

Supporting Internet of Things Activities on Innovation Ecosystems

H2020 – UNIFY-IoT Project

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White Paper on recommendations for societal and educational aspects and value co-creation mechanisms sustainability

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DoW	<p>This deliverable is an outcome of Task 04.03 Analysis and recommendations This task aimed at assessing the outputs of activities undertaken in task T4.2 and especially the efficiency, relevance and sustainability of value co-creation mechanisms. It evaluates good practices and propose recommendations and roadmaps to ensure long-term sustainability of the educational platform and of its mechanisms of value co-creation.</p> <p>The task will be done during the last 6 months of the project after having experimenting value co-creation mechanisms related to societal awareness and education. The analyses will include:</p> <ul style="list-style-type: none"> • Best practices analysis • Roadmap for co-creation mechanisms sustainability and roadmap for educational platform sustainability 		
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1. EXECUTIVE SUMMARY

1.1 Publishable summary

The UNIFY-IoT objectives are to stimulate the collaboration between IoT projects, between the different IoT platforms and support these in sustaining the IoT ecosystems developed by focusing on complementary actions, e.g., fostering and stimulating acceptance of IoT technology as well as the means to understand and overcome obstacles for deployment and value creation.

As such, UNIFY-IoT stakeholders developed, throughout the project, various tools and methodologies that notably paved the way for two major achievements: IoT-EPI value co-creation mechanisms and the Open Education Platform. Both these thematic were developed within the frame of Task Forces in which multiple stakeholders were involved.

This White Paper set the framework for the continuation of both Task Forces' outcomes beyond UNIFY-IoT project, notably through the interactions with the Large-Scale Pilot Programme launched by the European Commission.

1.2 Non-publishable information

This document's dissemination level is public. In parallel to this deliverable, technical information (specifications) from the web solutions developed by Unify-IoT partners are provided in an annex to relevant stakeholders.

2. INTRODUCTION

2.1 Purpose and target groups

This deliverable gathers the outcomes from Unify-IoT project achievements on two major axes developed throughout its activities: value co-creation mechanisms, and social and education. It aims at evaluating good practices and propose recommendations through ‘roadmaps’ to ensure notably the long-term sustainability of the educational platform and of its mechanisms of value co-creation.

The purpose of this document is to identify the best practices and set up the framework for the continuation of the efforts made by IoT-EPI projects beyond the lifetime of UNIFY-IoT project. It builds upon the discussions and activities having taken place within IoT-EPI Task Forces, notably the Value Co-Creation Task Force and the Task Force Education (TFE) which were composed of members from the RIA projects and managed by UNIFY-IoT partners.

This white paper is to be disseminated to EC officials as well as IERC and AIOTI working groups for further extending the developments of the project and platforms over time.

2.2 Contributions of partners

INNO coordinated the task activities and set the frame for developments over the white paper, contributing to societal and educational aspects

ISMB developed to the roadmap for value co-creation mechanisms, based on its development within the value co-creation taskforce

HIT developed the sections over IoT-EPI Task Force Education outcomes and the roadmap for societal and educational aspects

2.3 Relations to other activities in the project

This deliverable is encompassing outputs from WP4 and WP1 developments. The roadmaps being strongly linked to Unify-IoT follow-up initiatives and projects, WP6 leader was also involved in the mapping of outcomes included in both.

3. ROADMAP FOR EDUCATIONAL PLATFORM SUSTAINABILITY

3.1 Unify-IoT developments tackling social, societal and educational aspects

3.1.1 Dissemination efforts from IoT-EPI stakeholders for tackling social and societal awareness of IoT

For developing the roadmap for a sustainable impact of IoT-EPI works on social and societal awareness of the IoT ecosystem, INNO performed an analysis of RIAs' dissemination strategies through – part – of a survey disseminated among RIAs stakeholders. The survey aiming at “identifying the challenges and proposing remedies for increasing end-users' acceptance and fostering specific education in IoT” was launched on 21/06/2017 and stopped on 03/07/2017. Following analysis is extracted from the information provided by 93 respondents who took the survey (17 having left the survey before the second question), among which 67 indicated being part of one of the RIAs from the IoT-EPI community. IoT-EPI RIA projects have multiple communication channels and targets, from mobilising potential applicants from open calls to disseminating publications. Most of these communication efforts were, however, targeting public. H2020 format is of course a substantial reason for that trend, but the level of these efforts (almost one-third of the communication is towards general public) is quite high, regardless of the programme's incentives.



Figure 1: RIAs' dissemination contents

Technical parameters associated to IoT being relatively complex in the frame of the solutions developed through these projects, the dissemination towards general public can only be limited. This infringes on the messaging possible towards a non-specialised audience that is not ready to confer more time than necessary on a complex topic.

This is illustrated in the survey by the fact that the ‘satisfaction level’ of RIAs with regard to the feedbacks they received on their communication efforts is substantially lower when these efforts were targeting general public in comparison to “experts” target groups. As such, the question of vulgarisation is of essential importance here. Developing impacting messages for the general public is key for addressing the challenge set by the complexity. Indeed, the major factor for adoption of IoT solutions by end-users is linked to the understanding of the technology, over

legacy and security¹. It is to be noted that, according to certain literature on the impact of security awareness of IoT solutions by the end-users, the correlation between security consideration and adoptions is deemed as ‘weak’². In other words, despite acknowledging that privacy is a parameter of importance for end-users, this parameter does not prime over efficiency considerations. Users do tend to trade security and privacy for convenience. RIAs are also inclined to promote their developments towards developers, notably through the ‘Open Call’ strategy implemented in several RIAs focusing on platform development and testing, most projects offering real-life scenarios or environments.

3.1.2 IoT education challenges

As presented in previous UNIFY-IoT deliverables, the OEP was the central hub for discussions among IoT-EPI RIAs’ stakeholders upon IoT education challenges. The London task force meeting was the second workshop delivering suggestions for analysis and future OEP development. Three key issues have been discussed:

- OEP use cases;
- Suggestions for future developments and sustainability strategies related to marketing approach and community management

In particular RIAs members and UNIFY partners suggested some changes in the UX related to the first released platform to make the platform a tool to:

- Individual training
- Start-up training
- Collecting materials and resources for summer schools and
- Community engagement.

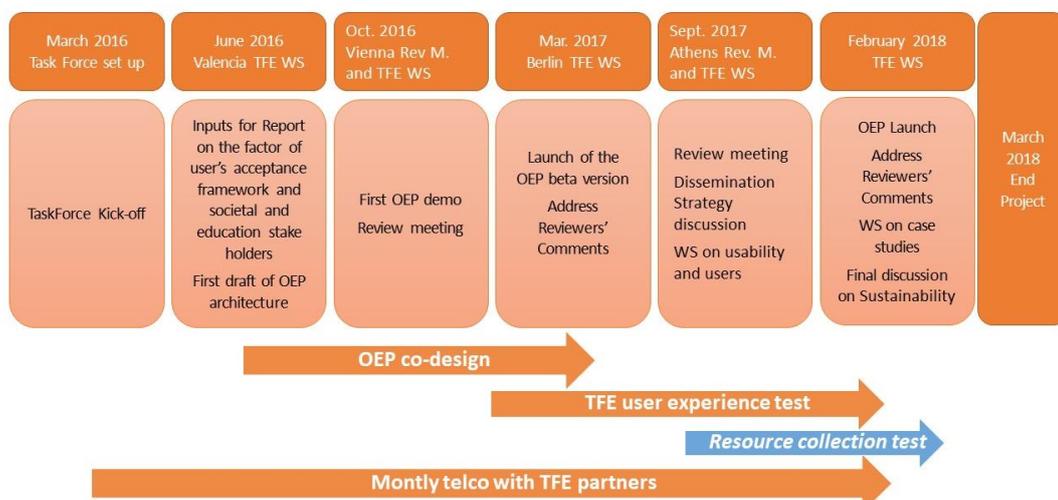


Figure 2: Task Force Education approach

3.2 Best practices identified

Discussions throughout the meetings of the TFE enabled identifying the best practices that have been and / or could be implemented on the OEP in next developments.

¹ <http://www.ironpaper.com/webintel/articles/internet-of-things-market-analysis-statistics-on-the-iot-opportunity/>

² <https://search.proquest.com/openview/473cbff993e6291f217d64af59234949/1.pdf?pq-origsite=gscholar&cbl=18750&diss=y>

3.2.1 At academic level

- Add complementary high-level contents (i.e. ‘green labelled’ publications from universities): by linking publications to the platform, researchers can gain additional notoriety and thus increase the number of citations, given that these publications are following Open Access ‘green’ access to publications
- Linking to research gate rating: Coupling Researchgate³ profile to OEP ones when registering as teachers on the platform could provide academics with incentives to be more active on the platform. Indeed, e-reputation being key for these stakeholders, the coupling of OEP activities with Researchgate ranking would incentivise the use of both websites
- Rating of teachers: Enabling the development of ‘IoT teachers of Excellence’ through the rating of their responses / the courses provided on the OEP can constitute another lever for mobilising academics and teachers.
- Link to the MOOC courses can help universities in the students recruiting process and develop links with Universities events

3.2.2 At company level

- Foster Education within companies: Enabling knowledge transfer from developers to market units is to be at the core of the OEP for companies. Experience shows that the linking from scientific to company education wise is complex. However, the OEP should serve by supporting the internal developments and learning within companies by providing the tools necessary for building common understanding
- Provide SMEs developing solutions in the field of IoT with courses enabling them to expand their works towards other topics, such as blockchain technologies and / or interoperability.
- Consulting facilitation: consultants are enabled to use the platform for providing their clients with updated information from the IoT field

3.2.3 At ‘general public’ level

- Develop integrated ‘courses’ or ‘journeys’ based on the contents of the platform. the principle is here to associate an ensemble of progressively specialised contents available on the platform to a defined topic, thus enabling a visitor to get an ensemble of progressive contents on one of IoT thematic
- Develop territorialised content: define silos of content based on the city / regions these are taken place: having a territorialised approach of educative contents may inspire the local stakeholders in further developing their competencies

3.3 Roadmap for OEP sustainability

Continuity within the IoT-EPI environment is a challenge that was discussed at various occasions within the TFE. All TFE members are convinced the OEP should exist beyond the lifetime of the UNIFY-IoT project as well as the IoT-EPI RIAs. Thus, several scenarios were discussed within the TFE for continuing the efforts and developments sets within the taskforce, and notably the Open Education Platform structure and contents:

3.3.1 Development / updating of the platform from one of the TFE member

During meetings with members of the TFE, the question of one of the RIA partners taking over the OEP was raised. Two TFE meetings contained items dedicated to the workload associated with

³ www.researchgate.net

the maintenance, monitoring and growth of the TFE. As such, the task force management team set an estimate per development scenarios over the efforts to be produced both on technical aspects and on community / content management aspects based on their experience with the OEP developments (see Table 1).

Table 1: OEP management Person Month estimate

Scenario	Technical maintenance	Content management
Minimal investment (validation of contents; technical maintenance)	0,25 PM	0,5 PM
“Business as usual” development (communication; community management; technical improvements)	0,5 PM	1 PM
Strong investment (community building; linking with key international stakeholders; adding platform features)	1 PM	1 PM

Discussions with the IoT-EPI partners revolved around these scenarios, setting the framework for each partner for considering their potential investment for such tasks.

As previously mentioned, content management structure was updated in line with the different experiences and discussions during TFE telco & meetings, so the actual process for validating contents do not require multiple stakeholders, thus facilitating its sustainability.

3.3.2 Integration of the TFE to EU platforms

An option explored in the first developments of the platform, the integration of the OEP to one of the tools monitored by a European Commission organism.

Discussions with the DG CONNECT with the possibility to take over the sustaining of the platform were opened as its approach fits the Digital Skills and Jobs Coalition ⁴initiative supported by the EC. According to initial contacts, the DG Connect would be very interested in knowing what the TFE do with the OEP and the opportunity it can offer in terms of dissemination. Such interaction with DG Connect was also with the objective of helping the OEP in terms of increasing both: the potential sources of education content and followers.

However, the discussions weren't yet successful and remain on standby as no agreement was set between the stakeholders in charge of the platform management and European organisms. These discussions will be pursued by the institution in charge of the OEP development beyond UNIFY-IoT.

3.3.3 Transmitting the OEP to the large-scale pilot project

The scope of IoT European Large-Scale Pilots Programme is to foster the deployment of IoT solutions in Europe through integration of advanced IoT technologies across the value chain, demonstration of multiple IoT applications at scale and in a usage context, and as close as possible to operational conditions.

As such, this initiative was deemed as interesting by TFE members for providing a fitting framework for the OEP endeavours. Discussions with Create IoT management team were taken (with notably SINTEF as entry point to the LSP partnership).

⁴ <https://ec.europa.eu/digital-single-market/digital-skills-jobs-coalition>

The OEP could be transferred for ensuring its sustainability. However, this would also raise the question of sustainability on longer terms, since the durability of this solution is equivalent to the life time of the LSP projects.

The framework conferred by LSP Action Groups does nonetheless dispatch education-related contents across the various thematic tackled, thus risks are that these contents are diluted between the different organisms. At the same time, the OEP would also provide a common ground for fostering the interactions on education-related topics, given that few adaptations are made.

3.3.4 Submitting a project dedicated to the development of the OEP

As the developments of the OEP and communities' involvements proved to be positive throughout the TFE developments, discussions over European programmes' opportunities such as H2020, EIT Digital KIC or ERASMUS + were regarded as a possible lever for deepening the platform strategy and ensure its financing over next period.

4. ROADMAP FOR VALUE CO-CREATION MECHANISMS SUSTAINABILITY

4.1 Value co-creation mechanisms developed with the IoT-EPI community

Value co-creation is key enabler for involving a variety of heterogeneous yet complementary IoT stakeholders (from large-scale companies to SMEs, passing through end users, governmental bodies and NGOs) into the open innovation ecosystems. This principle materializes in the uptake of integrated IoT offerings harnessing a common technological infrastructure and a set of capabilities and resources provided by several actors. These solutions try to answer to market needs (e.g. requirements of project's users and customers) and/or societal challenges (e.g., environmental and social priorities at the core of the EU policy agenda) while democratizing the access to IoT-related know-how (e.g. through Open Education Platforms).

To promote an innovative value co-creation approach, the UNIFY-IoT project developed a value co-creation framework that was defined together with the IoT-EPI community. Such framework can be considered a handy toolkit that the consortium has made available to IoT-EPI projects and relevant stakeholders, and in general to IoT professionals to support the co-design of IoT joint developments. The toolkit embraces a design-thinking inspired approach aimed at a practical, creative resolution of problems and creation of solutions, leveraging an agile mindset and an iterative *modus operandi* based on the rapid prototyping of self-contained, intermediate solutions.

Within the developed framework, The UNIFY-IoT project identified a set of value co-creation mechanisms that are of great relevance to the IoT-EPI projects community. Figure 3 shows a summary of such mechanisms classified in strategical technological and non-technological choices according to their nature.

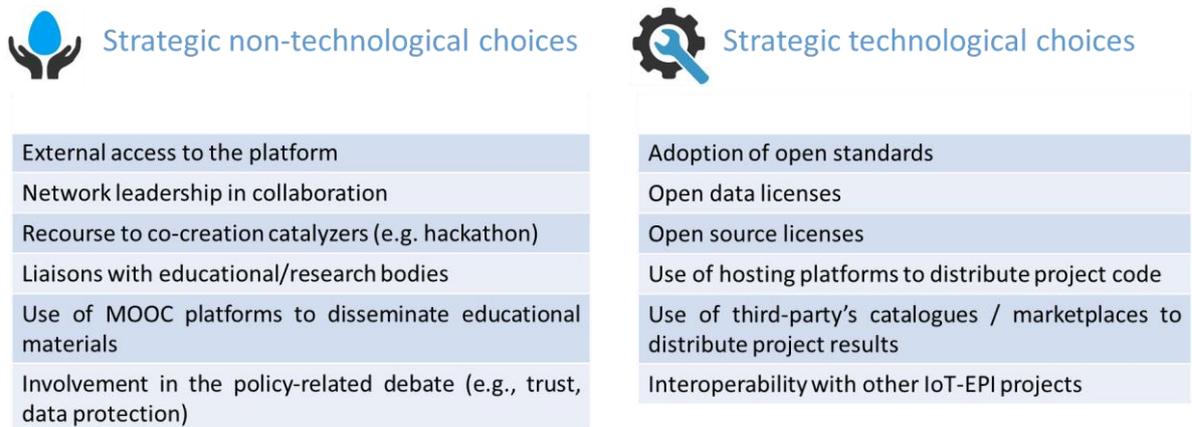


Figure 3: Strategic technological and non-technological choices for value co-creation in IoT-EPI projects

The value co-creation framework was continuously updated during the UNIFY-IoT project lifespan, refining its concept through inputs gathered from questionnaires and hands-on workshops carried-out with the IoT-EPI projects.

A methodology and tools to implement the IoT value co-creation framework were also defined and shared with the IoT-EPI community, which reflected the changes in the IoT value co-creation system based on new IoT business models' framework, evolving from product value to network value, providing strategy in relation to the entire value IoT ecosystem.

All three, the framework, methodology and tools defined within the context of UNIFY-IoT project were designed applying a co-creation approach, both involving the UNIFY-IoT consortium and the IoT-EPI projects’ community. This allowed to identify both the best practices and the obstacles that projects came across when implementing the proposed approach.

Since early phases of UNIFY-IoT, the consortium gathered useful insights from the IoT-EPI projects regarding the understanding and implementation of value co-creation approaches. In the following paragraphs, some of the most important results from the UNIFY-IoT activities to foster value co-creation will be presented.

From the first questionnaire distributed among IoT-EPI projects (June 2016), at a project level, roughly half of the IoT-EPI projects declared that they were implementing -or planning to implement- value co-creation mechanisms or approaches as innovation drivers.

The majority of IoT-EPI projects planned to deliver Open-APIs as part of their results, where 80% of the projects will or have already distributed their code and/or Open-APIs as Open source, which allows access to the results to developers outside the projects, and can attract new and unexpected innovation by third parties, while providing feedback from the developers’ community (see **Error! Reference source not found.**).

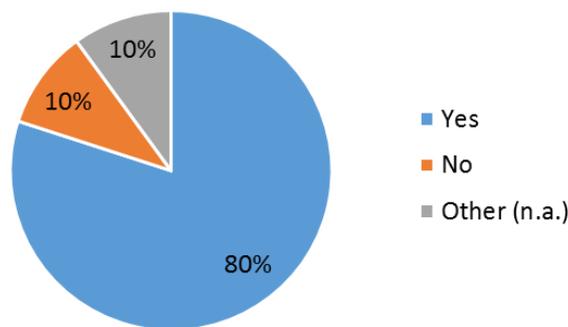


Figure 4. Code and/or Open APIs released as Open Source

More specifically, regarding the value co-creation mechanisms implemented, most projects were planning to implement techniques such as rapid prototyping involving final users/relevant stakeholders, a collaborative design approach, collaborative making, and hackathons (see **Error! Reference source not found.**).

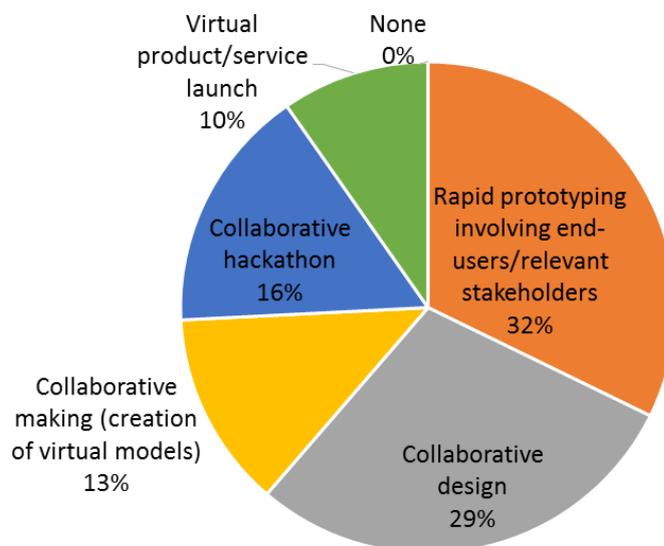


Figure 5. Value co-creation methodologies being implemented in IoT-EPI projects (June 2016)

From the results gathered from the self-assessment tool (February 2018) instead, the UNIFY-IoT team has been able to check that all IoT-EPI projects had somehow implemented co-creation approaches and mechanisms so far. Figure 6 shows a list of the value co-creation initiatives already implemented by IoT-EPI projects, till February 2018. Open calls were a new addition, since projects are already mature and have at least started the open call process at this point, taking the value co-creation approach one step further, by including external partners into the practice. After these, rapid prototyping continues to be the most implemented value co-creation approach within IoT-EPI projects, followed by the realization of collaborative hackathons and other collaborative approaches (design/making).

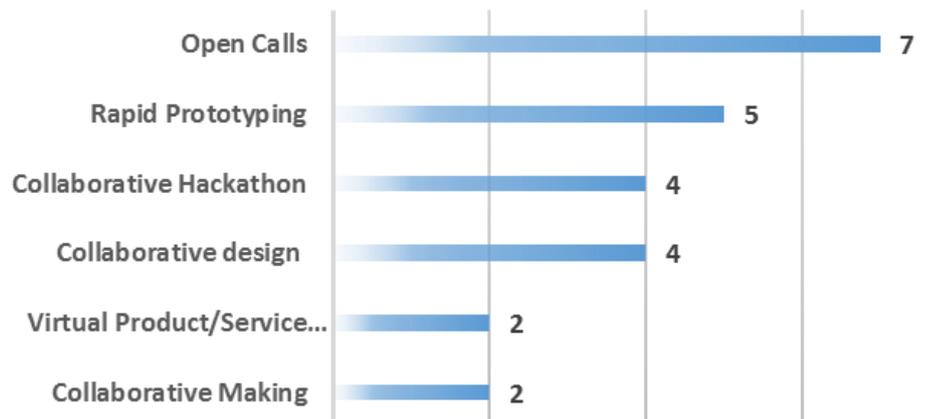


Figure 6. Value co-creation initiatives implemented by IoT-EPI projects (February 2018)

4.2 Best practices identified

Based on the previously presented results and from the discussion that took place during the final Value Co-creation (VCC) workshop in London during February 2018, the following best practices regarding VCC can be summarized:

4.2.1 At consortium level

- Applying value co-creation approaches since the beginning of the project helps to a better communication, allowing to identify a common language and define together a strategy to reach project goals
- Open calls allowed IoT-EPI projects to get inputs from the end-users, third-parties and the market in general regarding projects' value proposition, during the project lifetime. This allowed projects to evaluate the relevance of the project offering in terms of business models, software components, pilots and demonstrators, among others.
- The rapid prototyping mechanisms allows for a quick, yet not final deployment of project results (e.g. software, hardware, scale models) that minimizes design and operative flaws, saving costs and time, and allowing to incorporate necessary changes before finalizing it.
- Two key enablers for a successful value co-creation approach implementation were identified by the projects: a clear value proposition and an open-thinking and collaborative work team.

4.2.2 At external stakeholder's level

- Openness and standardization is key. Adoption of open standards together with an open-source approach in software development, and an Open-APIs offer, allows easy access to project

results to external parties, promoting new and unexpected innovation by other actors, while getting feedback from the developers' community.

- A clear value proposition towards developers' community and in general is important to get the attention of the right people and promote possible areas of collaborations outside the project consortia.

4.3 Roadmap for value co-creation mechanisms sustainability

Unify-IoT Consortium developed the Value Co-Creation framework jointly with the IoT-EPI Community. IoT-EPI projects have taken awareness of what Value Co-Creation is and how it can support the main dimensions of value generation, defined by Unify-IoT project, at the base of Task Forces activities: Adoption, Monetization, Social and Societal Awareness.

Value Co-Creation is an 'umbrella' that encompasses under a common roof a variety of themes and challenges faced by all the Task Forces.

Best practices described in the previous paragraph show how the IoT EPI Community perceives VCC advantages and how this approach is considered a key enabler to foster innovation, business modelling, stakeholder engagement, and acceptance by the final users. IoT-EPI projects agree on continuing the efforts and adoption of value co-creation tools beyond the end of Unify IoT project.

To foster Value Co-Creation mechanisms sustainability, the following actions will be acted:

4.3.1 Creation of an Infographic on Value Co-Creation Tools and access to public deliverables

Unify-IoT project produced Value Co-Creation framework, methodology, and tools, are potentially very interesting and useful for different stakeholders in the IoT-EPI Ecosystem.

All these tools are available and well documented in public deliverables of the project, but an effective communication of these results is needed to promote and consolidate awareness on VCC.

Since Target groups (e.g. CEOs and entrepreneurs, among others) will hardly spare too much time to read the full documentation, Unify-IoT consortium will produce an infographic illustrating clearly the main VCC tools and their potentials. The aim of the infographic is to raise the interest of potential readers and motivate them to continue reading the full reports.

As a consequence, public deliverables on Value Co-Creation, (namely D1.1-Value Co Creation Mechanisms, D1.2 - Activities Fostering Value Co-creation: Final Report, and D1.3 - Activities Fostering Value Co-creation: Interim Report) have to be easily accessed by the community at large after the end of the project, for instance making them available in other portals, such as the OEP, but also IERC and AIOTI websites.

4.3.2 Fostering IoT-EPI Community positive experience on VCC adoption

Discussion with IoT-EPI partners during the workshops held in London in February 2018, highlighted how all the projects are adopting value co-creation approach and how it is supporting them in approaching the market.

This positive experience will reinforce VCC adoption both in day by day work and in future applications, as EU research projects but also market oriented ones.

Further Value Co-Creation Practices will be enabled combining these positive experiences with the European Commission vision, that promotes an open approach (i.e. regarding software and open APIs). Such combination will stimulate new unforeseen collaborations with third parties or external stakeholders to project consortia. What's more important, European Commission has been

strongly promoting for some time now an open approach (i.e. regarding software and open APIs) which stimulates new unforeseen collaborations with third parties or external stakeholders to project consortia, resulting in Value Co-Creation Practices.

4.3.3 Transmitting the Value Co-Creation tools to the large-scale pilot projects

Value Co-Creation framework and related mechanisms could be transferred to the IoT Large Scale Pilots Programme, where IoT applications and solutions are demonstrated at a larger scale and as close as possible to operational/market conditions.

The entry point to the LSPs partnership could be the link between UNIFY-IoT and CREATE-IoT, a Coordination and Support Action (CSA) from the call Internet of Things H2020-IoT-2016.

CREATE-IoT seems to be the most effective bridge to sustain and scale Value Co-Creation mechanisms since it aims to stimulate collaboration between Internet of Things (IoT) initiatives, foster the take up of IoT in Europe and support the development and growth of IoT ecosystems based on open technologies and platforms.

5. CONCLUSIONS

The successful development of the OEP shows that integrated platform gathering IoT-related educational contents at every level has an added-value for IoT-related stakeholders, from students to professionals. It also serves to fill the gap of relevant info for wider audiences adopting IoT solutions and provides a front window for EU IoT project developments. The good dissemination efforts of IoT-EPI projects towards these publics and rather good numbers (users, page views, etc.) put up by the OEP illustrate these key considerations

On the other hand, Value Co-Creation practices will prevail in the next endeavours of the European IoT ecosystem, the methodology disseminated among the IoT-EPI stakeholders provides an adapted framework for analysing the threats and opportunities of their developments. This open approach discussed with key European IoT stakeholders has shown to have an impact on the Task Force members.

These challenges, tackled within the IoT-EPI community, need however to be further developed and deepened with business stakeholders, industrials and societies at large beyond this environment. These issues are illustrated both in the rather low ‘collaborative making’ initiatives achieved by the RIAs projects and the lack of interactions between academics and business stakeholders on the OEP. Indeed, both these ‘indicators’ illustrate the lack of involvement from stakeholders outside the ecosystem, which undermines the potential uptake of best practices and hinder the impacts sought after by the IoT-EPI stakeholders, notably upon the awareness of final users upon the opportunities and risks created by the IoT technologies.

Such considerations induce the need to foster “wider initiatives”, enabling, through the demonstration of multiple IoT applications at scale and in an operational environment, “wider audiences” to seize the opportunities conferred by these European developments. Thus, both Task Forces outcomes should be further developed within the framework of the Large-Scale Pilot initiatives in the times to come.

6. REFERENCES

- inno TSD. (2016). *D4.1 - Report on the factors of user's acceptance framework and societal and education stakeholders*. Retrieved from http://www.unify-iot.eu/wp-content/uploads/2016/10/D04_01_WP06_H2020_UNIFY-IoT_Final.pdf
- inno TSD. (2018). *D4.2 - Analysis of barriers for user' acceptance and awareness and operational guidelines and factsheets*.

7. APPENDIX

7.1 OEP technical infrastructure

The OEP is built has a regular web application. It has been developed using the Ruby on Rails web framework and relies on MySQL and Redis to store information. The application is served by an Apache HTTPd server and the full solution is hosted on single dedicated server.

7.1.1 Domain name

The OEP's FQDN is under the open-platforms.eu domain, managed by inno TSD.

7.1.2 Software

The OEP has been built on top of the Ruby on Rails framework. Moreover, it uses only open source software. The table below lists main tools used.

Role	Tool	Version
Web server	Apache HTTPd	2.2.22
Language	Ruby	2.3.1
Web framework	Ruby on Rails	5.0.1
Application server	Phusion Passenger	5.0.30
Database server	MySQL	5.5.54
Key/Value store	Redis	2.8.7
Operating system	Ubuntu	12.04.5 LTS
Deployment solution	Capistrano	3.7.1

Once core components will be installed (e.g. components listed above), all required Ruby libraries will be automatically installed thanks to the Bundler tool (e.g. by running `bundle install`).

7.1.3 SSL/TLS certificate

The OEP is only available through HTTPS (regular HTTP connexions being redirected to HTTPS).

7.1.4 Source code

The OEP's source code is hosted on a Git server managed by inno TSD.

7.1.5 Backup

Backups are done on a nightly basis. Individual backups are kept for 30 days. Backups are done thanks to the BackupPC⁵ open source solution.

7.1.6 Analytics

Statistics are provided by the Google Analytics solution.

⁵ <http://backuppc.sourceforge.net>