

# A Collaborative Environment to Boost Co-Production of Sustainable Public Services

Diego López-de-Ipiña  
Faculty of Engineering,  
University of Deusto  
Bilbao, Spain  
dipina@deusto.es

Julen Badiola  
DeustoTech,  
University of Deusto  
Bilbao, Spain  
j.badiola@deusto.es

Daniel Andrés Silva  
DeustoTech,  
University of Deusto  
Bilbao, Spain  
d.silva@deusto.es

Diego Casado-Mansilla  
Faculty of Engineering,  
University of Deusto  
Bilbao, Spain  
dcasado@deusto.es

Elena Not  
Fondazione Bruno Kessler,  
Trento, Italy  
not@fbk.eu

Chiara Leonardi  
Fondazione Bruno Kessler,  
Trento, Italy  
cleonardi@fbk.eu

Ana Ortiz-de-Guinea  
HEC Montreal,  
Montréal (Québec), Canada  
ana.ortiz-de-guinea@hec.ca

Igone Porto  
Deusto Business School,  
University of Deusto  
Bilbao, Spain  
igone.porto@deusto.es

**Abstract** – Government scholars claim that co-production might be the key to evolve towards more citizen-centric and sustainable public services. This paper describes the work carried out within the European H2020 project INTERLINK towards devising a co-production environment to democratize and boost the collaborative co-design and co-delivery of public services and to foster the reuse of a continuous growing plethora of public services’ building blocks (INTERLIKERS). The evaluation strategy to assess the provided co-production environment in 3 cross-European pilots is designed to understand the perceived quality of digitally co-produced public services and its influence on their acceptance and trust among civil servants, citizens and other stakeholders.

**Keywords** — co-production, enabler, building block, schemas, Open API, quality-assurance.

## I. INTRODUCTION

Much effort has been spent by the EU and National Governments in developing regulations and procedures for the interoperability and re-use of software to enable the EU Digital single market [1][2]. However, these “top-down”, i.e. government-pushed, approaches often fail to involve important stakeholders such as citizens and third sector organizations (TSO), thus creating outcomes that are technically sound but lack transparency and trust.

On the other hand, many examples of successful “Do It Yourself Government” [3] (Citizen to Citizen, C2C), where non-governmental actors such as TSOs carry out activities in place of the local administration (as in CAPS initiative [4]) have arisen in the last few years. Still, these approaches suffer from several breaking limitations, i.e. sustainability, accountability and legitimacy.

A public service can be formally defined as an aggregation of all activities that realize a public authority’s commitment to make available to individuals, businesses, or other public authorities some capabilities intended to answer their needs, giving them some possibilities to control whether, how and when such capabilities are manifested [5]. This paper explores the role and impact of applying co-production to public service creation or refinement. It refers to ‘co-creation’ as the process in which services are jointly designed and/or delivered by public authorities and other stakeholders. The term ‘co-production’, used in this work, is in practice often used interchangeably with co-creation but is generally seen as referring to the delivery stages of a service [6]. Unfortunately, there are several barriers that prevent Public Administrations

(PAs), companies, and citizens from fully exploiting the potential of ICT to co-produce and co-deliver services [7][8]. Among those:

- shortage of financial resources
- lack of skilled workforce able to coordinate and execute activities
- lack of effective planning for the day-to-day ICT use
- complexity of legal regulations
- negative attitude towards ICTs by citizens (e.g. privacy concerns) and government staff (e.g. perception of intrusiveness in work practices)
- often informal and experimental nature of most co-production initiatives.

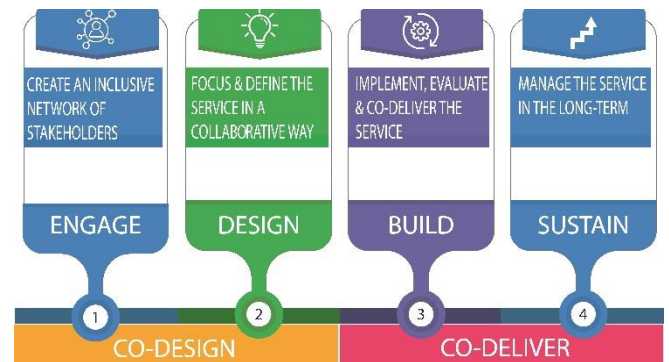


Fig. 1. Generic co-production model in INTERLINK.

The INTERLINK H2020 project [9] has been designed to overcome the barriers that hinder administrations to reuse and share services with private partners (including citizens) by combining the advantages of two often opposed approaches: (1) the “top-down” approach where Government holds primary responsibility for creating these services compliant with EU directives, sometimes seeking the support of citizens for specific design or delivery tasks; and (2) the “bottom-up” approach in which citizens self-organize and deliver grassroots services where government plays no active role in day-to-day activities but may provide a facilitating framework. For that, INTERLINK defines a *four sub-phase co-production process* (see Fig. 1) to be followed by *co-producers* (see Fig. 2):

- *Co-design phase*. It concerns activities that incorporate “the experience of users and their communities” into

the creation, planning, or arrangements of public services [10]. 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. See Fig. 1 for more details about the scope of each co-production sub-phase.

- *Co-delivery phase.* It is a joint effort by public authorities and stakeholders to provide and improve public services [11][12] where the service is implemented and delivered in a sustainable manner. The co-delivery phase entails two sub-phases: *Build* and *Sustain*.

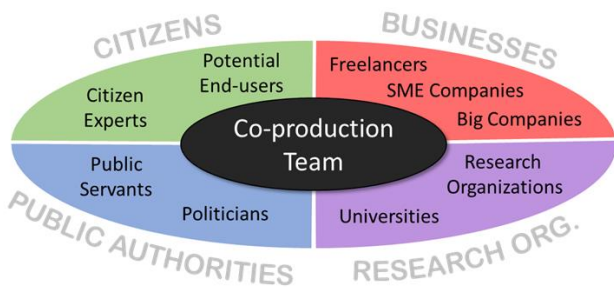


Fig. 2. Public Service co-production stakeholders (*co-producers*).

This paper reports the main contributions of INTERLINK to demonstrate to PAs and their stakeholders, that co-production should be beneficial, feasible and doable in practice. For that, section 2 describes the state of the art in co-production. Section 3 describes the INTERLINKER concept. Section 4 describes the Collaborative Environment component produced to streamline and make move feasible and viable co-production of public services. Section 5 outlines the evaluation strategy of the project. Finally, section 6 concludes the paper and draws some future work insights.

## II. RELATED WORK

The Digital Europe Programme [13] proposes a range of building blocks as standards-based open and reusable digital solutions that enable basic capabilities, such as trusted authentication and secure data exchange. These building blocks offer basic capabilities that can be used to facilitate the delivery of digital public services across borders. They implement the provisions of the eIDAS [14] regulation on authentication and trust services, a global legal and technical reference in secure, trusted cross-border authentication. On the other hand, portals such as the “Action catalogue” [15] or “Service Design Tools” [16], offer a range of methodologies, capabilities and techniques intended to enable researchers, policy-makers and others wanting to conduct collaborative processes, to find the methods best suited for their specific co-design needs. INTERLINK thinks that to boost co-production of public services is imperative to foster reuse of: a) open-source regulation-conformant, disruptive-technology based, existing software tools; and b) increasable growing online knowledge resources to support the different tasks within a co-production process. Hence, it builds on previous work to give place to a catalogue of reusable INTERLINKERS.

Collaborative software or groupware [17] is designed to help people working on a common task to attain their goals. Collaborative software relates to the notion of collaborative work systems (CWS), which are conceived as any form of human organization that emerges any time that collaboration

takes place, whether it is formal or informal, intentional, or unintentional. Collaborative Work Environments (CWE) are those in which conscious efforts have been made to create strategies, policies, and structures to institutionalize values, behaviours, and practices that promote cooperation among different parties in an organization to achieve organizational goals. There are quite a few successful, mostly commercial, platforms that foster collaboration such as Podio [18], Microsoft Sharepoint [19] or Notion.so [20]. INTERLINK collaborative environment is a CWE which includes inclusive team management, co-production model-based project management, recommendation, and integration of external tools for document management, decision-making, surveying or capabilities to foster collaboration and partnerships. It differentiates on its co-production centric and reusability driving approach leveraged on the INTERLINKER concept.

Persuading users to be actively motivated to take part in collaboration processes in a sustainable manner is complex. Past research efforts have used gamification approaches [21] to address this issue. Others have explored trusted registration mechanisms based on Blockchain [22] which provide social recognition and rewarding as an incentive to encourage long run collaboration of communities towards common objectives. INTERLINK, aware of this need, will incorporate contribution valorisation mechanisms in the form of INTERLINK tokens to incentivise and reward coproducers. The project will also evaluate the impact that involving citizens and other stakeholders in co-production may have on the delivery of higher quality more acceptable smart city services, as explored by some past works[23][24].

## III. INTERLINKERS

INTERLINKERS are common building blocks, provided as software tools or in the form of knowledge offered digitally, that offer interoperable, re-usable, EU-compliant, standardized 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.

#### A. Specification model for INTERLINKERS

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 licenses. Regarding *context*: a) Administrative: local, national, EU; b) Regulatory: standards, regulations it complies to; c) Organizational: 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) [25], 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.

Software INTERLINKERS usually contain a *logo.png* file to be able to depict them in the collaborative environment. Besides and very importantly, apart from common metadata to all enablers (e.g. problem profiles targeted, difficulty, license, name, description, etc.) they also include aspects to enable its integration with the collaborative environment, whenever they are of co-production type, e.g. through the *"capabilities"* dictionary which includes elements such *"instantiate"*, *"clone"*, *"view"*, *"edit"*, *"delete"*, *"download"* or *"open\_in\_modal"* Boolean fields among others. Fig. 4 illustrates the corresponding API methods to be provided by every software INTERLINKER to be neatly integrated with the collaborative environment.

#### B. INTERLINKER catalogue

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, Sillearning.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. Fig. 3 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.

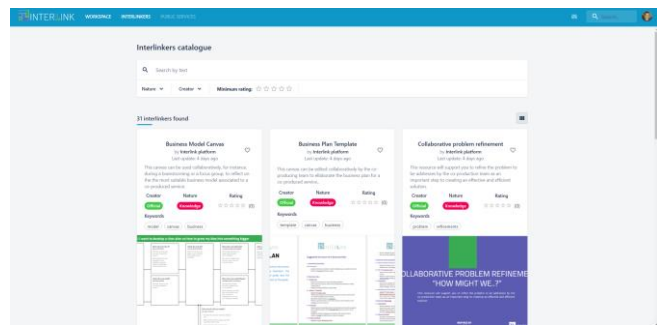


Fig. 3. INTERLINK catalogue.

### IV. COLLABORATIVE ENVIRONMENT

The INTERLINK collaborative environment has been designed to support the co-production methodology of INTERLINK (see Fig. 1) and facilitate its adoption and application in the co-production of novel public services. It offers the following core functionalities: a) co-producer team and project 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 and registry of use (displaying result of using the enabler, e.g. instantiation of a Business Plan) and e) INTERLINKER catalogue already showcased in Fig. 3.

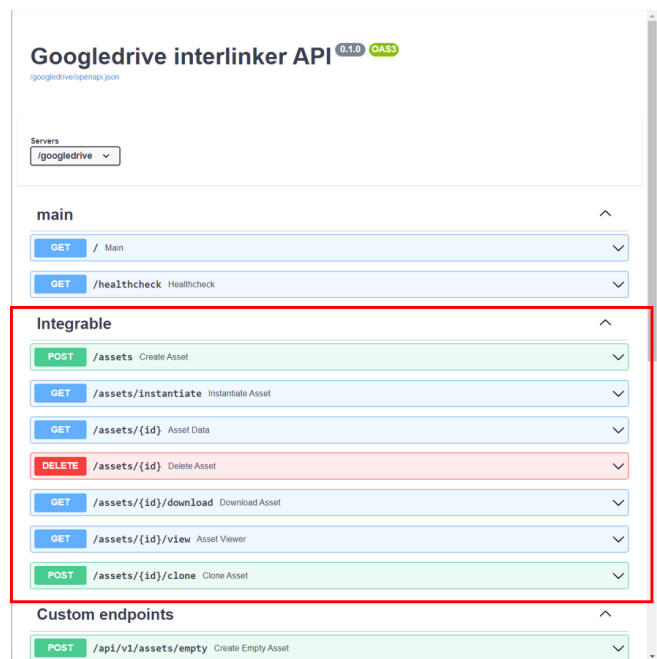


Fig. 4. INTERLINK API to be integratable in collaborative environment.

Notice that apart from methods required to integrate a co-production INTERLINKER with the collaborative environment, see TABLE I., custom endpoints are defined by each INTERLINKER, e.g. for GoogleDrive the endpoint shown as */api/v1/assets/empty* (see Fig. 4).

TABLE I. CO-PRODUCTION INTERLINKER API

URI	Method	Description
/	GET	redirects to swagger / redoc DOCS

URI	Method	Description
/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-googledrive* to deal with office like documents; b) *interlinker-survey* to design and host answers for surveys; c) *interlinker-ceditor* 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 organization 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. 1, purpose specific co-production trees can be defined as shown in Fig. 5 and Fig. 6. Notice that Fig. 5 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. 6. 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.

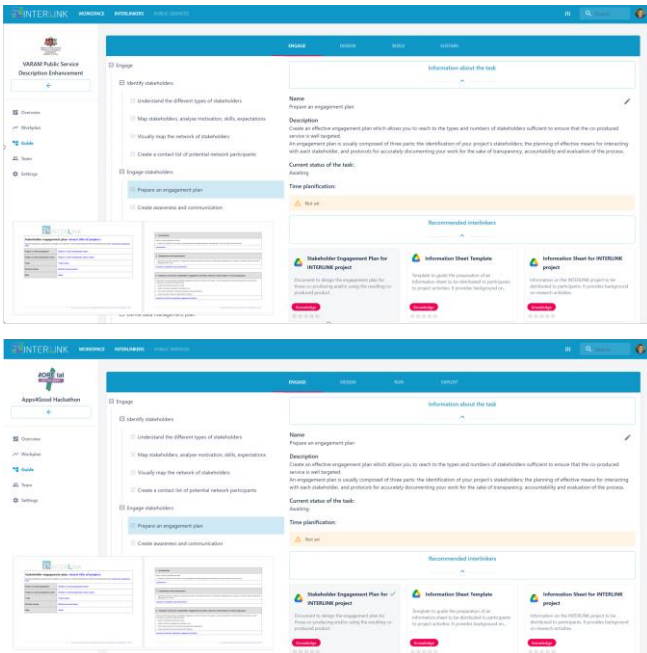


Fig. 5. Comparison of INTERLINK ENGAGE stage in 2 different co-production projects and INTERLINKER recommendation.

## V. EVALUATION & ASSESSMENT

INTERLINK is going to be 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 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. Thirdly, at Zaragoza city (ZGZ) and its Center for Art and Technology (eTOPIA), where the aim is promoting collaborative city-making facilities and programs and improving the process of Open Innovation.

The essence of the organization, planning and execution of pilots in INTERLINK is to assess whether the co-production model and supporting tools and co-produced assets put forward by the project will enhance the quality, quantity, and reuse of public services among European public administrations (PAs). INTERLINK wants to evaluate the usability, acceptability, and adoption of the Collaborative Environment as a key enabler for the co-design and co-delivery of public services. It is particularly interested in determining the degree of *adoption* achieved by INTERLINK co-production model, supporting tools and co-produced public services and INTERLINKERS.

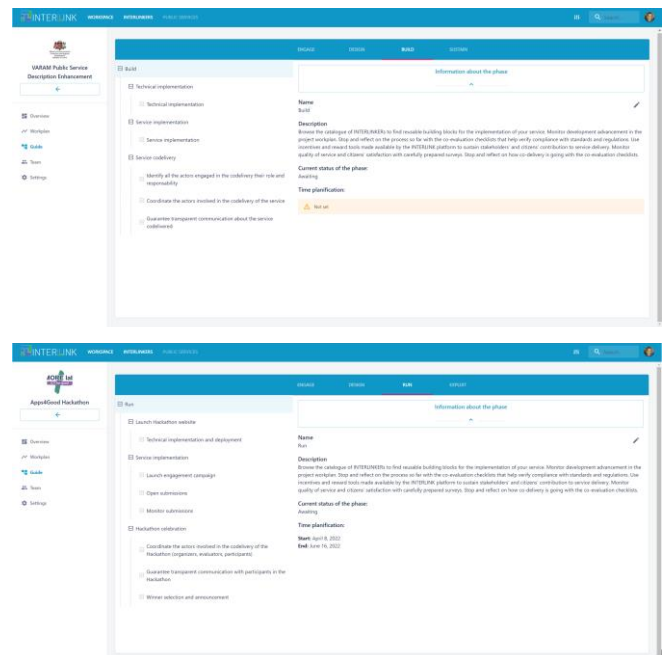


Fig. 6. Comparison of INTERLINK BUILD (standard) vs. equivalent RUN (custom) stages in 2 different co-production projects.

The evaluation objective is to explore differences in the process of service co-delivery between PRE- and POST INTERLINK. For that, a longitudinal field experiment with a PRE and POST INTERLINK evaluation is proposed. The object of the PRE (or "without INTERLINK") evaluation are public services delivered in each site via other means before INTERLINK was implemented and that are the same or

similar as those enabled by INTERLINK. The object of the POST (or "with INTERLINK") evaluation are public services enabled by INTERLINK. This PRE-POST field experiment is akin to that of A/B testing found in the computer science literature [26], with the pre-without INTERLINK being the A testing and the post-with INTERLINK evaluation being the B testing. However, a particularity of this experimental design is that it is longitudinal: the PRE- INTERLINK evaluation takes place before the POST-INTERLINK evaluation. That way, participants in the PRE-without INTERLINK phase can also take part in the POST-with INTERLINK phase if they interact with the INTERLINK solution. This is also a practical and pragmatic way to align the evaluation with the reality of each site. In addition, this longitudinal experiment allows for determining the best option among two alternatives A (PRE-without INTERLINK) and B (POST-with INTERLINK).

INTERLINK's *perceived adoption*, may be driven, on one hand, from usability, user experience and effectiveness, and, on the other hand, from the trust and acceptability brought forward by our co-production solution. Hence, special attention will be given to the perceived usability (user experience and effectiveness) of the INTERLINK environment; by mapping and examining the most problematic usability issues of the alpha version of the INTERLINK platform and collecting feedback to improve the user experience. On the other hand, the trust resulting from enabling and democratizing co-production processes will be explored. Finally, users' acceptance of the INTERLINK concept and pilot phase enablers and co-produced public services will be evaluated. However, to be able to measure and compare these evaluation constructs or dimensions, a longitudinal study will be carried out where technical tests, logs and questionnaires customized to different stakeholders will be used to determine the quality associated with the INTERLINK co-production model and artefacts (as shown in Fig. 8). Indeed, it is deemed that the highest possible quality assurance of the co-production process should drive towards a higher adoption rate of the INTERLINK co-production approach. Quality is going to be measured based on the dimensions, shown in Fig. 7:

- *Product quality*: based on ISO/IEC 25010:2011 [27] quality model, it indicates the degree to which a particular service or product conforms to its specification.
- *User-based quality*: based again on ISO/IEC 25010:2011 [27] quality model, it means that the attributes of a product meet the customer's requirements (in the public sector this is very important due to the need for public accountability).
- *Value-based quality*: quality as services being in line with requirements of public services (e.g. legal treatment) and broader societal notions (e.g. democratic values).

#### A. Qualitative measures

Qualitative data will be gathered during pre-evaluation, mid-evaluation, and post-evaluation sessions. For Pre-evaluation sessions:

- *Thinking aloud evaluations* with end-users (verbalization of users' interaction with INTERLINK) and Heuristic evaluations to gather the feedback of experts on public services (and their

design), among other qualitative research techniques, will be applied.

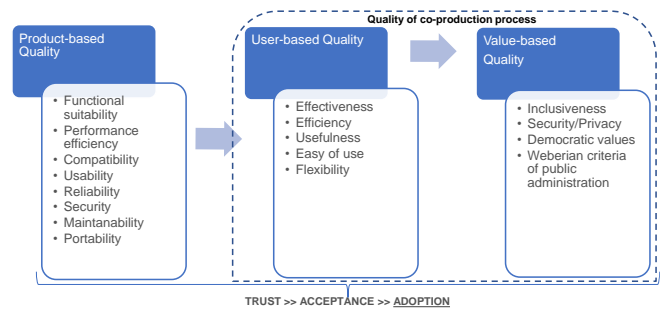


Fig. 7. INTERLINK quality-assurance and evaluation dimensions.

- *Cross-testing sessions* involving INTERLINK consortium members and a set of alpha testers (5 to 10 people) at each pilot, will be performed of the INTERLINK ecosystem to assess the whole functionality required, pilot case by pilot case. Testers will be provided with an alpha questionnaire through which they will be able to report back any issues identified during scenario-based testing sessions.

For mid-evaluation sessions and post-evaluation sessions:

- *Interviews with some end-users* can take place around the following three aspects: a) What did work well?; b) What did not work well?; and c) Other suggestions for improvement of the INTERLINK co-production approach?
- INTERLINK tools and services will be instrumented with short online questionnaires (in-app questionnaires) that will allow to get quick feedback from users about a given public service, INTERLINKER or functionality from the collaborative environment.

#### B. Quantitative measures

Quantitative data will be gathered through different KPIs and measures organized by objectives. Such KPIs cover *global* aspects common to all sites and *local* KPIs and measures, associated to specific pilots:

- *Surveys and questionnaires* to explore usability, trust, and acceptance, and, hence, deduce the adoption of INTERLINK proposed co-production process and artefacts. A thorough questionnaire, both for coproducers and end-users of co-produced artefacts has been designed. Such questionnaire figures out the potential (degree of adoption) of our approach as a result of exploring the usability, user experience, trust and acceptability of the INTERLINK platform. It is targeted to different stakeholders (public administration, businesses, citizens, and developers). Statistical analysis of the answers collected will be performed to be able to gain insights towards reflecting on the degree of adoption of INTERLINK co-production model and tools.
- *Data logs* will be collected both from the collaborative environment and INTERLINK powered public services to allow for the analysis of user interactions with those tools and services. Analysis of such logs should allow us to detect usability bottlenecks and issues with the co-produced tools and public services.

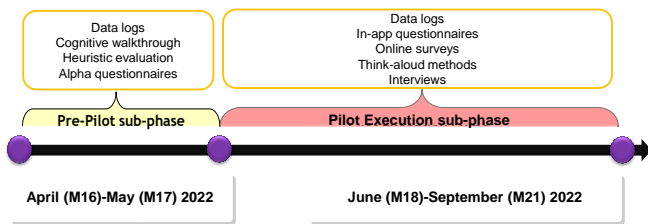


Fig. 8. Qualitative and quantitative measurements in INTERLINK for Iteration 1.

## VI. CONCLUSION AND FURTHER WORK

The INTERLINK collaborative environment has been released in alpha mode and is ready for being tested in the 3 mentioned pilots, according to the timeline shown in Fig. 8. The INTERLINKERS needed by the collaborative environment at each pilot site, the evaluation strategy and measuring instruments, pilots' workplan and engagement activities are in place to get started with the evaluation. Thus, this project will be able to assess whether its co-production methodology and associated tools and artefacts contribute to a wider adoption of co-production as a good practice to deliver more highly acceptable and usable public services or not.

Future work will keep enriching the catalogue with new co-production enabling INTERLINKERS. The environment will also be populated with new exemplary co-production trees for different purpose co-production projects. Besides, an agile process board (Trello-like) view to better monitor pending and in-progress activities of co-production tasks will be produced. As result of the first piloting iteration, enhanced usability and integration of co-production guide, timeline, tasks, and resources views to streamline the co-production of innovative public services will be amended and the project again assessed in a second iteration. In such second iteration, the x

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