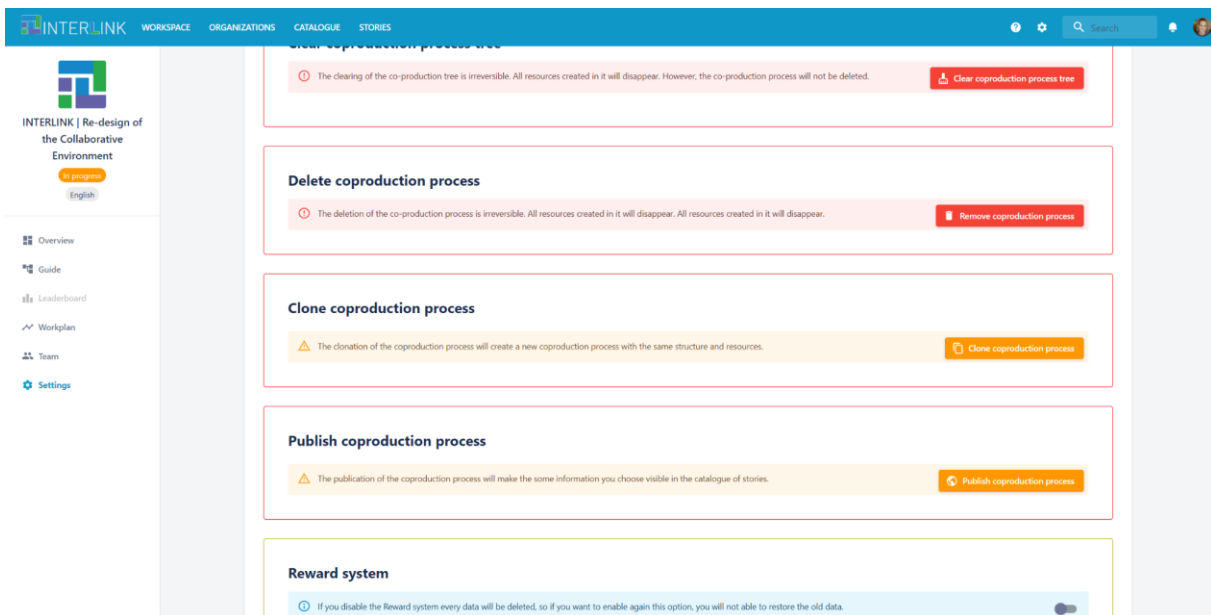


Figure 23. Settings view.

6 Preparation for the second Evaluation of the Pilot Cases

INTERLINK is tested in 3 cross-European pilots. Firstly, in the Ministry of Economy and Finance - Italy (MEF) - a mock-up of a Participatory Strategic Planning Module (called PSPM) will be produced, during iteration 2, which allows Public Bodies and their staff to actively participate in the definition of the Strategic Plans, as well as to have access to a repository of good practices on strategic planning approaches and methodologies.



Secondly, at VARAM, the Ministry of Environmental Protection and Regional Development of the Republic of Latvia and its Latvian State Portal (<https://latvija.lv/EN>), which is a portal that provides easy access to services delivered by state and local government institutions. The goal is to continuously update and enhance such portal descriptions so that the public services published are increasingly adopted. In this second iteration, they additionally will design a common template to better structure the future description of public services.

Thirdly, at Zaragoza city (ZGZ) and its Centre for Art and Technology (eTOPIA), where the aim is promoting collaborative city-making facilities and programs and improving the process of Open Innovation. In iteration 2, they will work on the co-design of new activities for eTOPIA and the coordination of different citizen science initiatives within the city.

This task T4.5 provides the different INTERLINK instances, i.e., one per use-case site. Starting from the common ground of the pre-operational platform built in T4.3, this task will then be in charge of setting up and deploying a specific individual instance for each use-case. While the basis for all the instances is common, INTERLINK acknowledges the need for specific customisation when taken to the deployment and real use in the specific context of each use-case site.

This includes:

1. selection, integration and parameterisation of INTERLINK enablers required for one particular instance;
2. fine tuning, according to the particularities of each local scenario, including (when/if necessary) small ad-hoc adaptations or bridges that could be needed, like e.g. the creation of parsers/gateway to integrate the local in-use data sources, systems, or legacy applications.

These stages and activities will be done in parallel for each use-case site (i.e. 3 subtasks for: Latvia, Spain and Italy).

As a result, an operational instance will be launched for each use-case, ready for evaluating INTERLINK on the 3 sites.

6.1 Guidelines for instantiation

Each environment uses a file containing certain environment variables that modify the behaviour and appearance of the platform components (.env files).

In addition, volumes of data are used to mount certain digital resources, such as images, in the containers responsible for providing the platform's services. In this way, the frontend can modify the images it displays depending on the environment where it is located.

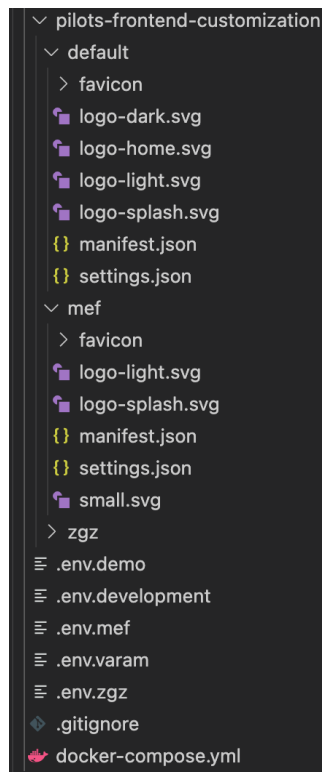


Figure 24. Interlinkers catalogue in the collaborative environment frontend.

Some logos and images can be modified in this way, as well as setting the default language and the allowed languages.

```
DOMAIN=dev.interlink-project.eu
MODE=production
PROTOCOL=https://

# pilot customization
FRONTEND_CUSTOMIZATION_IMAGES_PATH=./pilots-frontend-customization/default
PRIMARY_COLOR=
DEFAULT_LANGUAGE=en
ALLOWED_LANGUAGES=en,es,lv,it
```

Figure 25. Environment variables file for demo environment (.env.demo).

Besides, we cope with internationalization (i18n) aspects by means of the [weblate](#) tool which enables all the resources visualized in each environment to be customized to the users' preferred language. Notice that most string resources are global and only a few strings are specific to each deployment.

6.1.1. INTERLINKERS selection per Environment

As mentioned in the 5.1 section, each INTERLINKER is defined by a metadata.json file. This file contains the “environments” key, which defines in which environments must be launched.

```
{
  "name_translations": {
    "en": "Business Model Canvas"
  },
  "description_translations": {
    "en": "This canvas can be used collaboratively, for instance, during a brainstorming or a focus group, to reflect on the the most suitable business model associated to a co-produced service."
  },
  "environments": [
    "varam",
    "mef",
    "zgz"
  ],
  "languages": [
    "en"
  ],
  "problemprofiles": [
    "SUS_PROBLEM_1"
  ],
  (...)
}
```

Figure 26. Reduced metadata.json file for Business Model Canvas knowledge INTERLINKER.

6.2 Specific Instantiations

6.2.1. Latvian Use-Case

The variables set for the Latvian use case set Latvian as the default language, allow the use of English, and point to the directory containing the logos and images to customise the frontend.

```
DOMAIN=varam.interlink-project.eu
(...)
# pilot customization
FRONTEND_CUSTOMIZATION_IMAGES_PATH=./pilots-frontend-customization/varam
PRIMARY_COLOR=
DEFAULT_LANGUAGE=lv
ALLOWED_LANGUAGES=en,lv
```

Figure 27. Reduced environment file for Latvian use case

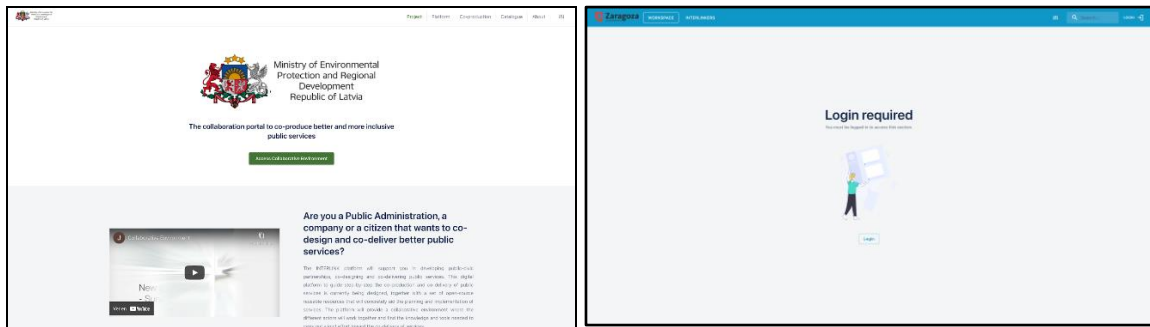


Figure 28. Result of the customization variables applied to the Latvian use case

6.2.2. Spanish Use-Case

The variables set for the Spanish use case set Spanish as the default language, allow the use of English, and point to the directory containing the logos and images to customise the frontend.

```
DOMAIN=zgz.interlink-project.eu
(...)
# pilot customization
FRONTEND_CUSTOMIZATION_IMAGES_PATH=./pilots-frontend-customization/zgz
PRIMARY_COLOR=
DEFAULT_LANGUAGE=es
ALLOWED_LANGUAGES=en,es
```

Figure 29. Reduced environment file for Spanish use case

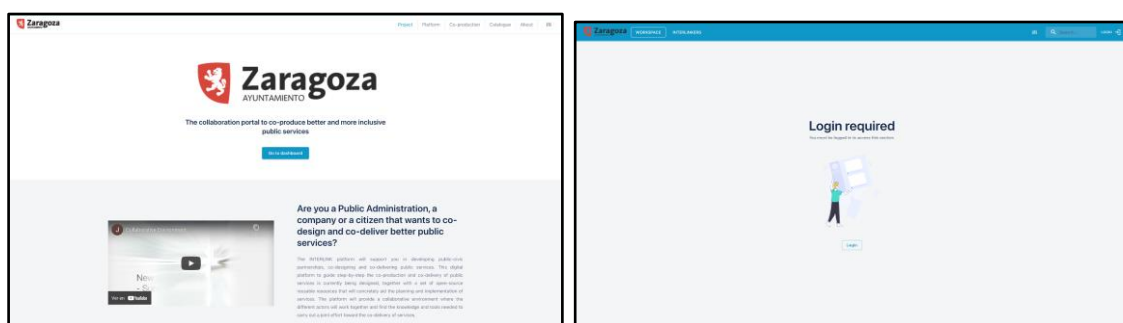


Figure 30. Result of the customization variables applied to the Spanish use case

6.2.3. Italian Use-Case

The variables set for the Italian use case set Italian as the default language, allow the use of English, and point to the directory containing the logos and images to customise the frontend.

```
DOMAIN=mef.interlink-project.eu
(...)
# pilot customization
FRONTEND_CUSTOMIZATION_IMAGES_PATH=./pilots-frontend-customization/mef
PRIMARY_COLOR=
DEFAULT_LANGUAGE=it
ALLOWED_LANGUAGES=en,it
```

Figure 31. Reduced environment file for Italian use case

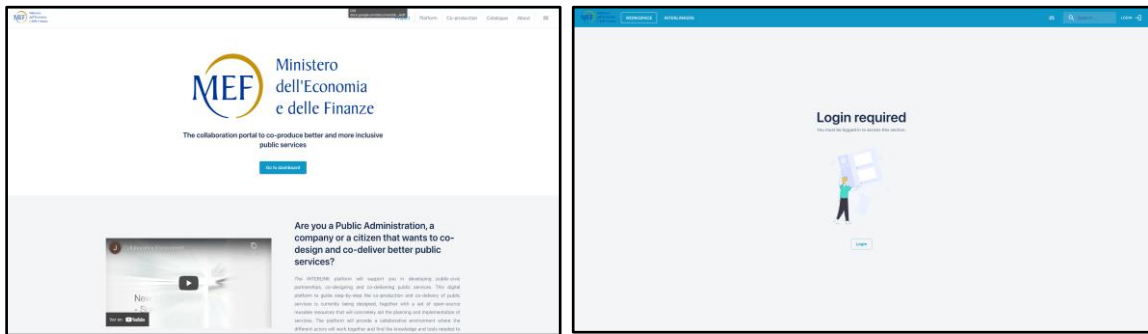


Figure 32. Result of the customization variables applied to the Italian use case



ANNEX

Annex 1 - Usability and usefulness scores for system v1 functionalities

USABILITY details

Descriptive Statistics																
	Generic Interlinkers for collaboration	Possibility to upload and share documents	Knowledge Interlinkers for co-production	Possibility to link external resources	Software Interlinkers for co-production	Catalog of INTERLINKERS	Edit of project description	Registration and Login	Co-production process overview	Coproduction Tree navigation	Landing page	Workplan	Creation of organization and teams	Creation of project	Schema selection	
Valid	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mean	9.000	8.167	8.167	8.000	7.667	7.333	7.167	6.667	6.667	6.667	6.500	6.333	6.167	5.500	4.833	
Std. Deviation	2.000	1.329	1.602	1.095	1.033	1.751	2.401	1.211	1.966	1.633	0.548	1.751	1.169	1.378	1.835	
Minimum	5.000	6.000	5.000	6.000	6.000	4.000	3.000	5.000	4.000	4.000	6.000	3.000	4.000	4.000	3.000	
Maximum	10.000	9.000	9.000	9.000	9.000	9.000	9.000	8.000	9.000	8.000	7.000	8.000	7.000	8.000	8.000	

USEFULNESS details

Descriptive Statistics																
	Generic Interlinkers for collaboration	Possibility to upload and share documents	Knowledge Interlinkers for co-production	Possibility to link external resources	Software Interlinkers for co-production	Catalog of INTERLINKERS	Edit of project description	Registration and Login	Co-production process overview	Coproduction Tree navigation	Landing page	Workplan	Creation of organization and teams	Creation of project	Schema selection	
Valid	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mean	5.000	10.667	4.167	9.000	5.667	4.833	7.333	11.833	7.667	9.667	9.333	11.000	7.667	8.833	7.333	
Std. Deviation	3.286	3.830	3.920	4.980	4.761	1.602	4.457	3.545	2.422	1.862	5.820	3.950	4.227	3.920	5.279	
Minimum	2.000	7.000	1.000	3.000	2.000	2.000	1.000	6.000	3.000	8.000	1.000	3.000	1.000	3.000	2.000	
Maximum	11.000	15.000	9.000	14.000	15.000	6.000	13.000	15.000	9.000	12.000	15.000	13.000	12.000	14.000	13.000	



Annex 2 - Mock-ups for Front End redesign

The following selection of commented mock-ups documents the process of redesign of the Collaborative Environment front end interface which occurred starting from the refined requirements emerged from the analysis of pilots' iteration I (Section 2.2.1) and from the two co-design workshops that followed (Section 2.2.2 and Section 2.2.3). An extended set of modifications was proposed and passed to the development team by means of a Figma prototype.

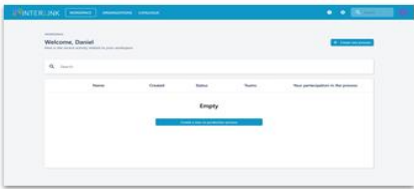
The mock-ups have been developed by Daniel Messina, a student at the University of Trento performing an internship within the INTERLINK project (supervised by FBK researchers) in preparation of his thesis for the Bachelor degree in Interfaces and Communication Technologies.

Mock-up for new Welcome Page

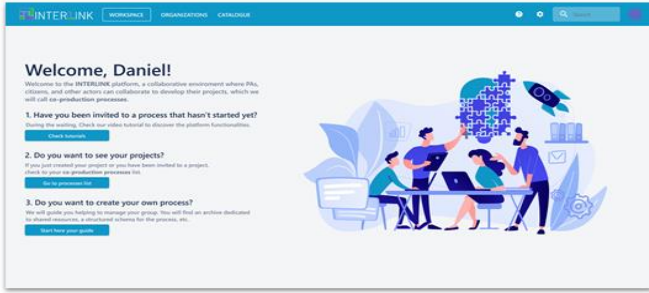
New welcome page

- ❖ less elements
- ❖ small introduction for the user
- ❖ only one button
- ❖ takes care of the different types of user and access

Before

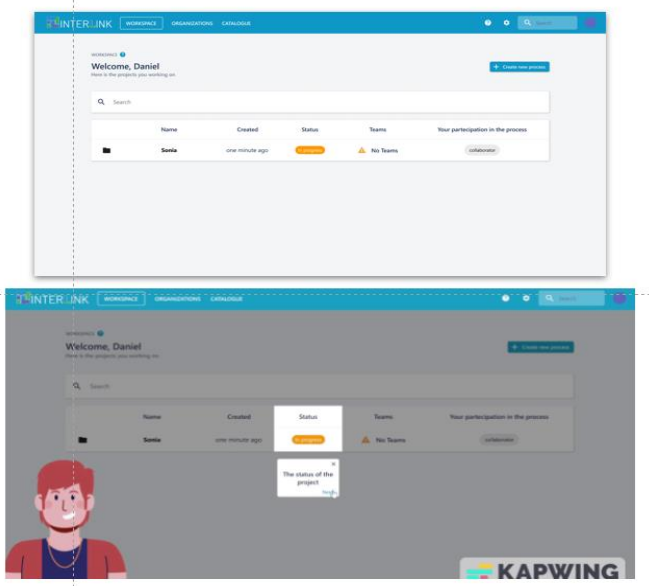


After



“Black screen tutorial”

Once the user creates a process or simply accesses to the list, if is the first access the user will see a tutorial that describes the workspace to ensure that all is clear





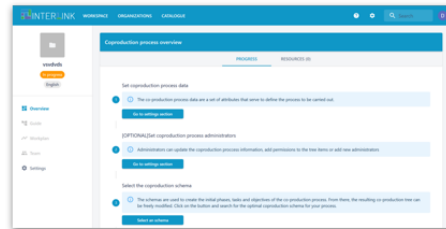
Mock-up for revised Overview section

The new Overview section

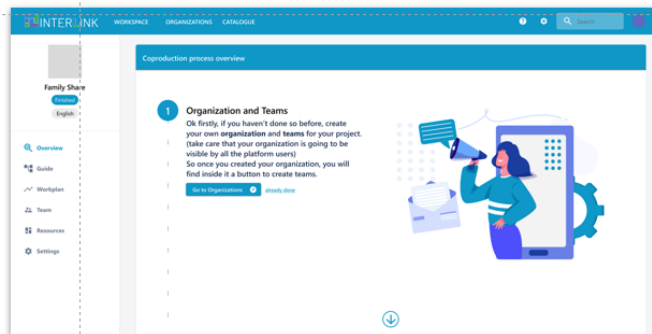
Every step has more importance. Now each step takes all the screen and an illustration provides a more impressive description to the user.



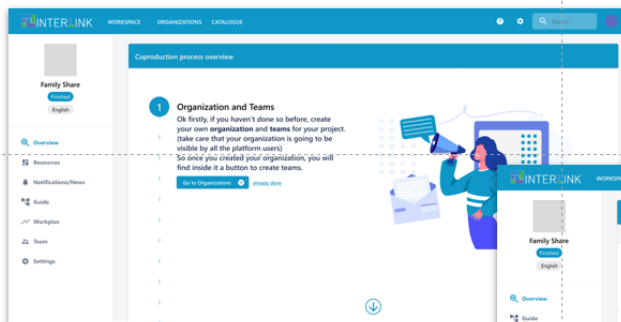
Before



After

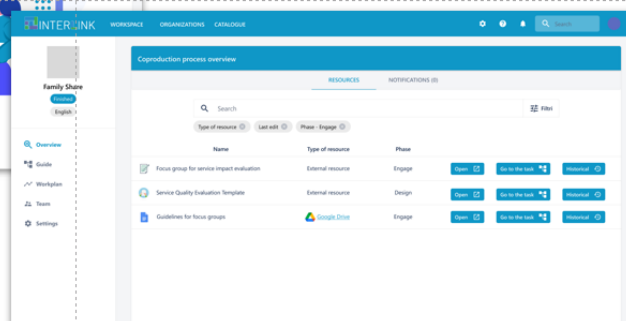


Admin



If the user is not an admin, s/he will not see the overview section considering that is not useful for her/him

User

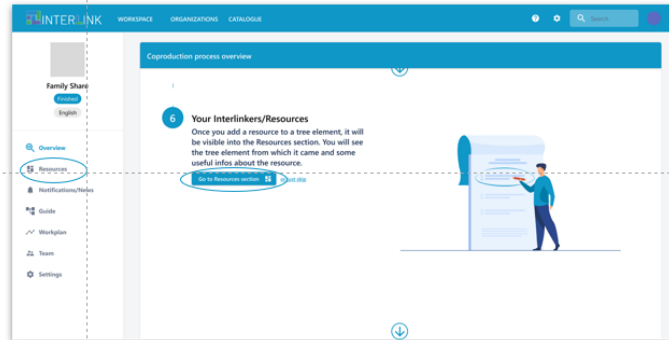




Mock-up for Resources view

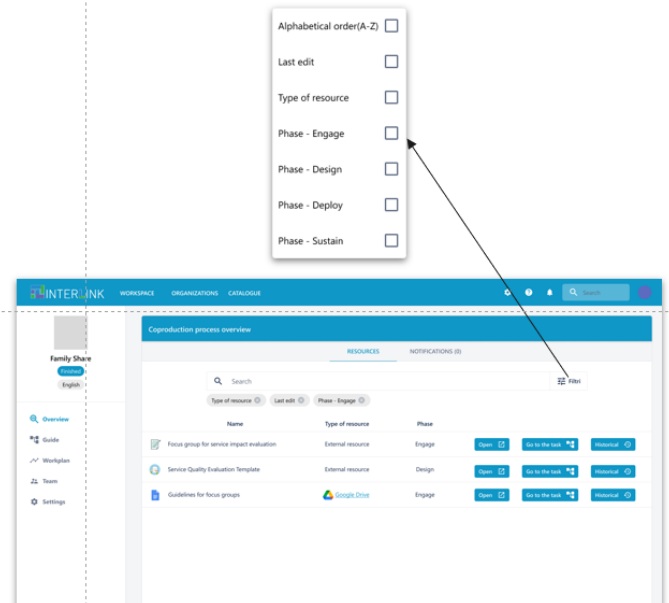
Project resources list moved to the drawer

To give more importance to the resources now they have a dedicated page. The icon that before was for the Overview section now is for the Resources. By doing this also the Overview has a completely dedicated page.



Filters

Following the filters concept into the Interlinkers catalogue, filters could be added also in the resource section, to help users to find the resource which they are looking for.




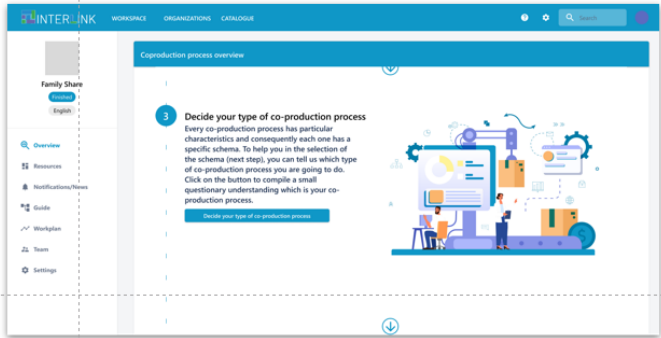
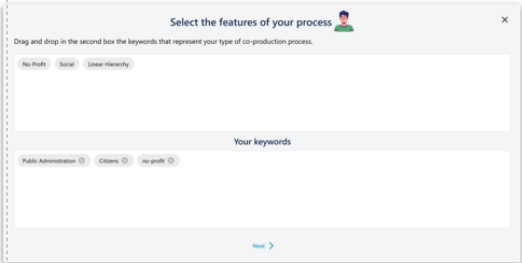


Mock-up for co-production process annotation

Keyword selection


The third step, allows users to decide the type of co-production process they are going to work on. With a drag and drop, the user can select some keywords that the system will use to recommend the right type of co-production process

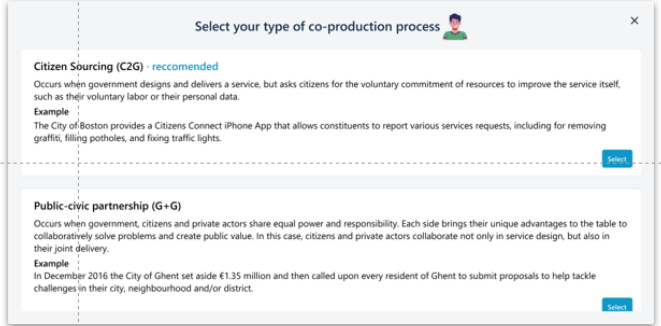


Selection of governance model

Once the user has completed the keyword selection, the type of recommended governance model is shown at the top, giving a description and an example. The user can also select the other types by scrolling down.







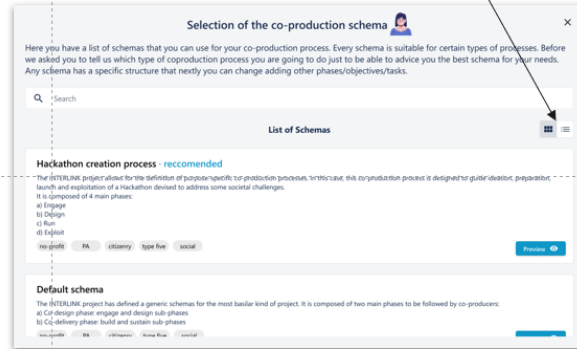
Mock-up for revised schema selection

The recommended schema

A short description may provide some initial guidance. Semantic tags may help clarify which situation a schema is best suited for. By exploiting the process categorization inserted by the user at the beginning, the system recommends the best schema for this type of process.

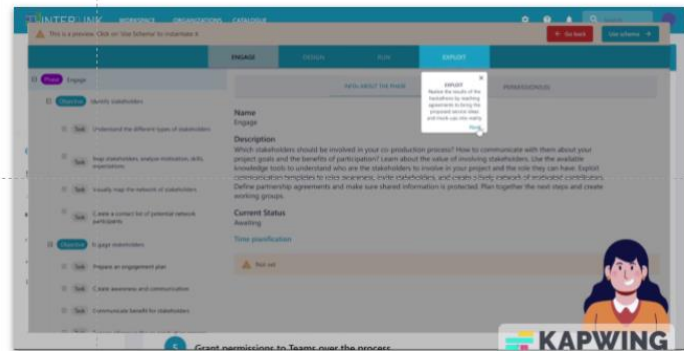


The user can also select the old style



Black-screen tutorial

A tutorial explaining the different parts of a schema can be made available for each schema. The user can click on the "x" to end immediately the tutorial.





Mock-up for placement of notification centre

Notification center in Drawer

Just like Resources, the notification center has been moved to the drawer. This permit to quickly access the notification center whenever the user wants.

