Tackling co-delivery in co-production processes

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***Abstract* – Co-production is a collaborative process involving two main phases, namely co-design and co-delivery. INTERLINK provides technological support to tackle co-production of public services. This work demonstrates how INTERLINK's Collaborative Environment supports effectively and efficiently co-designing public services, after having assessed it in 3 pan-European pilots, and outlines its approach to tackle co-delivery, which will deliver sustainable and replicable public services.**

Keywords — Co-production, public services, analytics.

I. Introduction

Co-production of public services is a collaborative process between *service providers* (such as government agencies or non-profit organizations) and *service users* (such as citizens, patients, or clients) to design, deliver, and evaluate public services. This approach recognizes that service users have valuable knowledge and expertise that can help to improve the effectiveness and efficiency of public services [1].

Co-design and co-delivery are two distinct phases within a co-production process, each with its own objectives. *Co-design* is the phase where the service is designed collaboratively, while *co-delivery* is the phase where the co-designed service is implemented and delivered collaboratively. Both phases are essential for successful co-production of public services, as they ensure that the service is co-designed to meet the needs of service users, and then co-delivered in a way that is responsive and equitable [2].

Co-delivery is a critical aspect of co-production processes since it tackles the sustainability and replicability of the service [3] and thus contributes to the long-term success and impact of the service. If co-delivery is effective, e.g. through continuous training, staffing, monitoring and evaluation, it can contribute to the sustainability of the service by ensuring that the service is delivered efficiently and effectively over time. Additionally, effective co-delivery can contribute to the replicability of the service by ensuring that the service can be adapted and adopted in different contexts or locations. For example, documenting the service delivery model or sharing best practices learned to support other organizations or communities interested in replicating the service.

The INTERLINK H2020 project [4] has been designed to overcome the barriers that hinder administrations to reuse and share services with private partners (including citizens), by providing a bespoke digital Collaborative Environment. This environment is devised to support the process of co-production of public services and incorporates a conceptual framework that consists of 2 main phases and 4 sub-phases, as outlined in [5]. Thus, INTERLINK has defined a *four sub-phase co-production process* [5] (see Fig. 1) to be followed by *co-producers* (see Fig. 1): a) *co-design phase* which entails two sub-phases: *engagement* and *design*; and b) *co-delivery phase* entailing *build* and *sustain* sub-phases.

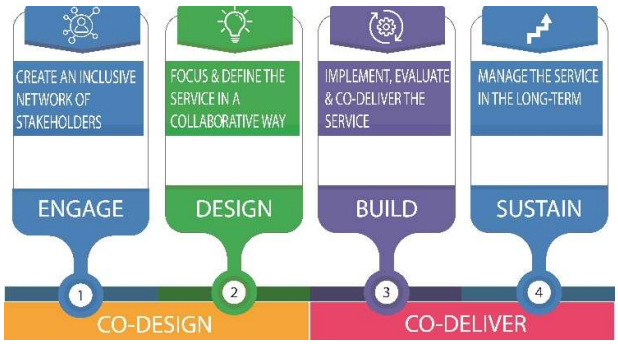

Fig. 1. Generic co-production model in INTERLINK.

This paper reflects on the results of piloting INTERLINK in 3 pan-European pilots where the platform has been used to co-produce 3 different public services. In the first round of system usage (iteration 1), the focus of the project was on supporting *engage*, *design*, and *build* sub-phases. A second version of the INTERLINK collaborative environment is currently under way which aims to approach the challenging but most needed sub-phase of co-delivery, namely *sustain*, not been tackled by previous research efforts. Consequently, this paper describes, in section 2, the state of the art in co-production environments. Section 3 summarizes the features of the Collaborative Environment component produced to streamline, make feasible and viable the co-production of public services and assessed. Section 4 describes the evaluation strategy and results of the first piloting iteration. Section 5 reflects on the results gathered and summarizes the innovations realized to tackle co-delivery. Finally, section 6 concludes the paper and draws future work insights.

II. Related Work

Co-design and collaboration tools are important enablers of co-production processes, as they help service providers and service users to work together in the design, delivery, and evaluation of public services. Beside, digital tools can facilitate new connections within the community, establishing relationships not possible before by overcoming problems of geographical dispersion of users, and empowering individuals by facilitating the sharing of sovereignty and responsibilities when it comes to service co-design [6].

Collaborative platforms can aid in co-design and co-delivery efforts by providing communication tools like messaging systems, discussion forums, and video conferencing that allow stakeholders to communicate and establish a shared understanding of the problem, establish goals, and resolve conflicts. Research has shown that for collaborative initiatives to be effectively supported digitally, key factors include coordination, continued engagement, access to open data, and shared information [7]. Some widely used tools in this regard are: Miro [8] – a virtual whiteboard platform that enables collaborative brainstorming and diagramming; Trello [9]– an online project management tool to manage and track the progress of co-production projects; Figma [10]– a design tool to support the co-design process by providing frameworks, templates, and guidance for service design or Microsoft Teams [11], Podio [18] or Notion.so [20] – communication and collaboration tools for virtual collaboration, file sharing, and task management between service providers and service users. However, the flexibility and freedom of use of these tools come at the expense of guidance. What is missing is an explicit operationalization of the whole co-production process.

In INTERLINK, a Collaborative Work Environments (CWE) has been designed to support the whole co-production life-cycle, including functionalities for 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 from the above-mentioned commercial tools on its co-production centric and reusability driving approach leveraged on the *INTERLINKER* concept – 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. Indeed, INTERLINK's Collaborative Environment goes beyond collaboration, since it focuses on holistically support co-production, spanning all phases from engagement to sustainability. In fact, its most distinguishable feature is that it tackles co-delivery from the start, trying, at the same time, to promote replicability and sustainability. This is the focus of this article.

III. INTERLINK Collaborative Environment

INTERLINK's CWE is 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 process management*; b) *guide for co-production process*; c) *recommendation of INTERLINKERs* most suitable to the problem domain represented by the chosen co-production task; d) selection and *registry of use* of INTERLINKERs (displaying result of using the enabler, e.g. instantiation of a Business Plan) and e) INTERLINKER *catalogue to promote reuse* of publicly available enablers for co-production as showcased in Fig. 2.

An assortment of co-production INTERLINKERs has been created to provide functionality useful in many co-production contexts, e.g.: a) *interlinker-googledrive* to deal with office like documents; b) *interlinker-survey* to design and host answers for surveys; or c) *description augmenter* to annotate web pages. All those software enablers leverage on a common API defined by the collaborative environment to ease integration, previously reported in [5]. On the other hand, several knowledge INTERLINKERs have been defined, e.g. Stakeholder Mapping Canvas, Use Case Scenarios or Business Model Canvas templates, created declaratively by means of a JSON schema. Likewise, co-production schemas can be declared in JSON which are tuned to the specifics of a co-production process, e.g. a Hackathon organization and celebration, co-refinement of public service descriptions or co-refection and collaborative re-design of an existing solution (app, tool or service). As an illustration, Fig. 3 shows how the same INTERLINKER for similar purpose tasks has been recommended and selected. Observe in Fig. 3. how the generic *build* sub-phase (at the top) is replaced in the custom hackathon's co-production tree (below) by a *run* sub-phase, with different composing objectives and tasks. Besides, co-production processes can be customized (adding, modifying and removing phases, objectives and phases to a process) clicking on the "+" sign following the right most phase name.

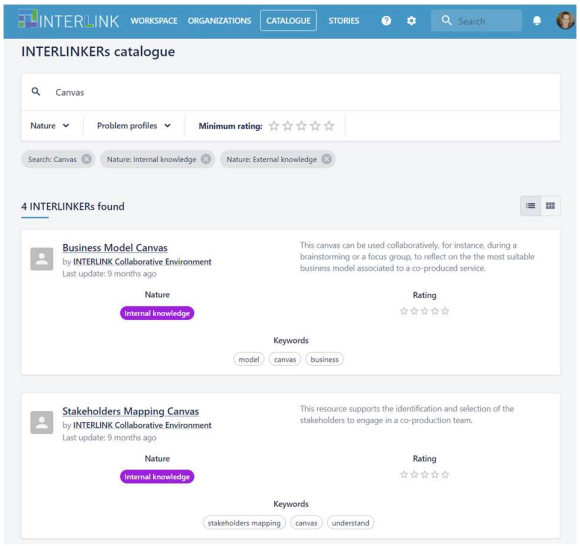

Fig. 2. INTERLINK catalogue.

IV. Evaluation & Assessment

INTERLINK has been evaluated during iteration 1 (April to September 2022) in 3 cross-European pilots by co-producing three new public services. Firstly, in the Ministry of Economy and Finance - Italy (MEF) – a mock-up of a Participatory Strategic Planning Module (called PSPM) has been co-produced which allows Public Bodies and their staff to actively participate in the definition of the Strategic Plans. Secondly, at VARAM, the Ministry of Environmental Protection and Regional Development of the Republic of Latvia and its Latvian State Portal (a portal that provides easy access to services delivered by state and local government institutions), portal descriptions have been co-refined so that the public services published are increasingly adopted. Thirdly, at Zaragoza city (ZGZ) and its Center for Art and Technology (eTOPIA), the aim has been to promote collaborative city-making through organization of activities and programs for promoting Open Innovation.

A. Overall evaluation strategy

The motivation for the planning and execution of pilots in INTERLINK has been to assess whether the co-production model and supporting tools and co-produced assets put forward by the project have the potential to enhance the quality, quantity, and reuse of public services among

European public administrations (PAs). For that, INTERLINK has evaluated the usability, acceptability, and adoption of the Collaborative Environment as a key enabler for the co-design and co-delivery of public services. The following *global goals* have driven the evaluation process:

- *A. INTERLINK USE and CO-PRODUCTION of SERVICES*. It considers the number of INTERLINKERs in use, stakeholders involved during the pilot experiments, as well as the co-production of services enabled by INTERLINK, which correspond to the global key performance indicators (KPIs) specified in the project objectives and their targets.
- *B. THE VALUE PROVIDED by INTERLINK*. It measures the value improvements provided by INTERLINK. It addresses the following aspects: a) INTERLINK decreases the PA's administrative and management costs; b) INTERLINK increases the number and quality of co-produced initiatives; c) INTERLINK increases the participation of citizens and private entities in the co-delivery of services.
- *C. THE USERS' PERCEPTIONS of INTERLINK*. It addresses users' perceptions regarding acceptance, usability, and trust.

Besides, *pilot-specific goals* have been defined:

- *D. PILOT SPECIFIC KPIs*. It considers key indicators that are custom made at each pilot site.

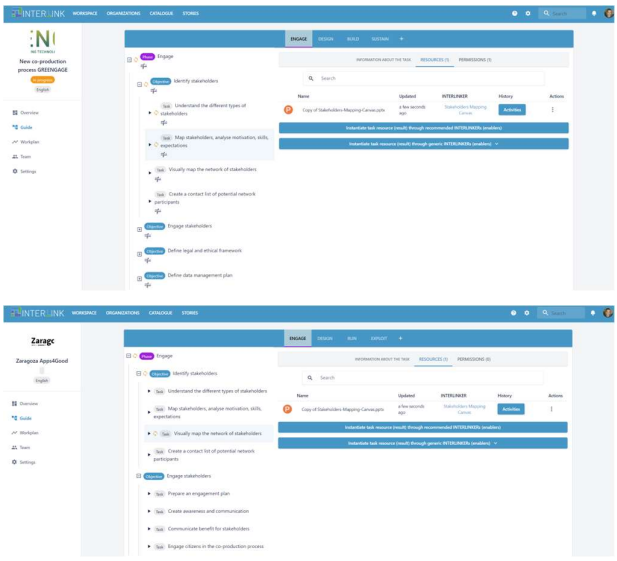

Fig. 3. Comparison of INTERLINK ENGAGE stage in 2 different co-production projects and INTERLINKER recommendation.

Our evaluation hypothesis has been that a high quality assurance of the co-production process should drive a high adoption rate of the INTERLINK co-production approach. Hence, we have modelled quality in co-production based on the dimensions shown in Fig. 4 [12]:

- *Product quality*: based on ISO/IEC 25010:2011 [13] quality model, indicates the degree to which a particular product conforms to its specification.
- *User-based quality*: based again on ISO/IEC 25010:2011 [13] quality model, it means that the attributes of a product meet the customer's requirements.
- *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).

To calculate these evaluation dimensions, a longitudinal study has been carried out where technical tests, logs and questionnaires customized to different stakeholders have been used to determine the quality associated with the INTERLINK co-production model and artefacts.

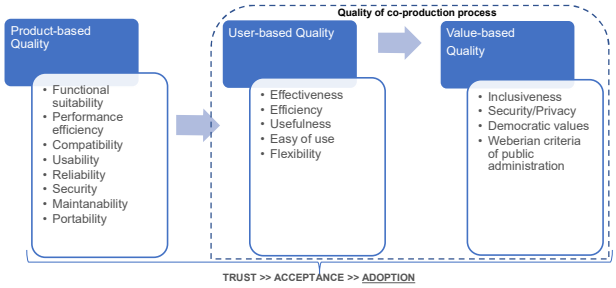

Fig. 4. INTERLINK quality-assurance and evaluation dimensions.

B. *Qualitative measures*

Qualitative data has been gathered during pre-evaluation, evaluation, and post-evaluation sessions. In pre-evaluation, *thinking aloud evaluations* with end-users (verbalization of users' interaction with INTERLINK) and *Heuristic evaluations* to gather the feedback of experts on usability, were used. Besides, *cross-testing sessions* involving INTERLINK consortium members and a set of alpha testers (5 to 10 people) from each pilot, were used to test the functionality provided by INTERLINK. Testers filled in an alpha questionnaire to report any issues identified during script-driven testing sessions.

For mid-evaluation sessions and post-evaluation sessions, on one hand, *interviews with end-users* around the following three aspects were carried out: a) What did work well?; b) What did not work well?; and c) Other suggestions for improvement of the INTERLINK co-production approach?. On the other hand, INTERLINK tools and services were instrumented with short online questionnaires (in-app questionnaires) that allowed to get quick feedback from users about a given public service, INTERLINKER or collaborative environment (N=27).

C. *Quantitative measures*

Quantitative data have been gathered through different KPIs and measures organized by the earlier mentioned evaluation goals. Such KPIs covered *global* aspects and *local* KPIs and measures, associated to specific pilots. On one hand, a *questionnaire* for co-producers and users or co-produced artefacts was used to explore usability, trust, and acceptance, and, hence, deduce the adoption of INTERLINK proposed co-production process and artefacts (N=88 respondents). Such questionnaire calculates the degree of adoption of INTERLINK by analysing the usability, user experience, trust and acceptability of its co-production supporting tools. It is targeted to different stakeholders (public administration, businesses, citizens, and developers). Statistical analysis of the answers collected was performed to be able to gain insights. In fact, the following formula was proposed to

measure quality in co-production: `QoS co-production = AVG (user-based quality; value-based quality; satisfaction; trust; acceptance)`, where `User-based quality = AVG(Effectiveness, Efficiency, Usefulness, Ease of Use, Flexibility)` and `Value-based quality = AVG(Inclusiveness, Security/Privacy, Democratic values, Weberian criteria)`. For each dimension, a couple of 5-point Likert scale questions were included.

On the other hand, *data logs* and *data model entries* were 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 and queries allowed us to gain insights about the success of the co-produced apps in the pilots and populate the KPIs of the project.

D. Automatic KPI calculation

Given the richness of the evaluation dimensions and the possible complexity for pilot owners to distil related KPIs manually from the diverse set of qualitative and quantitative measures, two mechanisms to automatically gather KPI values for each of the pilots were created:

- A spreadsheet, updated every hour, was generated with shows the latest values for the KPIs (belonging to the evaluation goals "A. INTERLINK USE and CO-PRODUCTION of SERVICES" and "B. THE VALUE PROVIDED BY INTERLINK") that can be automatically gathered by formulating queries to the databases of the project, namely Catalogue and Co-production services relational databases. Besides, we also gathered logs every time a user interacts with the Collaborative Environment. Those logs go to an ElasticSearch database[10]. Thanks to the Dremio Community Edition [11] tool we have been able to issue cross-database SQL queries and joins so that data in the two relational and the logs document-oriented one can be correlated. A Python script issues the queries posted to Dremio to calculate the KPIs.
- The collection of KPI values for KPIs of category "C. The Users' Perceptions of INTERLINK" has been realized through a second spreadsheet, which goes through the evaluation questionnaires completed at each pilot. The spreadsheet through a bespoke script, developed in Apps Script [14], retrieves all the files with answers to questionnaires and calculates the different operands of the QoS co-production formula earlier shown.

E. Evaluation results in iteration 1

Fig. 5 shows the pilots evaluation process for iteration 1. Departing from the *alpha version* of the platform, the pre-pilot execution subphase was executed, delivering the *beta release* of the solution. From the beta release the pilot execution subphase was carried out delivering *release 1* of the platform. As observed in Fig. 5, different evaluation techniques were applied with the collaboration of *alpha testers*, a controlled group of users during the pre-pilot execution subphase, and *beta testers*, a wider open group of stakeholders during the pilot execution subphase, to increasingly improve the INTERLINK co-production model and its associated supporting tools, and, at the same time, evaluate the value delivered by this co-production enabling platform.

Overall, in the pre-pilot execution subphase the emphasis was on usability and robustness, while in the execution sub-phase the focus was on understanding whether the co-production models integrated in the platform and the supporting tools, supported pilots to accomplish co-production processes successfully or not.

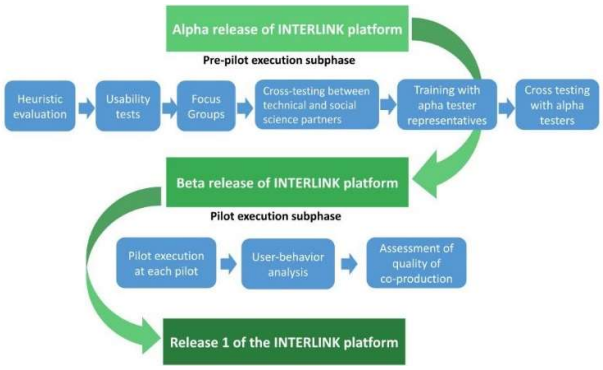

Fig. 5. Evaluation process in INTERLINK's iteration 1.

The main outcome of the pre-pilot execution subphase was the usability enhancements conducted over the Collaborative Environment and the refinement of the measurement mechanisms put in place to evaluate INTERLINK, as result of pilots' feedback. In fact, a list of more than 30 issues were compiled combining the reflections produced by the heuristic analysis, usability tests, cross-testing sessions with pilots' sites and interviews with experts on governance aspects. Likewise, this sub-phase was used to refine the logs issued by the platform, the evaluation questionnaires and developing the automatic KPI population script which exploits platform's logs, questionnaires, and its underlying Data Model.

The bottom blue part of Fig. 5 depicts the pilot execution subphase of iteration 1. Each of the pilots was equipped with a deployment of a refined INTERLINK Collaborative Environment (beta release), customized to the pilot specific domain and language, and populated with the relevant INTERLINKERs. In this sub-phase pilot owners arranged a set of activities conducted towards meeting the objectives at each pilot, e.g. training sessions with beta testers, workshops to co-refine a given service description in VARAM pilot and so on. The final release of the Collaborative Environment and associated evaluation tools at the end of iteration 1 was published at GitHub (https://github.com/interlink-project). In this second subphase, all pilots corroborated that the INTERLINK co-production model and supporting tools do help them towards better quality, resource, and effort efficiency in co-production of public services.

Indeed, favourable evidence in the form of compliance with KPIs defined to meet evaluation goal "A. INTERLINK USE and CO-PRODUCTION of SERVICES" were gathered, e.g. 62 INTERLINKERs were published or 213 users registered with the system. Besides, favourable user perceptions regarding "B. THE VALUE PROVIDED by INTERLINK" evaluation goal were also gathered. Although it was unfeasible to demonstrate whether INTERLINK reduces the costs of developing public services (it is hard to define the average cost of a public service), it was possible to demonstrate that through INTERLINK higher interest and

number of co-produced initiatives has been obtained. Besides, in the co-production of the devised services, participation of citizens and private entities has been increased, as most of the pilot cities had not considered co-production before. Finally, the evaluation goal "C. THE USERS' PERCEPTIONS of INTERLINK", was met given the high levels of acceptance, usability, and trust found among pilot participants. The achieved QoS values per pilot are very encouraging, overall, 3.79/5,0, and a moderate acceptance level perception, 3.24/5, have been obtained. Hence, we can conclude that a wide adoption of INTERLINK can be expected. Nevertheless, our results cannot be categorized as conclusive given the small sample size, only answers from 53 coproducers and 35 end users were considered in September 2023 to analyse their co-production experience in INTERLINK.

F. *Post-pilot reflection sub-phase evaluation*

A post-pilot reflection questionnaire was structured around themes that relate to how end-users of the Collaborative Environment interacted with the technology to organize their co-production processes and what perception they had about workflows and other stakeholders' engagement with the platform. As result of this reflection process the following main conclusions were obtained:

- A *facelift of the GUI* of the Collaborative Environment, including *better contextual information*, is needed to reinforce acceptance. Better, easier and more effective team member management is needed, e.g. allow the creation of teams from CSVs rather than inputting members one by one.
- Team members entering in a co-production process should be aware about what other team members and themselves have performed over a co-production process. There is a need to follow the *activity timeline of the project*.
- *Long-term engagement in co-production processes* requires that individual team member contributions are measured and valued. Only reinforcing accountability it would be possible to consider the future adoption of exploitation plans for co-produced artefacts.
- *Replicability of co-production processes needs to be promoted*. Consolidated successful co-production processes should be made available and allow third parties to instantiate new co-production processes based on those successful experiences.

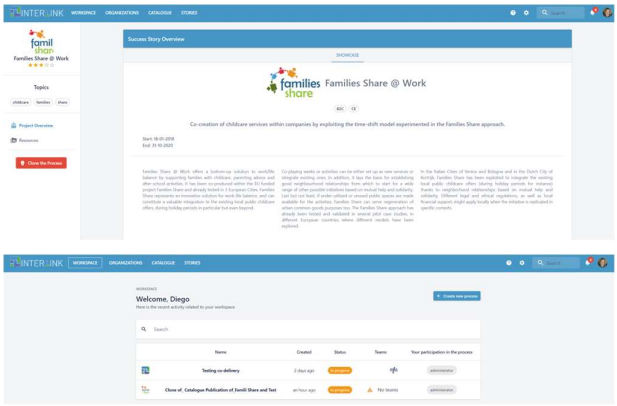

Fig. 6. Instantiation of a co-production process based on a success story.

V. TACKLING CO-DELIVERY: REPLICATION & SUSTAINABILITY

As result of the post iteration 1 reflection, the need to reinforce *replicability* was made clear, i.e., it should be able to share success stories and to use them to bootstrap new processes. Besides, the need to reinforce *sustainability* was evident, INTERLINK has to portray progress in co-production processes and acknowledge team member contributions.

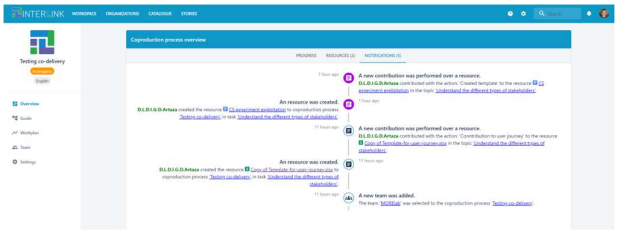

Fig. 7. Activity timeline in co-production process.

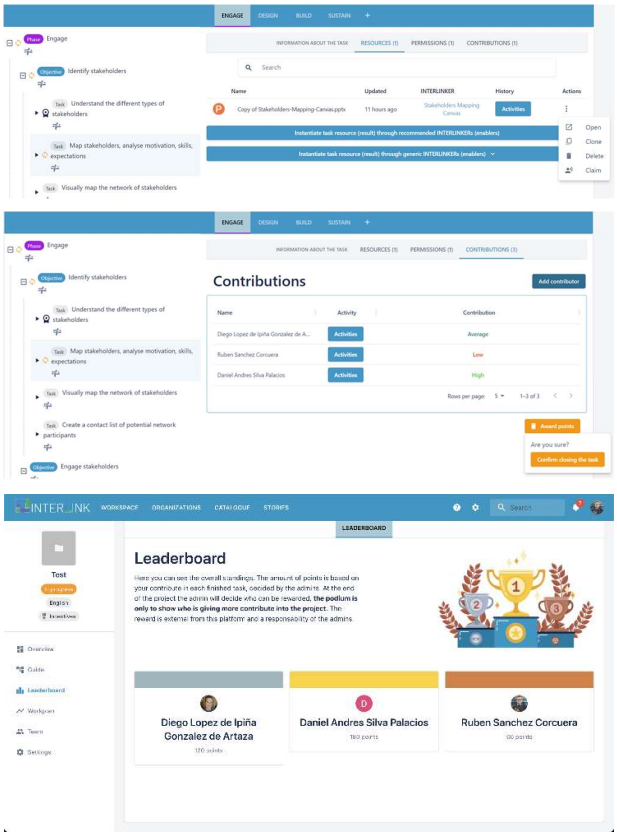

Fig. 8. Contribution claim, validation and visualization in leaderboard.

A. *Replicability*

The following features have been added to the Collaborative Environment to promote replicability:

- *Process cloning* – so that a new co-production process can be created based on an existing one. Only valid for own processes, it is useful for teams that want to reuse processes where they participated previously.
- *Success story publication* – based on a previously cloned process, after pruning the tree if needed and cleaned up confidential resources, a given process may be ready for public availability.

- *Cloning from success story* – given a success story, you may start cloning a process. This might be interesting to allow third parties to leverage from the co-production efforts of other teams for envisaged artefacts/results of similar nature.

Fig. 6 shows at the top the STORIES view where success cases are published. Notice that a story includes not only a co-production process, but further metainformation to make it useful, e.g. objectives, lessons learnt, materials generated or license. At the bottom, it shows the newly instantiated process once the cloning is completed.

B. Sustainability

The Collaborative Environment has been integrated with a Gamification Engine [15]. The idea is to be able to account what each member of the team contributes with and, hence, acknowledge the contribution of each team member in the whole co-production process and its composing tasks, by providing a board of points. For this integration, the following additional functionalities have been added:

- *Activity timeline* – the Collaborative Environment has been improved to be able to see what the team has done over a process or what everyone has contributed with for the whole process (see Fig. 7) or a single task.
- *Contribution claim and validation* – team members can now claim what they have done over resources of a tasks. On the other hand, process admins may validate the team members contributions. The platform calculates the contribution of a user in each task based on the complexity of the task and the level of contribution of the user in that task, calculated based on the individual contributions against total contributions. Once a given task contributions are validated, it is closed and point calculations realized. A central leader board showcases the contributions, valued as points calculated by the underlying gamification engine, for the different team members.

Fig. 8 shows in the top screenshot how a user may decide to claim her contribution and introduce its details. The middle snapshot illustrates how a process admin may add new contributors (button "Add contributor"), may change the pre-calculated contribution level and confirm it so that the underlying Gamification Engine can compute the points corresponding to each contributor. Fig. 8's bottom snapshot shows the process contributors' leader board.

VI. Conclusion and Further Work

Since INTERLINK collaborative environment v1 was released in September 2022, several new features, as result of iteration 1's evaluation results, have been added: a) modification of the co-production tree by process admins; b) add teams to a whole process; c) ease the creation of teams, allowing contact details import from CSV file; d) notification functionality to allow updates in a given co-production process to be seen by different team members; e) allow users to claim contributions over a task and to be granted points according to their relative contribution by a Gamification Engine; and f) publication of success stories from cloned and cleaned successful co-production processes, allowing instantiation of new processes from them.

INTERLINK has been successfully evaluated in iteration 1 in the mentioned pilots. The pilots' evaluation strategy resulted effective and drove us to devise the mentioned set of new features. Particularly, those promoting CO-DELIVERY will be thoroughly tested in iteration 2. Indeed, future work will seek to better understand how INTERLINK can support co-delivery, how different gamification/rewarding strategies may be adopted depending on the nature of the co-production process. For that, it will depart from this paper's contributions towards promoting replicability and sustainability. The results at the end of iteration 1 indicate, although not conclusively, that INTERLINK might be in the right way towards democratizing co-production of sustainable and more widely acceptable public services. Still, it is expected that iteration 2 will demonstrate how it is feasible to fully realize co-delivery to more widely adopt co-production.

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