Identity Management in PUbLic SErvices

D2.3 IMPULSE requirements specification V2

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Executive summary

This deliverable is the second version of IMPULSE requirements specification that extends the requirement gathering from literature and project partners (D2.2) to include input from potential users of the electronic identification (eID) solution. The input is gathered by executing scripted co-creation workshops at different pilot sites. Through the workshops, users articulate their positive and negative implications of IMPULSE and propose possible solutions to counter the highlighted issues.

The main goal of this task is to provide requirements to the IMPULSE solution by utilising co-creative methods. During the first iteration (D2.2), the project partners were included to gather the basic set of requirements to develop the solution. The second iteration (D2.3) expands upon the requirement set by gathering input from end-users through the co-creative workshops. The third iteration (D2.4) will refine existing and introduce new requirements through end-user pilot testing (T2.5).

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Summary (for dissemination)	This deliverable includes an adaptation and refinement of general requirements (D2.2) into pilot specific requirements in M15. It demonstrates a user-centred design approach applied in a co-creative requirements elicitation process through the workshop sessions conducted in pilot case studies. The findings were compared in a cross-case analysis to prepare a refined set of the IMPULSE requirements.
Keywords	Software requirements, co-creative design, electronic identity, eID

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Abbreviations and acronyms

ACL:	Access Control List
AI:	Artificial Intelligence
ARH:	City of Aarhus, Denmark
ASR:	Architecturally Significant Requirements (deliverable D2.7)
CEL:	CyberEthics Lab.
CNS:	Carta Nazionale dei Servizi (Italian national eID scheme)
DPA:	Data processing agreement
EBSI:	European Blockchain Services Infrastructure
eID:	Electronic identification
ERTZ:	Basque Government – Security Department – Ertzaintza
EU:	European Union
GIJON:	City of Gijón, Spain
ISO:	International Organization for Standardization
MOP:	Municipality of Peshtera, Bulgaria
OTP:	One-Time Password
PA:	Public administration
PKI:	Public Key Infrastructure
QES:	Qualified Electronic Signature
RVK:	City of Reykjavik, Iceland
SMS:	Short Message Service
SPID:	Sistema Pubblico di Identità Digitale (Italian national eID scheme)
SSI:	Self-Sovereign Identity
UC/IC:	Union of Italian Chambers of Commerce / InfoCamere
VC:	Verifiable Credential
WP:	Work Package (IMPULSE DoA)

Definitions

This section provides general definitions about technical terms and key concepts in the scope of electronic identification, to provide background information to the reader. These general definitions shall not be interpreted as a specification of requirements or list of features of the solutions to be piloted in IMPULSE.

Authentication

An electronic process that enables the electronic identification of a natural or legal person, or the origin and integrity of data in electronic form to be confirmed (European Parliament and the Council, 2014).

Electronic identification (eID)

The act of making an entity known, through a unique combination of attributes used for the authentication (i.e., assessing the identity) and authorization (i.e., granting permission) to electronic public or private services (Söderström, 2016; Bazarhanova, 2020).

Interoperability

The ability of one software system to use parts of another software system (Vernadat, 2009) or access the data generated by it (Giachetti, 2004).

Stakeholder

Any group or individual who can affect or is affected by the achievement of the objectives in a specific organization or project context. Stakeholder relationships are characterized by power, legitimacy, and urgency (Mitchell, Agle and Wood, 1997).

Usability

Qualitative assessment of the extent to which a novice user interacts with software, to accomplish specific goals in a given use context with relative effectiveness, efficiency, satisfaction, and overall ease-of-use as the standard of measurement (Agarwal and Venkatesh, 2002; Baker, 2009; Karkin and Janssen, 2014).

1 Introduction

1.1 Goals and objectives

Following the first iteration of IMPULSE requirement specifications (D2.2), the second stage of T2.2 has been aimed at refining a general set of requirements produced from studying relevant sources of literature and the outcomes of the first co-creation workshop. This refinement entails the adaptation of IMPULSE technologies into a set of pilot-specific requirements, identified by way of involving various stakeholder groups in co-creation workshops.

Accordingly, the present deliverable extends the co-creative requirements elicitation scheme in IMPULSE, featuring a co-design approach to articulating requirements with prospective end-users of the electronic identification (eID) solution in six case studies. To accomplish this, the report is structured in reference to research questions evoked by a statement of purpose:

- How to communicate the design of an eID solution to prospective end-users, applying co-creation methods?
    - How to design a co-creative activity for developing a shared understanding of an eID solution amongst people with different knowledge and skills?
    - How to arrange a co-creation session and replicate this activity across six different instances or case studies?
- What will be the user requirements for an eID solution, identified through the process of co-design?
    - What are the similarities/contrasts between the requirements stated by end-users and experts?

First, the deliverable describes the research methodology and then it provides a description of the activity planning which is part of the pre-piloting stage in the co-creation process. Thereafter, the replicable workshop template (co-creation design) is introduced but that was developed specifically for 'IMPULSE' requirements elicitation with prospective end-users. Finally, the deliverable reports on the findings from workshops conducted in different case study settings that, respectively, reflect user needs for eID solution in public services. The results are compared in a cross-case analysis and mapped with the requirements elicited in the first iteration (D2.2) to clarify and improve the general set of requirements.

1.2 Background

As IMPULSE has been progressing through its early development phases, the synergies between different work packages become more evident. For example, the first basic system prototype developed by the technical partners in WP5 was demonstrated in a video presentation to Consortium members in February 2022 (M13). This video demonstration of IMPULSE technologies (the system for onboarding and authentication using facial metrics) prompted the need for alignment with stakeholder expectations of eID solution being used for online access to local services of public administrations.

For WP2, the prototype demonstration serves as a boundary object[1] (Star & Griesmer, 1989), i.e., to facilitate the communication of knowledge between the technical partners (ALiCE, GRAD, ICERT, TREE) and the LUT research group who is leading the co-design strategy. Developing a shared understanding of IMPULSE software components, resulted in identifying architecturally significant requirements (ASR) reported in D2.7 ("IMPULSE architecture specification V1"). This set of requirements elaborates the specifications from a technical perspective (expert mindset), complementing a high-level design of the onboarding and authentication solution.

From an end-user perspective (participatory mindset), the technological complexity of IMPULSE designs is distantiated from conceptualising and understanding the merits of 'such a function' or 'such a solution'. In other words, the demo, as a boundary object (see Figure 1), provides prospective users with a tangible idea of what IMPULSE technology is and what it is for, and therefore is used as a probe to meaningfully engage participants in a co-creative design process.

[1] The theoretical origins of the 'boundary object' in Science and Technology Studies lies with the landmark work of Star and Griesmer (1989).

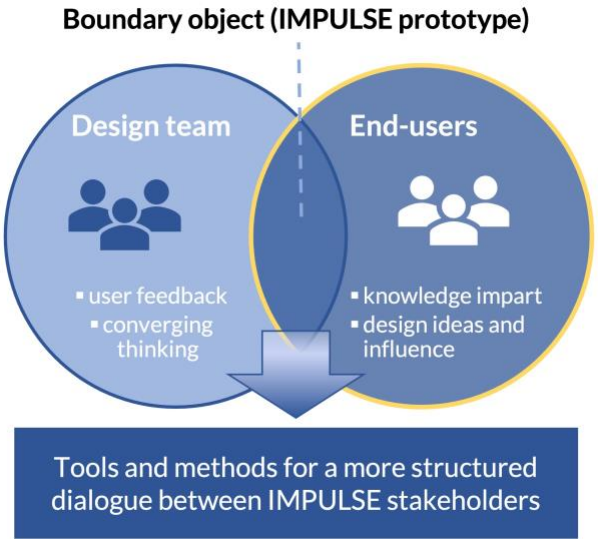

Figure 1: Boundary object in interactions between IMPULSE stakeholders.

At the pre-piloting stage, the WP2 partners identified cohorts for co-creation activities based on the initial analysis presented in D2.1. Exploring a more diverse pool of stakeholders for participation in collaborative activities such as the co-creation workshops, fostered the uptake and communication of user-centred design practices among Consortium members. A key activity in T2.2 that underpins the co-design strategy is eliciting/articulating requirements *together with* prospective users of the IMPULSE solution.

1.3 Requirements elicitation approach

Following the course of action during the pre-piloting phase (D2.5), the second iteration of eliciting requirements (Figure 2), sets the objective to enhance and upscale the co-creation methodology across the case studies. Reaching out to prospective end-users at the piloting sites prompts the cooperation of IMPULSE stakeholders in analysing and prioritising problems and possibilities afforded by the eID technology in question.

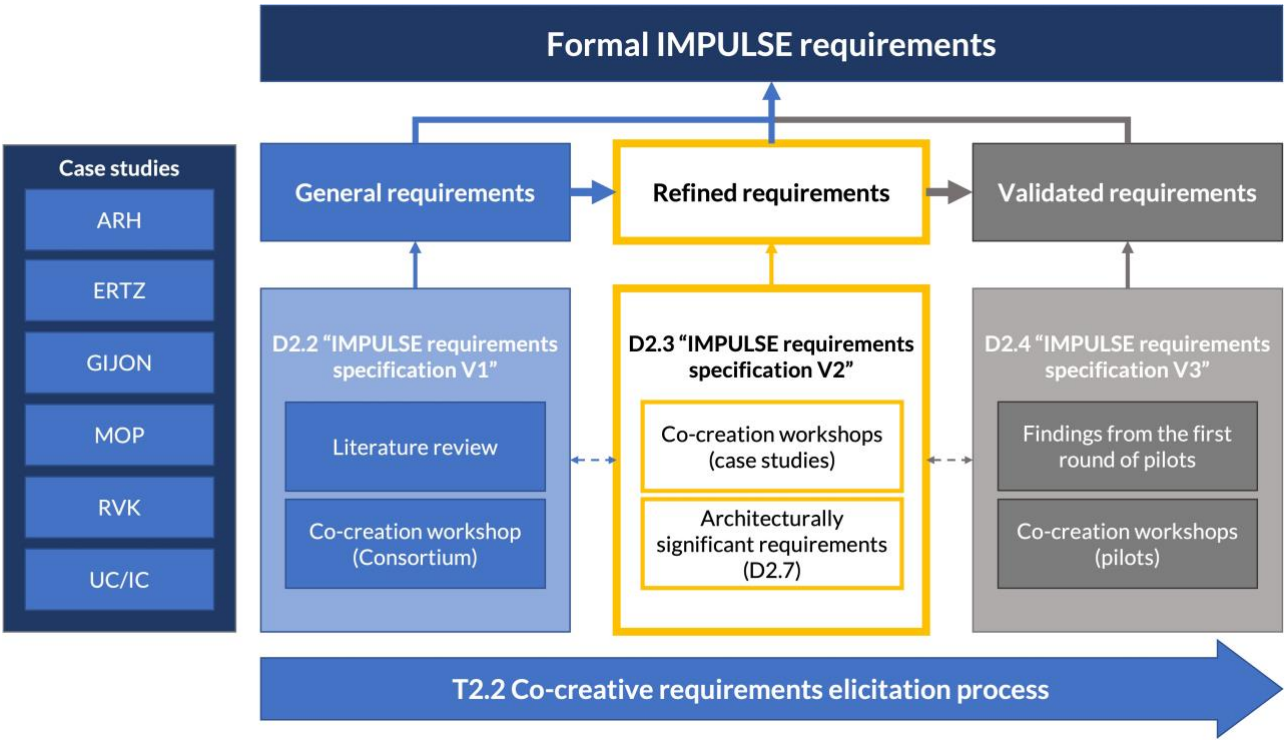

Figure 2: Second iteration of the co-creative requirements elicitation process in IMPULSE.

To elicit requirements and communicate user needs in reference to pilot specifics, the participatory approach is realised in a series of co-creation workshops jointly coordinated by the LUT research group and the public administrations (ARH, ERTZ, GIJON, MOP, RVK, UC/IC). Taking language barriers into account and the geographical dispersion of the case studies, these workshops were organised as individual instances, each as a part of (and in preparation for) the respective case study pilots in these locations. Leading the co-creation process, LUT designed a replicable workshop template and provided the public administrations with support and guidance on practical arrangements, along with training of facilitators to execute the workshops.

2 Co-creative requirements elicitation process

2.1 Research methodology

The design process, in IMPULSE co-creation methodology, is continuously transitioning between the expert and participatory dimensions (see Figure 3). During the pre-piloting phase, the Consortium members build and evaluate the IMPULSE technology prototype on the basis of user participation in co-creation activities.

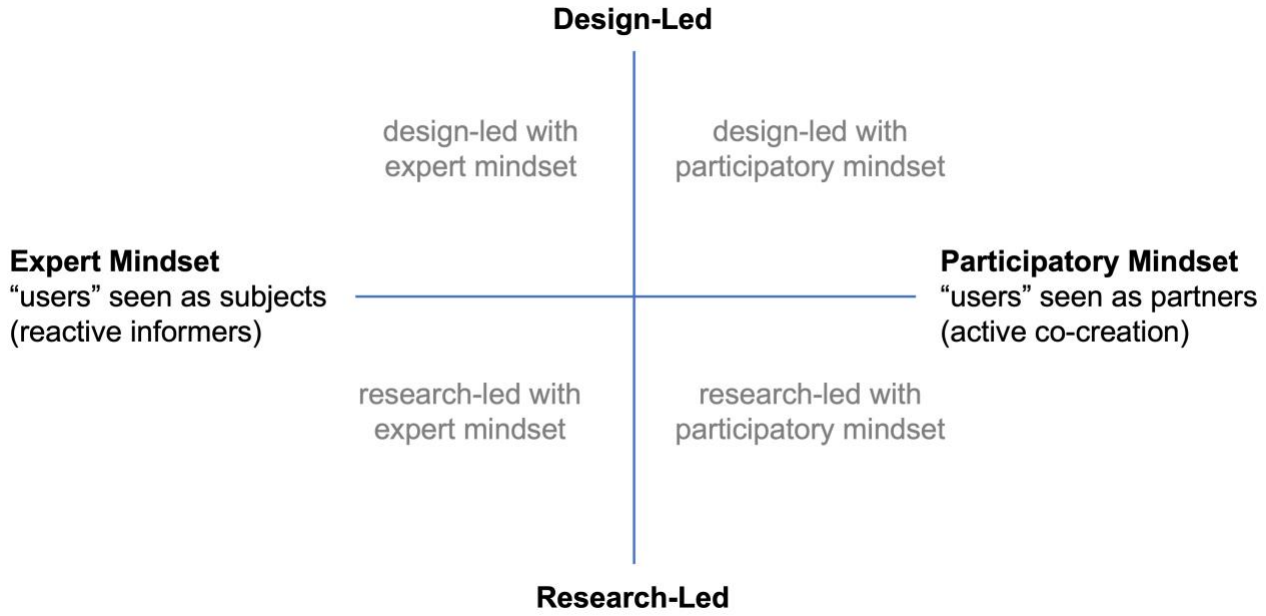

Figure 3: Design research dimensions for the human-centred approach (Sanders, 2011).

User-centred design is employed in the problem-solving process that puts the user needs in focus for developing solutions. In design research, this approach employs research-led practices with an expert mindset to collect, analyse, and interpret data, in order to develop specifications and evaluate prototypes with different tools and methods (Sanders, 2008).

Conversely, participatory approach attempts to actively involve the people who are being served by a design, in the process of problem-solving (Sanders, 2008). While users may not be able to communicate precisely or technically some requirement or other, they are able to explain their goals and how they approach their tasks (Kujala, 2003). Therefore, users should not be passive informants as they have different values in relation to a system and its use (Kujala, 2008). Involving the end-users to participate in a design process by means of co-creation practices, encourages the elicitation of more accurate requirements.

In this sense, a basic prototype or demo helps communicate IMPULSE designs to potential stakeholders and, especially, to prospective users of eID solutions to access public services online. Stakeholders are provided with a tangible idea of the design so they can anticipate their experiences, interacting with the interface as well as their perceptions of using the solution to satisfy certain needs. In this process, users express their needs which can represent problems if the design is hindering them in achieving certain goals or hindering opportunities to improve the likelihood of achieving those goals (Kujala, 2002). Therefore, users can contribute to the design by assessing prototypes and exploring their features in imaginary contexts.

Capturing user needs, the co-creative activity will have implications for IMPULSE developments from different angles: positive attitudes, concerns and issues, and opportunities to devise how to overcome potential problems. Exploring these facets is suitable in the application of co-designs that are prompting of creative thinking, teamwork, and knowledge exchange. Some of the methods include, but are not limited to, brainstorming, user personas and idea portfolio.

To transform user needs into software requirements, the research team intends to employ the ISO/IEC 25010 quality model, adopted from the previous iteration of IMPULSE specifications (see D2.2, Figure 2), and refine it by enhancing the quality dimensions with extra categories. The refined model shown in Figure 4 presents the additional attributes for classifying the requirements that are aimed at addressing user needs.

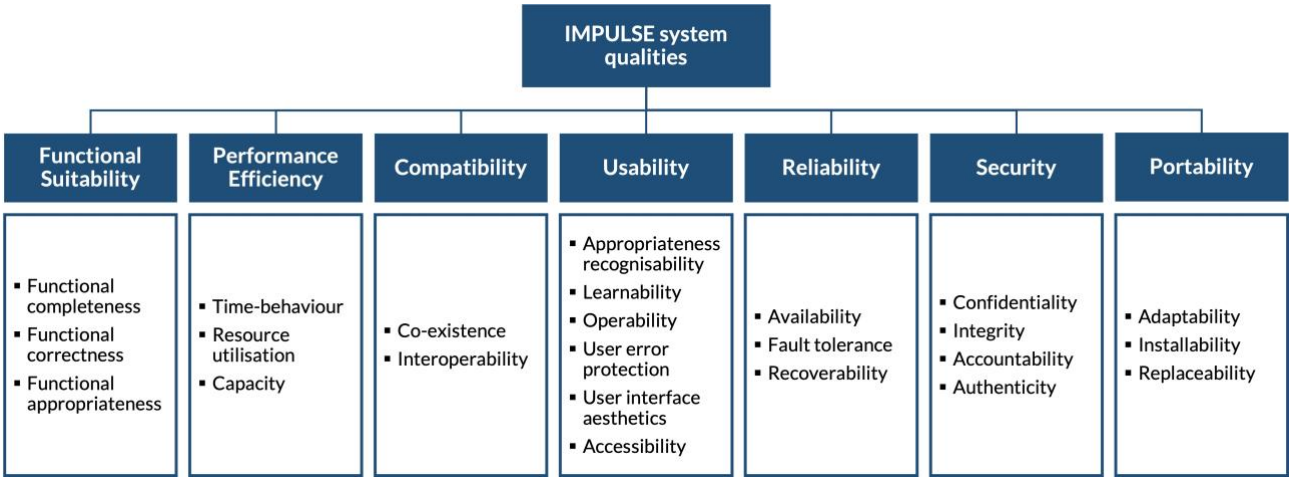

Figure 4: The IMPULSE system qualities for classifying user requirements.

Since the first version of IMPULSE specifications, the quality model is augmented by three new dimensions: functional suitability, performance efficiency, and reliability. These quality dimensions provide with the structure for allocating user needs in their respective category and subsequently transforming them into requirements based on the general set. Using this model, the newly identified requirements will be communicated to the technical partners for incorporating them in future development iterations.

The co-creation in IMPULSE is realised by adapting the framework presented in Figure 5. It shows the execution steps of the co-design activities and constant revision of the front-end and back-end stages of this process.

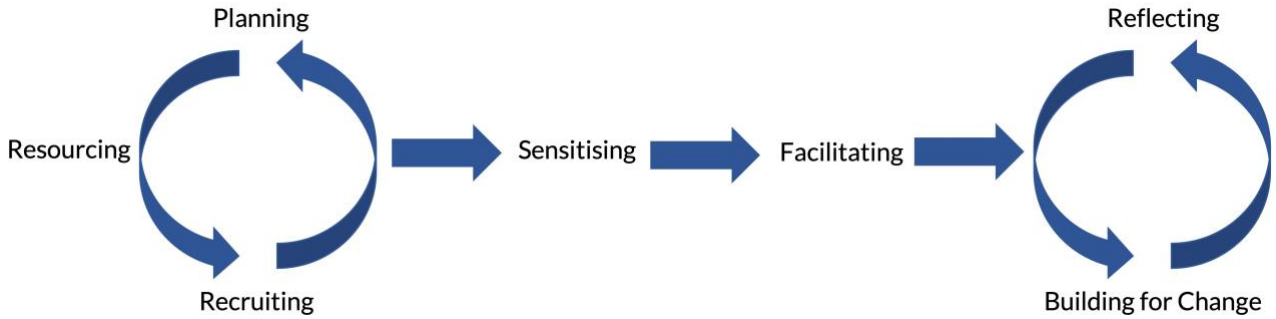

Figure 5: A co-design framework for public service design (Trischler et al., 2019).

The front-end comprises the planning of co-creation activity, resourcing, and recruitment of the volunteers for participation. Given the unpredictive challenges associated with this phase, the front-end allows for continuous improvement of the co-creation process that is iterative in nature (Trischler et al., 2019). This process is applicable for designing the co-creation activities such as the workshops as part of the case studies to involve residents and service providers as prospective users of the eID solution.

2.2 Activity planning

To conduct the co-creation workshops with the end-users, LUT and the public administrations partners (ERTZ, GIJON, ARH, MOP, RVK and UC/IC) negotiated and devised a plan for the necessary preparations which is reflected on the timeline in Figure 6. These practical arrangements fit into pre-piloting activities (D2.5) and comprise the following key elements:

- Setting up data management facilities
- Arranging volunteer recruitment campaigns in the municipalities
- Workshop set-up and training of facilitators

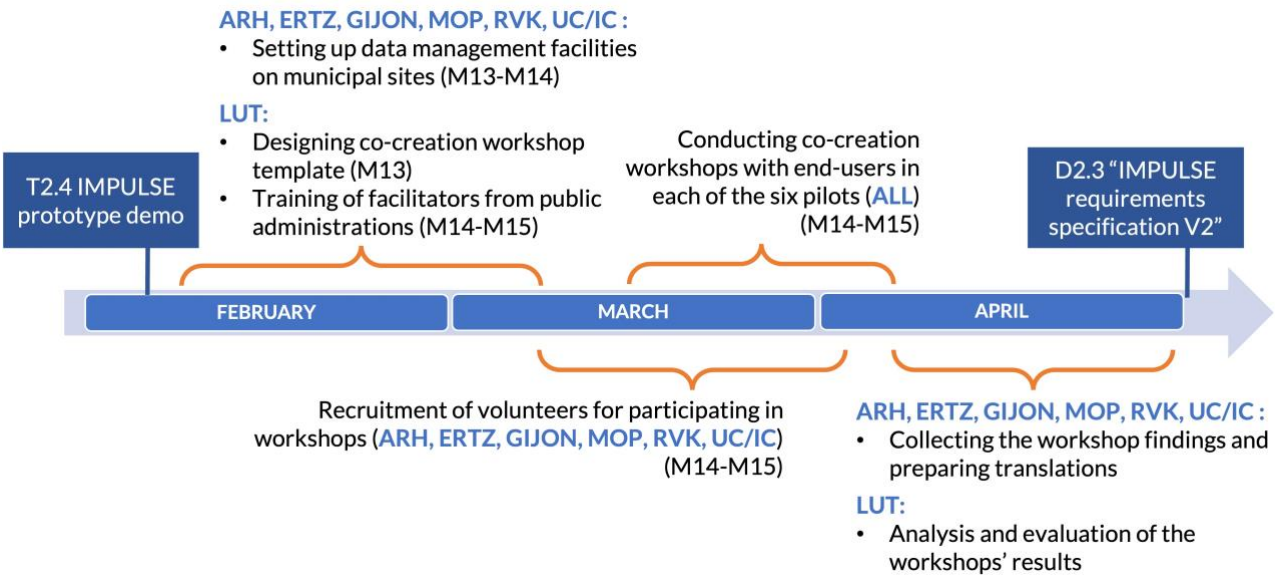

Figure 6: IMPULSE co-creation workshops planning timeline.

Requirement elicitation implies the collection of data produced in co-creation workshops with prospective end-users, analysing and using this data as an input into IMPULSE specifications and other deliverables within the project. Data collected in these joint activities include audio recordings, screen captures and other visual recordings, as well as the minutes taken during the workshop sessions.

The data are garnered in the local languages of the respective case study sites, however, they are translated into English before being analysed and incorporated into the findings in this deliverable. That includes transcriptions of audio recordings as well as literal translations of text.

Following the data processing agreements (DPA) between LUT and the public administrations, data storages are managed on the piloting sites. These are essentially shared repositories on servers owned by the administrations, utilising a preferred file hosting service, e.g., SharePoint, OneDrive and Google Drive. File uploads and management are coordinated by the administrations as owners (the data controllers) while LUT, as the main data processor, is given access to shared folders.

The participants in the workshops were meant to be representative of end-users of the eID solution. These are the local residents and service providers who make up the stakeholder groups that potentially benefit from the functionalities introduced by IMPULSE (see D2.1, Table 2). Total number of attendees was between 12 and 20 persons at each site, the very minimum number of people to ensure that the data produced in the co-creation activities would be diverse enough and sufficient. The public administrations disseminated workshop invitations by contacting their local networks and communities4.1. To participate in the workshops, the invitees would have to register and give their informed consent to the processing both personal and workshop data, collected are a matter of course during the workshop. The registration form (see Annex A) was developed jointly by CEL and LUT and tailored by the public administrations to their local regulations as well as being translated into the local languages.

Taking into account the geographical dispersion of the partner organisations, these workshops were convened by facilitators from the public administrations or assigned by them locally. The general workshop template was disseminated also to be tailored locally to the specifics of the case study pilot, along with instructions that were used in training sessions organised by the LUT researchers who imparted their knowledge of this type of facilitation. Included were instructions on working with the digital tools (in the virtual setting), information explaining the workshop structure, and trialling of the performance of the co-creation exercises. These instruction materials with detailed explanations about how to convene and execute the workshops can be found in Annex B.

2.3 Co-creation workshop design

The co-creation workshops are designed as a structured step-by-step process to help participants share their vision of what IMPULSE technologies should be like. To accomplish this, the workshop arrangement employs design thinking to implementing co-creative activities.

The general template was developed by LUT for replicating the workshop in six different instances, adapting them to the respective case studies. Considering the prerequisites for organising the workshops at the piloting sites, particularly the restrictions imposed on mobility and gatherings during the coronavirus epidemic, the template is adaptable to both physical settings (face-to-face sessions in some local venue) and virtual settings, using online communication and collaboration tools. For running the workshop virtually, the template suggests how to carry out the activities using the Miro digital whiteboard and MS Teams/Zoom for voice communication. It allows workshop participants to collaborate, generate and discuss their ideas as they complete the exercises using digital tools.

Each exercise helps to share expectations and perceptions of IMPULSE from the end-user perspective and, in completing these exercises, participants contribute to the design of future solutions as part of other input from the Consortium partners in a broader co-creative process.

2.3.1 Introducing IMPULSE

At the beginning of each workshop session, participants are introduced to the IMPULSE project, its key objectives and goals. The workshop facilitators (staff members in the public administrations that each are Case Owners) communicate these objectives framed in a "What? How? Why?" outline, using short and simplified project statements as shown in Figure 7

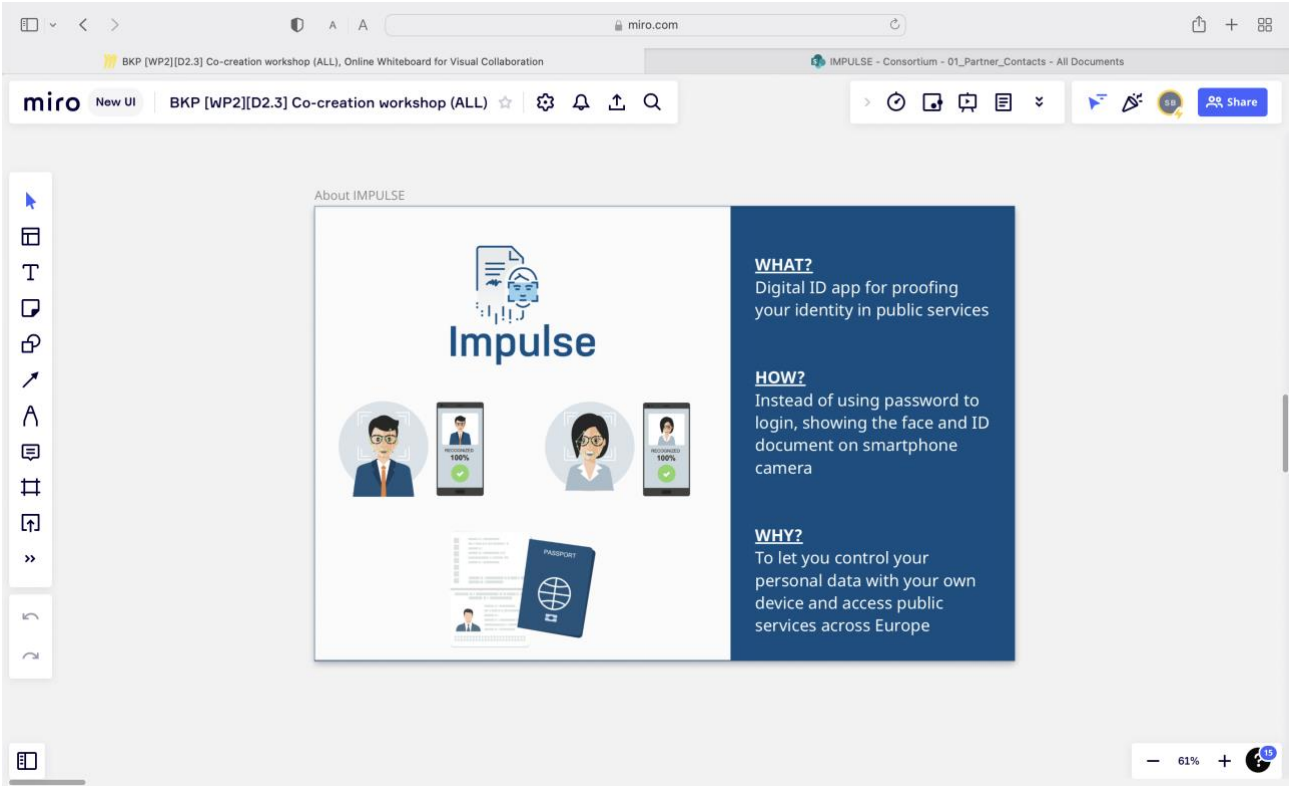

Figure 7: "About IMPULSE" on the dashboard in Miro (virtual setting).

Representing the Case Owner side, the facilitators further explain what they anticipate will be the outcomes of the co-creative sessions, i.e., reflecting in important ways the specifics of the respective pilots that will take place later in the year 2022 (see Figure 8 and Figure 9). For example, the technological components developed

by IMPULSE and shown in the demo video, are inspiring in the sense that they can frame broader topical dimensions for consultation and debate.

Figure 8: The co-creation workshop being introduced in the Municipality of Peshtera, Bulgaria.

Figure 9: Introducing the IMPULSE project in the co-creation workshop in Gijón, Spain.

While the intention of workshops was to focus on (and refine) requirements specific to IMPULSE technologies, there are more general concerns that the project raises. This was also foregrounded in preparing the workshop in Reykjavík (RVK), where four topical dimensions were additionally introduced as *guides*, as shown in Figure 10: 1. *Public services are undergoing a digital transformation*; 2. *Online instruments have to be 'in hand' and 'at home' for users*; 3. *Contexts for verifiable identification are under scrutiny*; and, 4. *Accessibility issues are under scrutiny*.

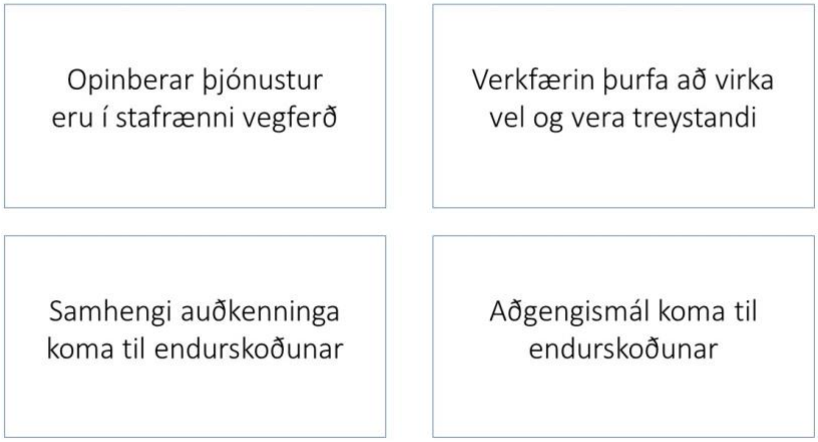

Figure 10: Topical dimensions as *guides*. An additional introductory slide prepared for the RVK workshop.

Following the opening presentations, the facilitators proceeded to show the IMPULSE prototype, a demo video produced by the technical partners (WP5), which provides the workshop participants with better understanding of IMPULSE technologies, helping them to envision the interface and prepare for interactions in everyday use.

2.3.2 Step 1 – The Positives

The first step of the workshop is framed as "What do you like about IMPULSE?" and it is set to explore the positive user expectations from the eID technology. This is mainly a warm-up exercise designed for engaging a creative attitude and acclimating participants to the workshop format. In the online setting, this exercise also helps participants adapt to the interface of the digital whiteboard. Figure 11 and Figure 12 represent examples of the first exercise.

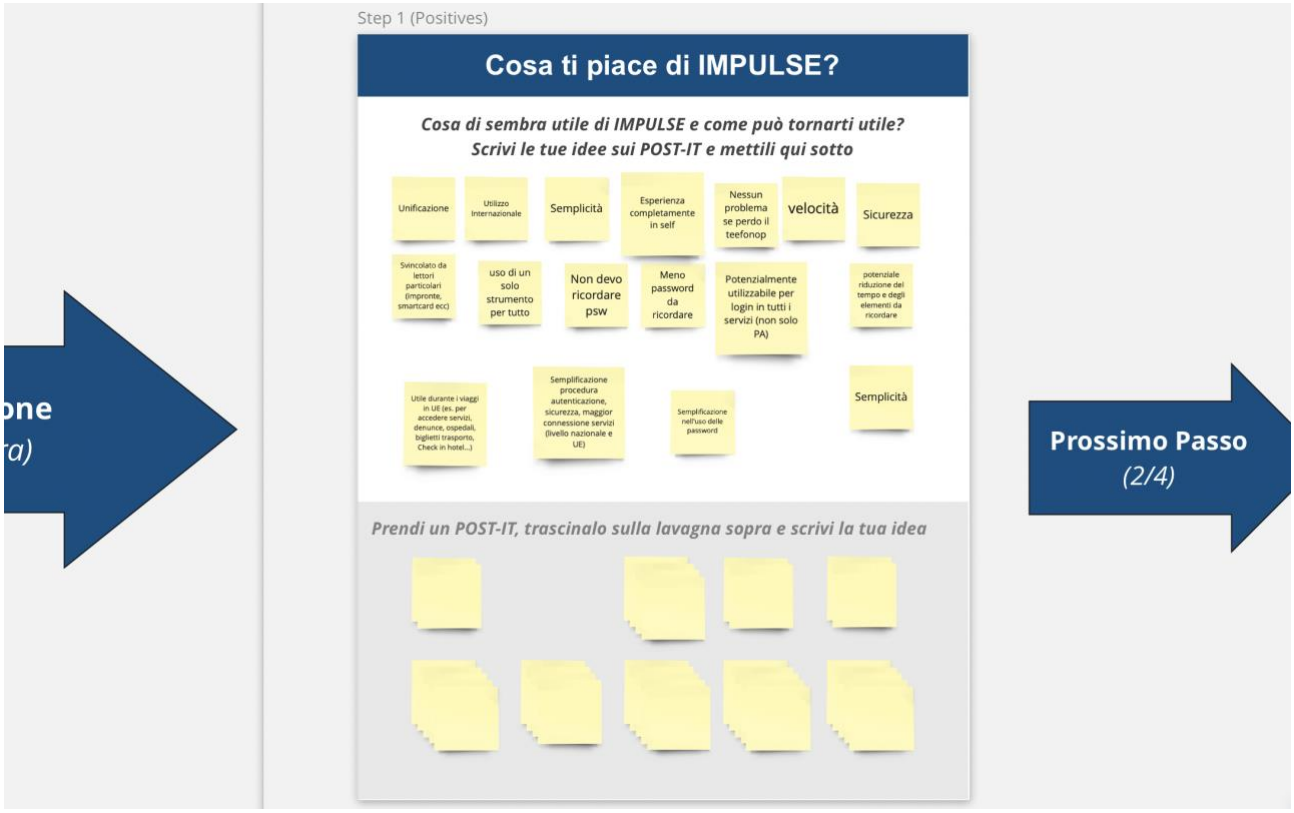

Figure 11: Positive statements on digital sticky notes in the Italian (UC/IC) co-creation workshop, using the online Miro board.

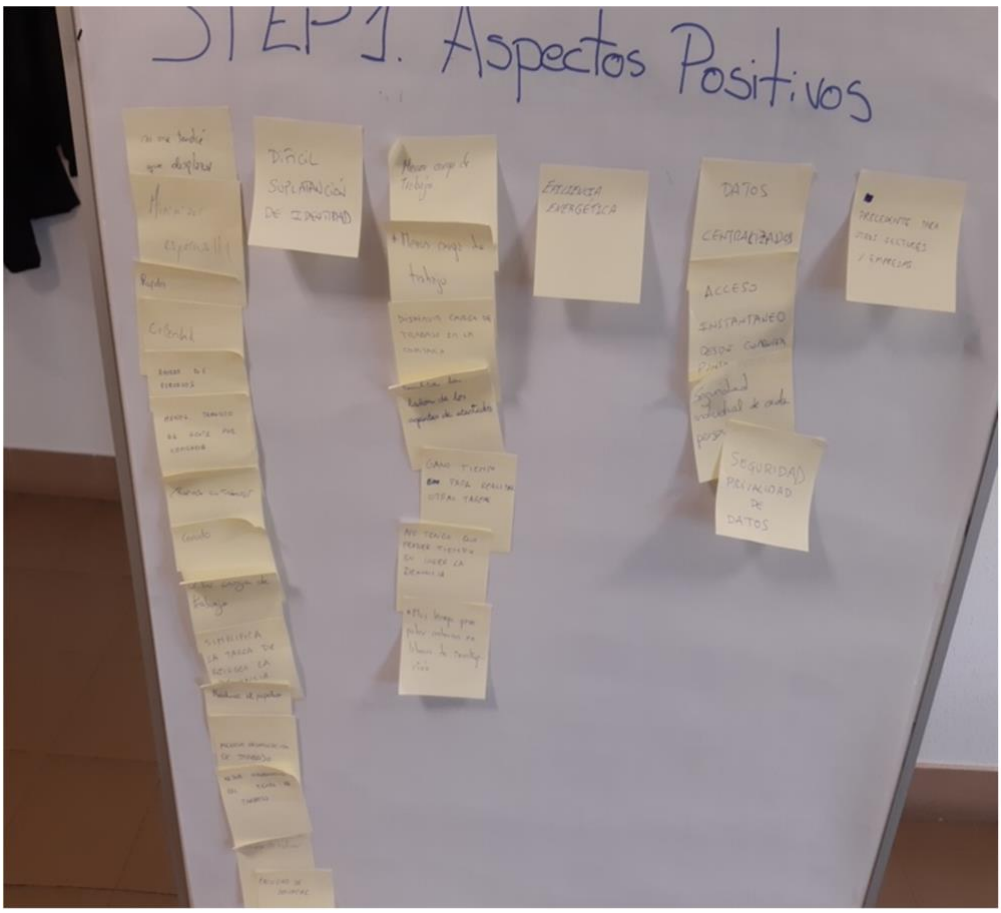

Figure 12: Positive expectations in the ERTZ workshop where participants attended in-person.

In a short time (5-7 minutes), all participants write their statements, one per sticky note. Online, participants can share their ideas and anticipations anonymously but, in either case (online or in-person), they post their notes without further comment to enable an open-minded brainstorming environment. Once time is up and participants finish their writing, the first step is complete.

2.3.3 Step 2 – The Negatives

The second step is framed as "What can go wrong with IMPULSE?" and therefore is set to explore user pain points. It is completed in three parts, i.e., activities aimed at defining and prioritising the potential problems. Accordingly, in the first part, participants are invited to write down their concerns and issues associated with IMPULSE in relation to their respective use cases. These negative anticipations can reflect potential drawbacks in the technology design from a human-centred perspective.

Next, the participants vote for the concerns they deem most important using red voting dots. Each of the participants is given three of those dots to vote for any idea placing one, two, or all three dots on one or more sticky note with a negative statement. Examples of this exercise in an online and physical settings are shown in Figure 13 and Figure 14, respectively.

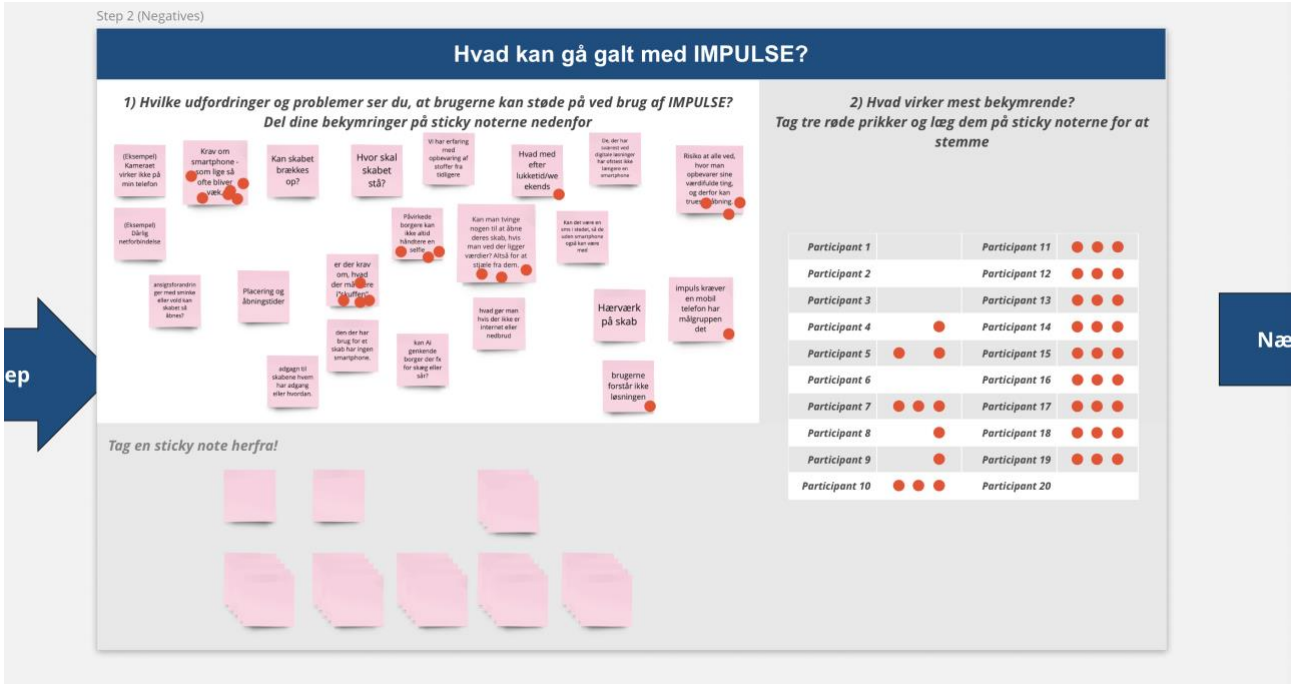

Figure 13: The Miro board for sharing concerns associated with the IMPULSE eID in the Danish (ARH) co-creation workshop.

Figure 14: The workshop participants sharing their concerns about eID technology in Gijón.

Having voted on their ideas, the third part is for participants to engage in discussion about the top-voted concerns and explain their priorities. In the online setting, attendees are sharing their thoughts in the MS Teams/Zoom conference space. Once the time is up and the participants have shared meaningful comments, this second step is complete.

2.3.4 Step 3 – "How might we…?"

The third step is done in two rounds where at least five top-voted problems from the previous exercise (The Negatives) serve as inputs. Framed as "How might we...?" the exercise is outlined as follows. To overcome the Concerns (from the second step), participants need to devise Solutions, and think of the Benefits they can get from them (see Figure 15).

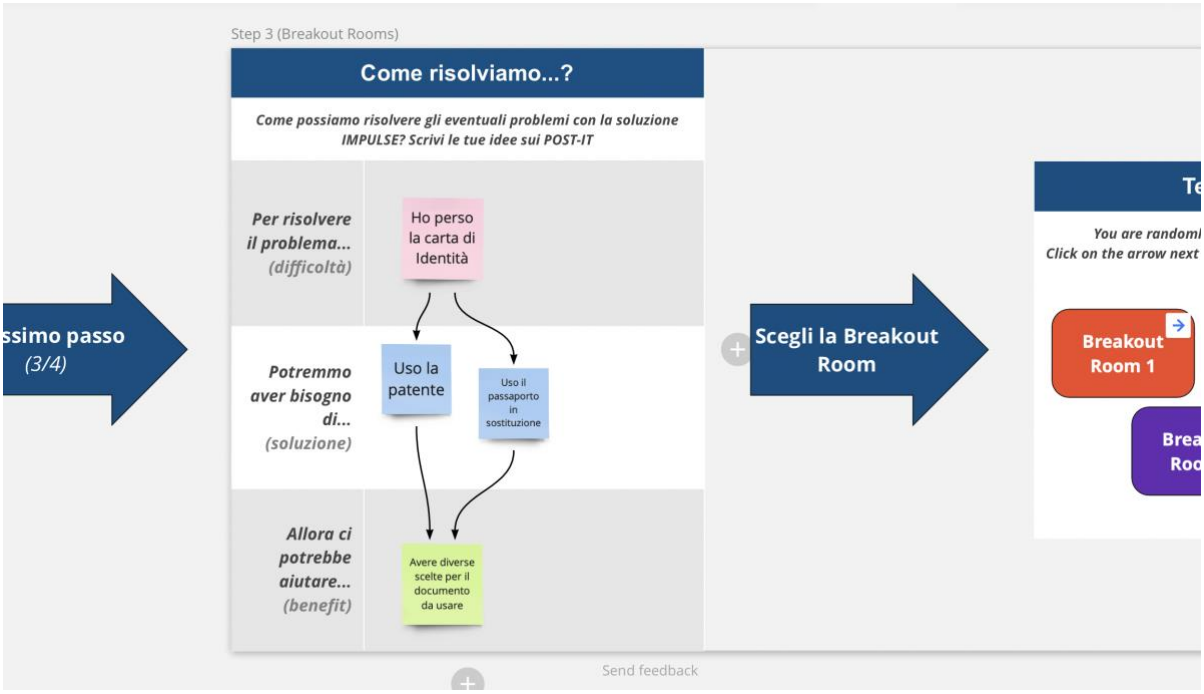

Figure 15: Third exercise structure: Concern - Solution - Benefit.

Workshop participants are randomly assigned to five parties to work on the exercise in a group. This activity is designed to represent the World Café method in both physical and online settings. The method is aimed at facilitating collaborative discussions about a specific issue in smaller groups around tables. Some participants change their table occasionally, while each table has its host who remains and summarises the previous conversation to the new table guests (Slocum, 2003). In a virtual environment, the tables are adapted to breakout rooms in MS Teams/Zoom and separate dashboards in Miro as represented in Figure 16 below.

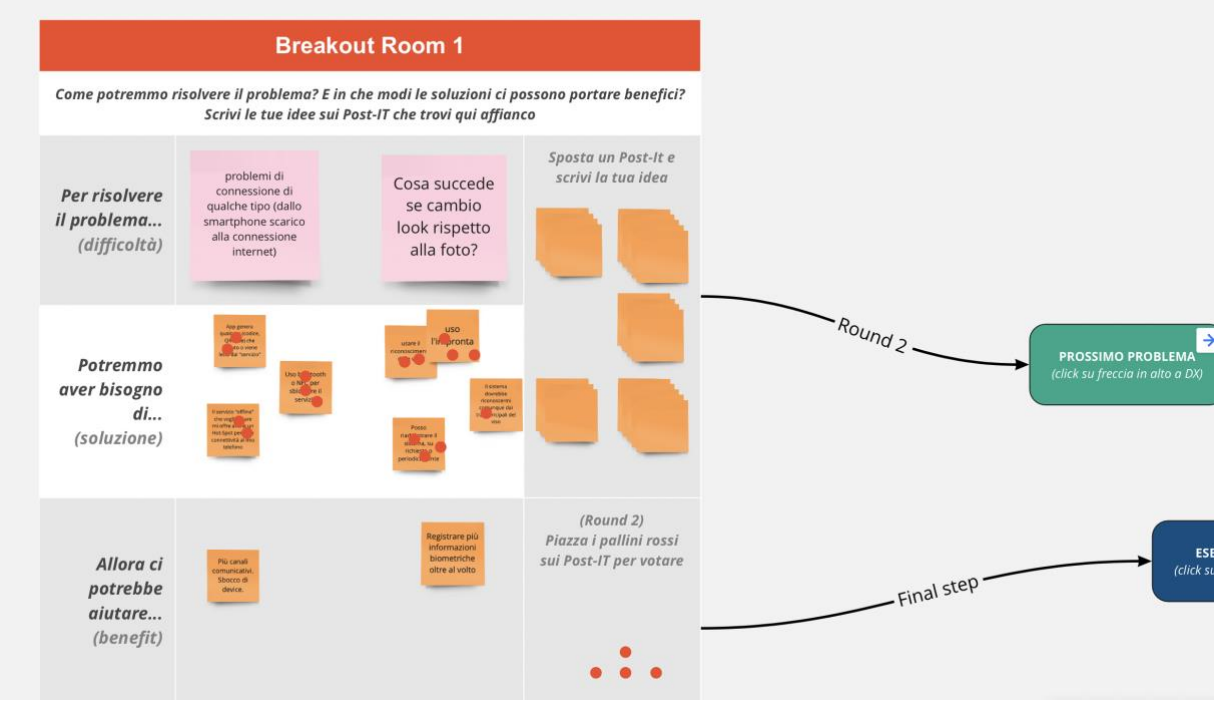

Figure 16: Breakout Room 1 dashboard in Miro from the co-creation workshop in the UC/IC workshop.

Each of the five groups works on one *Concern* around their table or in a Miro breakout room. In the first round, participants think of possible solutions for their problem. Once the time is up, some participants are switching

between the groups, i.e., moving to another table or breakout room, to complement the solutions from the previous work and to think about the benefits they can get from implementing new ideas. Using the voting dots, participants can highlight the most appealing or prominent solutions.

Working in smaller groups encourages the participants to have fruitful discussions which can help reveal the insights of user needs and to articulate ideas regarding the usability and usefulness of solutions. Additionally, the World Café method is particularly amenable to diversified teams and ideas, inviting different groups of stakeholders to work together with their experiences and perspectives in a problem domain such as the IMPULSE design.

2.3.5 Step 4 – Categories

The final step of the workshop is essentially an open discussion about the benefits and solutions that the participants voted for in the previous step. All participants can overview the statements selected in the priorities either on the flip chart or Miro dashboard to find similar ideas and create the categories. These categories can be labelled based on their perceptions and feelings evoked with the solution-in-mind. Therefore, the final exercise is aimed at identifying user experience requirements for IMPULSE.

Once the participants finish sharing meaningful comments about their ideas, the workshop is concluded with closing remarks about the elicited requirements and a wrap-up of the session. The participants are reminded about the follow-up communication for participating in future co-creation activities and pilot experiments of the eID solution.

2.4 Workshop outcomes

IMPULSE co-creation workshops were conducted by the public administrations as part of their respective case studies. The LUT research team, leading the co-creative requirements elicitation process, assisted facilitators in setting up the online and offline formats to ensure a consistent and straightforward execution of the workshops.

Participants were asked to give their consent individually, providing the researchers with personal data such as name, email, occupation, age and gender, along with permission to audio record discussions and capture screenshots. Workshop minutes were collected and stored in the data management facilities of the public administrations and their staff prepared translations and summaries for LUT with access to these pre-processed data for analyses.

The following subsections introduce workshop findings. In the summary tables, user statements regarding the IMPULE design were grouped by the exercise stages, where 01 – are the positive implications, 02 – the negatives, or user pain points, and 03 – the proposed solutions for those pain points. As participants prioritised their ideas, the most prominent challenges and solutions were selected and grouped by the corresponding categories based on the characteristics of the software and their quality. These statements were extracted from the workshop notes and discussion minutes translated into English.

2.4.1 ARH

The case study in Aarhus, Denmark implies the probe of IMPULSE focusing on vulnerable group of residents, including homeless people living in shelters. The recruitment of volunteers was entailed with challenges for the immediate online participation of people from the targeted group. Therefore, the pool of the workshop attendees in ARH was mainly comprising service providers, i.e., the shelter workers and staff members from the municipal services indirectly dealing with the targeted user group through various networks and initiatives. The total number of the attendees was 11 where more than half were women. The main findings are summarised in Table 1 below based on the statements made by participants on different stages of the workshop.

Table 1: Co-creation workshop findings in ARH.

Exercise step	No.	User statement	Category
01	**01**	*"A "democratic" solution citizens own by themselves. Data not controlled by authorities."* *"Confidence in that personal data are not stored on multiple servers"*	Management of VCs, Security, Confidentiality, Transparency

Exercise step	No.	User statement	Category
01	**02**	*"Digital inclusion of all citizens"* *"Citizens can access the document box in safe environments - not only municipal facilities"* *"Digital safety for both employees and citizens"* *"Fewer conflicts (with user group)"*	Compatibility, Environmental
01	**03**	*"The possibility to use my eID in other EU countries"*	Environmental, Usability, Adaptability
01	**04**	*"<…> the facial recognition part of the solution seems advantageable for the citizens to quickly access the self-service solutions."*	Usability, Confidentiality, Accessibility
02	**01**	*"It's a risk that people know where you store your personal information and therefore can be threatened to open the document box."* *"Can someone be forced to open their drawer so that personal information can be stolen?"*	Management of VSc, Security, Confidentiality, Environmental
02	**02**	*"Drug affected citizens cannot always handle to take a selfie"* *"Can the document box be accessed if citizens' faces have changed due to e.g., violence or makeup"*	Face verification, Authentication, Usability, Effectiveness, Reliability
02	**03**	*"Users do not understand the eID solution"*	Onboarding, Management of VCs, Accessibility, Appropriateness recognisability, Usability
02	**04**	*"Smartphone required… Device is often lost"* *"Vulnerable citizens don't usually know how to use smartphones. Many of the users <…> converted to an old phone model <…>"* *"<…> smartphone solution might narrow the prevalence among the user group."*	Accessibility, Portability
03	**01**	*"Possible SMS-solution"* *"Can the camera be on the document box (instead of the smartphone)"*	Portability, Interoperability, Adaptability
03	**02**	*"Place the document box in a facility that is open 24/7 with staff."* *"Video surveillance"*	Environmental, Compatibility, Security

The positive expectations from IMPULSE were associated with the digital inclusion of all groups of citizens including the vulnerable. Participants stressed decentralised data controllership by the users empowering the citizens through a "democratic" technological solution in the public services' provision. The solution would introduce positive changes in the extant processes creating a safer environment where the citizens, for example, could access their documents in lockers installed elsewhere outside of the municipal premises. From the service providers' perspective, the technology could reduce tensions and conflict situations between the public authorities and the vulnerable groups as it was seen as a self-service solution for accessing public services online. Additionally, the participants envisioned that the eID solution would operate in another European countries.

On the second step, several concerns were associated with the use of eID solutions by the targeted group. Particularly, the participants observed security and usability risks. Biometrics authentication could become a technological barrier for the users since the homeless people do not usually possess a smartphone device. It could also be challenging to take a picture of the face or documents especially for the drug affected people or

individuals with remarkable visual changes in their face appearance (e.g., makeup or facial injuries). Vulnerable citizens conventionally lack in digital literacy to comprehend the electronic identification. This inexperience could create a risk of exposing their personal information online for a possible abuse.

To overcome these issues and mitigate the risks, the participants devised an external interface for embedding the software running IMPULSE eID. This interface should enable biometrics authentication with the camera installed on the lockers stand. Moreover, the participants considered additional user support for the onboarding process. The offered solutions included SMS notifications sent for verifying procedures and assistant staff who would provide a vulnerable citizen with guidance for onboarding and authenticating on-site.

2.4.2 ERTZ

The co-creation workshop in Basque Country, Spain was conducted in a physical setting of the police department facility. This case study is aimed at exploring the potentials of IMPULSE technologies in digital services such as the filling of crime complaints online through the website of Ertzaintza. Biometrics authentication is premised for improving experience for the citizens and service providers and reducing procedural tensions in the police investigation workflow.

The total number of attendees was 17 represented by telecom experts, system analysts, investigation agents, police officers, and the people whose occupation was not corresponded to the police duties. Table 2 outlines the key findings from the workshop session.

Table 2: Co-creation workshop findings in ERTZ.

Exercise step	No.	User statement	Category
01	**01**	*"Minimize waiting time"* *"Speed"* *"Resource saving"* *"Comfortable"*	Usability, Effectiveness, Efficiency
01	**02**	*"Less people in the police station"* *"I will not move to the police station again"*	Environmental, Usability
02	**01**	*"Fake complaints"* *"Easy way for lying"*	Document verification, Security
02	**02**	*"Similar tech already exist, why should I choose IMPULSE?"* *"Here in Basque Country, we needed to download BakQ, now this?"* *"Do I have to download a different app for each administration?"*	Environmental, Replaceability, Co-existence, Interoperability
02	**03**	*"Identity theft"* *"Could be hacked"*	Management of VCs, Data protection, Security, Confidentiality
02	**04**	*"Not available for all the devices in the market"* *"All the devices don't have facial recognition system"* *"The older people could have problems with this technology"*	Accessibility, Portability, Usability
02	**05**	*"Legal validity"* *"Information gaps"* *"Complaints can be accumulated without verifying identity"* *"The police officer doesn't have the chance to ask about the complaint"* *"The complains could be deficient"*	Compatibility, Environmental

Exercise step	No.	User statement	Category
03	**01**	*"It should not be an automatic process when involving third parties"* *"Validate the registration process in the tool with an authority that can validate identity"*	Authentication, Document verification, Security, Compatibility
03	**02**	*"The same tool for all the public system"* *"Normalization of using the app from citizens"*	Compatibility, Environmental
03	**03**	*"A video-call system available"* *"Explanation videos available"* *"Informative talks on the use of the tool in elderly people's centres"*	Onboarding, Authentication, Management of VCs, Accessibility, Appropriateness recognisability, Usability, Learnability
03	**04**	*"The tools should be able to detect fakes"* *"Legal warnings"*	Authentication, Document verification, Face verification, Security, Integrity

In the first step of the workshop exercise, the participants agreed that the solution could help reduce the resource costs and consequently speed up the process of proofing the citizen's identity who submit the crime complaint using the online service. This could lead to a decreased number of people who would be physically present in the police department dealing with the complaints.

On the negative sides, the participants were more concerned with the potential rise of fake complaints along with the other risks for disrupting the complaints processing. Particularly, these risks might cause information deficiency as the citizens, released from the necessity to come to the police department, might be reluctant to elaborate on them. The participants recognised significant risks in security and accessibility of the technology to the elderly people. It is not guaranteed that these citizens have a compatible smartphone device or have a sufficient experience of using it in everyday life. Another aspect that was discussed is the overburden and saturation caused by the new technology. The participants found the idea of introducing another electronic identification solution frustrating and unreasonable, although the underlying technological features were not recognised as an advantage. At the same time, interoperability with the legacy of the local electronic identification scheme and regulation compliance was considered as an important issue.

To confront possible fake applications and secure the service providers' reliance on the technology, participants stressed the system's ability to detect malicious user activity and dubious credentials. Compliance to legal regulations could be prompting for the ubiquity of the eID solution and its uptake in the local electronic identification ecosystem. To ensure IMPULSE is accessible for the elderly people, the participants proposed to enable video descriptions and guiding elements in the interface. This way, the user could be supported when onboarding and managing verifiable credentials.

2.4.3 GIJON

The City of Gijón, Spain, offers various public services to its residents who are the holders of the “Citizen Card”. The card is recognised as the *de facto* identity document in the municipality, and therefore, in this pilot, IMPULSE is set to provide with authentication mechanism for the issuance of the card to the city residents.

To explore stakeholders’ anticipations and position their envisaged eID solution based on AI and blockchain technologies, the city council held a co-creation workshop in the municipality premise with 15 participants. The attendees were representing the residents and employees of different public service providers of the city. More than a half of the workshop participants, being of middle age, were women.

Table 3 provides with the summary of findings from the GIJON workshop.

Table 3: Co-creation workshop findings in GIJON.

Exercise step	No.	User statement	Category
01	**01**	*"Speed and agility"* *"Ease"* *"Simplification"*	Usability, Efficiency
01	**02**	*"No need to remember keys and passwords"* *"No need to remember so many passwords"*	Authentication, Usability
01	**03**	*"Integration with Europe"* *"<…> valid for all administrations and procedures of the EU"* *"Possibility of carrying out procedures in other countries"*	Environmental, Compatibility, Interoperability
01	**04**	*"It is positive to move towards new identification systems but they are immediate"* *"Motivating and very useful for electronic administration"* *"Remove unnecessary paper documentation"* *"Minimization of documentation, and <…> streamlining of procedures"* *"<...> facilitate the performance with more or less rapid and trustful identification"* *"Fewer discharge processes"*	Environmental, Functional appropriateness, Usability
01	**05**	*"Useful for people with motor disabilities"*	Usability, Accessibility
01	**06**	*"It is good it is validated by a human, given the possibility that [AI] deviates from its purpose"*	Authentication, Document verification, Security, Usability
02	**01**	*"Control"* *"The state monitors"* *"Security risks"* *"Could be safer"*	Data protection, Security, Usability
02	**02**	*"Not everyone is a user of new technologies or smartphones"*	Availability, Accessibility, Portability
02	**03**	*"<…> possibility that someone could impersonate someone using their photograph"* *"<…> very similar people such as twins"*	Authentication, Face verification, Document verification, Reliability, Security, Effectiveness
02	**04**	*"Difficult to explain to older people"* *"Installing the app for the first time"*	Accessibility, Learnability, Usability
02	**05**	*"Danger of artificial intelligence developing its own language"*	Security, Integrity, Reliability
03	**01**	*"<…> provide the system with a double authentication <…>"* *"<…> message type on the mobile <…>"*	Authentication, Functional suitability, Reliability
03	**02**	*"<…> the fact that a human had to verify the identity of the person was reassuring for many <…>"*	Authentication, Document verification, Security

Many of the positive expectations in GIJON were associated with usability of the eID solutions enabled with biometrics authentication. Performance speed and ease-of-use were highly regarded among both the regular citizens and service providers as the system would effectively utilise the resources and reduce unwanted tasks of working with the documentations. The service providers especially favoured the streamline of their procedures accompanied by the trustworthy identification solutions with AI. Some participants pointed the advantages the technologies bring to the people with motor impairments. Another key benefit was seen in the compliance with the EU digital identity infrastructures for a cross-board identification and access to public services.

At the same time, the participants were much concerned with the system's security and data protection aspects. The citizens did not want to expose themselves to a stricter government control with the unauthorised access to their data. Another breach could appear in case of authenticating by a person with similar facial features, twins, for example. The AI continuous evolvement could not be predicted and therefore was posing risks in that sense as well. The participants perceived the issues for technology accessibility as smartphone devices are not available to some, and this especially could become a barrier for the elderly people. The usability could be hindered at the earlier adoption stages, from installing the system to onboarding process.

However, the participants remained uncertain about the opportunities to overcome the above-mentioned issues as those were mainly perceived by the major environmental (organizational and behavioural) changes brought by the AI technology for identification. The dialectical discourse resulted in spreading opinions about the AI stating that the public officer should still be carrying out the procedures for verifying citizen identities. For solving the "twins" problem, the participants proposed to implement two-factor authentication, such as the OTP message sent to the identity owner's device.

2.4.4 MOP

The Municipality of Peshtera, Bulgaria, organised a co-creation workshop with a physical attendance of citizens in the administrative municipal building. In their case study, the public administration foresees IMPULSE eID in replacing the extant authentication through qualified electronic signature (QES) and enhancing the citizen's experience of accessing digital public services available on the website of the State eGovernment Agency.

The total number of the participants was 15 including the workers from education and health care sectors, lawyers, bank officers, economists, and unemployed people. The 35-45 age group was the most representative, while more than 10 of the attendees were women.

Table 4 provides with the summary of the workshop findings grouped by the exercise steps and requirement categories which were derived from the participants' statements.

Table 4: Co-creation workshop findings in MOP.

Exercise step	No.	User statement	Category
01	**01**	*"It will save time"* *"It will not be necessary to visit the municipality physically"*	Usability, Efficiency
01	**02**	*"It will facilitate the digital interaction between citizens and municipality"* *"It is not bound with timeframes"*	Environmental, Usability
01	**03**	*"It can increase security and privacy of personal data"*	Security, Usability
01	**04**	*"It can be an alternative to the current eID solutions"*	Environmental, Compatibility
02	**01**	*"No connection to internet and inability to use it"* *"Low speed of internet connection"* *"No smartphone - inability to use it"* *"Low battery of smartphone and inability to use the application"* *"Potential technical bugs"*	Availability, Reliability

Exercise step	No.	User statement	Category
02	**02**	*"Language barrier"*	Usability
02	**03**	*"Could be difficult to elderly people to use it"* *"Could be difficult to use it (not only to elderly people, but in general)"* *"Too complex to use it"*	Accessibility, Appropriateness recognisability, Usability
02	**04**	*"Problem with selfie - inadequate lightning, or using a facemask"*	Face verification, Effectiveness, Reliability
02	**05**	*"Working on just one device"*	Portability, Usability
02	**06**	*"Leakage of personal data"* *"<...> leakage of data was mainly associated to lost/steal of the smart device."*	Data protection, Security, Confidentiality
03	**01**	*"To provide opportunity to work on more than one device"* *"To provide opportunity to work on different operating systems, not only android but also windows"* *"It should provide a transferability option in case of change of smartphone"* *"Use the app offline"*	Availability, Portability, Usability
03	**02**	*"To provide alternative ways for initial identification of citizens during the registration procedure: for example, to use ID number and do this with the help of municipal officer"* *"Elderly people should receive support from municipal officer (facilitator)"*	Onboarding, Environmental
03	**03**	*"Help menu and questions section but they also should be in Bulgarian"* *"Support with a sound/voice file, not only written instructions"* *"Bulgarian language of the App"*	Accessibility, Appropriateness recognisability, Usability, Learnability
03	**04**	*"The app should be free of charge to citizens"*	Environmental, Usability
03	**05**	*"The app should use very small data, so that we can use it at very low internet speeds"*	Resource utilisation, Performance efficiency
03	**06**	*"It should have the possibility to be protected with a password"* *"To have alternatives of Facial ID - it could be for example a fingerprint, so that in cases of low light and facemask, the citizen can use the app with a fingerprint"*	Authentication, Reliability, Functional suitability

After IMPULSE introduction and a video demonstration of the prototype, the participants shared their first impressions. They envisioned positive changes in the existing processes of services' provision brought with the time efficiency and facilitation of interactions between citizens and municipality by the means of digital technologies. This changes would result in reduced necessities for visiting municipal premises physically, as the IMPULSE eID would allow for authorising in public services online, without the location and time constraints. It was also seen as a promising alternative for the current electronic identification solutions available to the citizens.

However, the language barrier was a considerable usability issue as the lack of Bulgarian language would have made the solution less appealing and accessible. The participants also recognised technological complexity of

IMPULSE which poses difficulties for using it by the elderly people. Another concern associated with technology availability was a dependency on smartphone device. Moreover, the eID solution is virtually unavailable without a stable internet connectivity. In relation to this, low internet speed and possible connection disruptions were given a particular emphasis. Regarding the system performance, the participants were uncertain about the face recognition functionality in inadequate light conditions or if a user would be wearing a face mask. A risk of potential data leakage was also concerning, although the data controllership by user was not considered in that sense.

For addressing these problems, the participants devised some solutions to incorporate in IMPULSE eID design. First, the system should provide with spoken and video guidance available in Bulgarian language. This would make the solution accessible to a wider range of users including the elderly people. The user support with onboarding could also be provided on behalf of the civil servants which would require organisational changes. It is worth mentioning that the participants stressed the availability of the eID solution without any payment due. The participants also wished for the alternatives that would allow for using the eID solution on another device or system and therefore the ability to transfer their personal data between the devices. Additionally, some attendees stated that the software application should be using less data for dealing with low internet connectivity. Finally, the participants expressed some enthusiasm for the biometrics alternatives to face verification, such as the fingerprint and password verification methods that would help overcome the image processing quality issues.

2.4.5 RVK

The Reykjavík case is premised on the Icelandic state operating an e-certification key distribution system (PKI Iceland) and issuing electronic certificates to eID providers (so-called trust services) in compliance with both local and EU requirements and standards for the Internal Market. The goal of this system is to provide a common distribution key structure and certifications for both the economy and the public sector and for them to provide their services inter-operationally where needed. Accordingly, the RVK case is defined as an 'eRegistry' case study (see D2.1), taking into account that the vast majority of the population already uses eIDs to access all sorts of online services (public and private) each of which require verifiable identification, including for e-signatures, and for which existing eIDs are certified (e.g., the banks, the Inland Revenue Department of state and the Child Support Collection Centre of the Icelandic municipalities, to name a few).

The solutions developed by IMPULSE are significantly different from existing arrangements in the sense that: 1. they rely on facial recognition for identification purposes and AI for registering into the system (onboarding) in the comforts of one's home; and, 2. they use blockchain for traceability of records and suggest a shift towards Self-Sovereign Identities. While the latter is not at issue for the purposes of the RVK case study pilot and the co-creation activities associated with it, the former serves as a catalyst to investigate more closely accessibility issues facing vulnerable groups, e.g., those who struggle to operate keyboards, live with physical/motor or other impairments, and might need to be registered by their careers. At the same time, IMPULSE is an opportunity for the Reykjavík City administration to investigate the use of eIDs that are based on facial recognition as a serious contender and a genuine alternative to existing eID solutions for the general population. Reykjavík City is the largest provider of services to publics in Iceland.

In order to achieve these objectives, the RVK case chose a public service for piloting which is an online participatory democracy portal "Betri Reykjavik" (Better Reykjavik) developed in collaboration with a non-profit organisation. Through this online platform, resident can initiate discussions on topics of public concern and the administration can initiate consultation so, anyone can comment on different proposals to solve urban challenges, guide in policymaking, and so on. IMPULSE will generate an instance of this module specifically to test IMPULSE technologies while also discussing and debating their implications

The main benefit expected from the integration of the IMPULSE eID solution into this platform is the provision it affords for involving vulnerable residents (and their carers) in public discussion and debate on issues of e-accessibility and inclusion, prioritisation in public services, and similar. The case owner also sees potential benefit in broadening the scope of participants in both the co-creation activities and the pilots, precisely because IDs are already widely adopted by the general population, including the groups of citizens described as older and/or women in the IMPULSE DoA. This is to say, the IMPULSE project raises a number of general concerns that can be categorised as 'dimensions' for consideration and debate. For example, one dimension is to consider the fact more broadly that p*ublic services are undergoing a digital transformation* and what the wider implications are of the changes that may follow. *Online instruments have to be 'in hand' and 'at home' for users*. Are they? If so or if not, how and why? *Contexts for verifiable identification are under scrutiny*. Where and when do I absolutely have to proof who I am? When is it non-essential and should not at all be

required? *Accessibility issues are under scrutiny*. Are we leaving people behind and are we making everyday lives far too cumbersome for some, not others?

A list of roughly 160 persons was devised for invitations. There amongst were people from the disability allegiance and similar groups and task forces defending the interests of disadvantages persons, RVK also included persons from the city administration, those who operate the welfare technologies lab but also people who serve as digital officers and those who are at the heart of the digital transformation programme. Finally, a small number of persons where included, who have been publicly vocal about accessibility issues and prioritisation in public (municipal) social services because they have felt in on their own skin as parents and carers. Unfortunately, RVK did not manage to recruit enough participants in time for the workshop to go forward but is eager to make another attempt once the communications and networking with relevant stakeholder groups is further along.

2.4.6 UC/IC

The Italian case study is focused on testing IMPULSE eID solution by the legal representatives who are acting on behalf of their business organisations when applying for the public services. Therefore, the pool of the workshop attendees in UC/IC primarily comprised of entrepreneurs followed by the national authorities and InfoCamere specialists who are working with the Italian Business Register. Most of the 13 participants were of 45-55 age group, and mainly represented by men.

The workshop findings are listed in Table 5 below presenting the key statements that were made throughout different exercise stages.

Table 5: Co-creation workshop findings in UC/IC.

Exercise step	No.	User statement	Category
01	**01**	*"Useful to use when travelling in EU, to get access to services, hospitals, travel tickets, documents, hotel checkins…"* *"No dependency to any third party"*	Environmental, Adaptability, Usability
01	**02**	*"Time saving and less thing to keep in mind"* *"Less password to bear in mind"*	Usability, Efficiency
02	**01**	*"Connection problems (flat smartphone or connection issues)"* *"Broken smartphone"*	Availability, Reliability
02	**02**	*"How do photos get processed and stored?"* *"Using only photos can make identity theft easier?"* *"Where are my data stored?"*	Data protection, Security, Confidentiality, Transparency
02	**03**	*"What happens if I change my look (e.g., glasses)?"* *"Document photo and online photo do not match"* *"What if two people look very similar?"* *"Document checking: is the visual check strong enough?"* *"Is the document checking reliable?"*	Authentication, Face verification, Document verification, Reliability, Effectiveness, Security
02	**04**	*"Businessmen usually delegate the access to secretary or other. Is this an issue?"* *" How does it work with a mentor?*	Authentication, Management of VCs, Reusability, Operability
03	**01**	*"Retrain the system on demand or periodically"* *"<…> ask the user to correct biometric data, training the App again over its "current " face in order to incorporate some "face changes" that may have occurred over time <...>"* *"AI tools must be "strong" and reliable"*	Time behaviour, Adaptability, Usability, Reliability

Exercise step	No.	User statement	Category
03	**02**	*"The app generates something (text code, QR code) that I can manually enter on the "service" interface, or is read by the "service""* *"I could use bluetooth or NFC to "unlock" the service"*	Interoperability, Compatibility, Adaptability
03	**03**	*"Photo must be stored in a safe and secure way"* *"<…> IMPULSE should make sure photos are not accessible from other then the owner <…>"* *"<…> photos should be dumped right after the usage of them (no photos storage)"*	Security, Confidentiality, Authenticity
03	**04**	*"<…> it could be possible to access services also through voice recognition via call center"*	Environmental, Adaptability
03	**05**	*"Extra field labelled "Mentor/Proxy" needed"* *"Proxy managed by the service itself and not by IMPULSE"* *"ACL integration and granular authorizations"*	Accountability, Operability, Usability
03	**06**	*"I can use the fingerprint"* *"<…> voice recognition instead of just face recognition <…>"* *"<…> an OTP code, to be sent to the phone, to make the process safer"*	Authentication, Reliability, Functional suitability

From the D2.1 stakeholder analysis, it was known that the attendees were the confident users of the Italian eID schemes, such as SPID (Sistema Pubblico di Identità Digitale) and CNS (Carta Nazionale dei Servizi). Nevertheless, the positive impressions evoked in participants by the introduction of IMPULSE design were linked to the system's usability and effectiveness. Biometrics authentication was seen as advantage compared to using a password in terms of its time efficiency and convenience. An idea of using the eID solution without mediations from a third-party while travelling in EU backed this appeal.

In turn, the main concerns were associated with the risks around the security and the uncertainties about personal data storage along with the reliability of the face and document verification mechanisms. The entrepreneurs stated they should be aware of how and where the credentials connected to their personal and business identities are processed. The face recognition in eID solution might be hindered if a person changed her/his appearance (e.g., wearing glasses) or if the document photo was outdated and therefore the system would be challenged to match it with the actual look of the user. The participants also recognised internet connectivity problems and a broken smartphone impeding user's ability to access service with IMPULSE. A special attention was drawn regarding the management of verifiable credentials and authentication processes. Since one single enterprise could be represented by different officials, the entrepreneurs were questioning the ability to operate one business identity by multiple users.

These challenges were addressed with the solutions, the participants devised working in smaller groups. Particularly, one group stressed the AI tools' reliability to ensure face verification performs appropriately. The eID solution should also provide with the ability to "retrain" biometrics model on user's demand or periodically to keep it relevant and secure system's availability. To deal with the disruptions in internet connection, the participants came up with the functionality for code generation (either composed of symbols or QR code) that would be stored on the user's device and therefore allowed for accessing the services while offline. For troubleshooting and user support, a call-centre was mentioned. To operate with IMPULSE eID by multiple users on behalf of a business organisation, the participants proposed integrating access control lists (ACL) and self-service on proxy management.

3 Refined set of requirements

After the preliminary analysis of the co-creation workshops' summaries, the results which reflected the user statements and corresponding software qualities were compared in a cross-case analysis. For that purpose, the statements were grouped by the context were assigned with unique identifiers which reflect the case study origin, the nature of the requirement (i.e., 01 – user expectation, 02 – user pain point, 03 – user need), and a serial number. The identified similarities and contrasts allow for transforming the statements into user requirements and mapping them with the literature-based set (D2.2) and ASR (D2.7) to refine the formal IMPULSE requirements.

3.1 Cross-case analysis of the results

The analysis of the co-creation workshops' results revealed certain similarities and differences in the requirements that were mainly referring to the specifics of the case studies. In a cross-case comparison, the contrasts in stakeholders' implications and expectations from the eID solution became more apparent. This was associated with the target profiles of IMPULSE pilot participants explored in D2.1 through the interviews with stakeholders. It was noted that the contrasts were corresponding to different levels of trust and confidence in knowing how to use the technologies on behalf of the targeted user groups. However, the design of the co-creation sessions was not specifically aimed at exploring user's familiarity with the technologies underlying IMPULSE. Instead, the participants were encouraged to take the role of experts of the eID solution through cooperative design process. The following tables present the differences and similarities in the results of this process between the case studies.

One of the most recurring issues mentioned during the workshops was linked to security and reliability of the AI part in eID solution. The participants had doubts about face recognition and document verification mechanisms performing in various surroundings and at different periods of time. For example, the visual changes in face appearance and mismatch between the document and face photographs were questioned by the users. The relevant statements listed in Table 6 reflect those concerns.

Table 6: User concerns about reliability of face and document verification functionalities.

Req. ID	User statement	Category
ARH-02-02	*"Drug affected citizens can not always handle to take a selfie"* *"Can the document box be accessed if citizens' faces have changed due to e.g. violence or makeup"*	Face verification, Reliability, Effectiveness
MOP-02-04	*"Problem with selfie - inadequate lightning, or using a facemask"*	Face verification, Reliability Effectiveness
ERTZ-02-01	*"Fake complaints"* *"Easy way for lying"*	Document verification, Security
GIJON-02-03	*"<…> possibility that someone could impersonate someone using their photograph"* *"<…> very similar people such as twins"*	Authentication, Face verification, Document verification, Reliability, Security, Effectiveness
UC-02-03	*"What happens if I change my look (e.g., glasses)?"* *"Document photo and online photo do not match"* *"What if two people look very similar?"* *"Document checking: is the visual check strong enough?"* *"Is the document checking reliable?"*	Authentication, Face verification, Document verification, Reliability, Effectiveness, Security

On the other hand, the idea of implementing biometrics authentication in IMPULSE technology was not found intrusive per se. In fact, in some cases the participants were rather enthusiastic about it and to overcome the above-mentioned issue suggested using even fingerprint or voice recognition as a workaround method.

However, the "traditional" password and, particularly its OTP kind (one-time password) were also seen as way to secure user's authentication. Table 7 summarises these ideas.

Table 7: User statements about the methods of authentication.

Req. ID	User statement	Category
ARH-01-04	*"<…> the facial recognition part of the solution seems advantageable for the citizens to quickly access the self-service solutions."*	Environmental, Compatibility, Usability
GIJON-03-01	*"<…> provide the system with a double authentication <…>"* *"<…> message type on the mobile <…>"*	Authentication, Functional suitability, Reliability
MOP-03-06	*"It should have the possibility to be protected with a password"* *"To have alternatives of Facial ID - it could be for example a fingerprint, so that in cases of low light and facemask, the citizen can use the app with a fingerprint"*	Authentication, Reliability, Functional suitability
UC-03-06	*"I can use the fingerprint"* *"<…> voice recognition instead of just face recognition <…>"* *"<...> an OTP code, to be sent to the phone, to make the process safer"*	Authentication, Reliability, Functional suitability

Nevertheless, in two workshops the participants argued that the public officers should retain the authority to validate the identity of the registered/onboarding users. Table 8 provides with the example of these statements.

Table 8: User needs for manual verification by civil servant.

Req. ID	User statement	Category
ERTZ-03-01	*"It should not be an automatic process when involving third parties"* *"Validate the registration process in the tool with an authority that can validate identity"*	Authentication, Document verification, Security, Compatibility
GIJON-03-02	*"<…> the fact that a human had to verify the identity of the person was reassuring for many <…>"*	Authentication, Document verification, Security, Usability
GIJON-01-06	*"It is good it is validated by a human, given the possibility that [AI] deviates from its purpose"*	Authentication, Document verification, Security

In Ertzaintzia workshop, the participants stressed the system's ability to detect forged attempts of authentication using fake photographs which user submit for the onboarding process. And in the Italian case study, the participants suggested to provide the user with ability to "retrain" the face verification mechanism periodically or on demand for addressing the issue of appearance' change. These two user requirements are garnered in Table 9 below.

Table 9: User needs for enhancing face verification in eID system.

Req. ID	User statement	Category
ERTZ-03-04	*"The tools should be able to detect fakes"* *"Legal warnings"*	Authentication, Document verification, Face verification, Security, Integrity

Req. ID	User statement	Category
UC-03-01	*"Retrain the system on demand or periodically"* *"<…> ask the user to correct biometric data, training the App again over its "current " face in order to incorporate some "face changes" that may have occurred over time <...>"* *"AI tools must be "strong" and reliable"*	Time behaviour, Adaptability, Usability, Reliability

At the same time, the participants recognised technological complexity of IMPULSE which could become a barrier for the elderly people and vulnerable citizens to use it. For this reason, the participants were advocating the support enabled by the means of spoken and video descriptions in IMPULSE user interface. In addition to this, an external support could be provided by the public authorities for the onboarding process, especially to the elderly people. The user statements aimed at enhancing IMPULSE accessibility are listed in Table 10.

Table 10: User needs for increasing system's accessibility.

Req. ID	User statement	Category
ARH-02-03	*"Users do not understand the eID solution"*	Onboarding, Management of VCs, Accessibility, Appropriateness recognisability, Usability
GIJON-02-04	*"Difficult to explain to older people"* *"Installing the app for the first time"*	Onboarding, Accessibility, Learnability, Usability
ERTZ-03-03	*"A video-call system available"* *"Explanation videos available"* *"Informative talks on the use of the tool in elderly people's centres"*	Onboarding, Authentication, Management of VCs, Accessibility, Appropriateness recognisability, Usability, Learnability, Adaptability
MOP-03-02	*"To provide alternative ways for initial identification of citizens during the registration procedure: for example, to use ID number and do this with the help of municipal officer"* *"Elderly people should receive support from municipal officer (facilitator)"*	Onboarding, Environmental, Adaptability
MOP-03-03	*"Support with a sound/voice file, not only written instructions"* *"Help menu and questions section but they also should be in Bulgarian"*	Accessibility, Appropriateness recognisability, Learnability

Interoperability of IMPULSE eID with the external interfaces was much desired since the smartphone dependency was perceived as a problem hindering the systems' availability. Particularly, in ARH case study the participants stressed the difficulties vulnerable citizens would have operating the smartphones. The availability issue also extends to low internet connectivity and potential disruptions in networks. Considering this problem would preclude the user from accessing public services, the participants agreed that the solution requires additional mechanisms for using verifiable credentials stored in the device while in "offline" mode or with a limited internet connection. The proposed solutions for securing system's availability are summarised in Table 11.

Table 11: User needs for system's availability.

Req. ID	User statement	Category
ARH-03-01	*"Possible SMS-solution"* *"Can the camera be on the document box (instead of the smartphone)"*	Portability, Interoperability, Adaptability
MOP-03-01	*"To provide opportunity to work on more than one device"* *"To provide opportunity to work on different operating systems, not only android but also windows"* *"It should provide a transferability option in case of change of smartphone"* *"Use the app offline"*	Availability, Portability, Adaptability
MOP-03-05	*"The app should use very small data, so that we can use it at very low internet speeds"*	Resource utilisation, Performance efficiency
UC-03-02	*"The app generates something (text code, QR code) that I can manually enter on the "service" interface, or is read by the "service""* *"I could use bluetooth or NFC to "unlock" the service"* *"<...> hybrid service or "offline" service <...>"*	Interoperability, Adaptability, Compatibility
UC-03-04	*"<...> it could be possible to access services also through voice recognition via call center"*	Environmental, Adaptability

It is noteworthy that data controllership by the user was given less attention, although system's security and data protection were much more in focus. The participants required transparency for data processing and storage location to ensure safe and appropriate use of the eID solution. Several ideas were proposed to address this issue as it was mainly the topic on the second exercise of the workshop. The following Table 12 provides with the summary of the relevant user statements.

Table 12: User concerns about data protection and security.

Req. ID	User statement	Category
ARH-01-01	*"A "democratic" solution citizens own by themselves. Data not controlled by authorities."* *"Confidence in that personal data are not stored on multiple servers"*	Management of VCs, Security, Confidentiality
ARH-02-01	*"It's a risk that people know where you store your personal information and therefore can be threatened to open the document box."* *"Can someone be forced to open their drawer so that personal information can be stolen?"*	Management of VSc, Security, Confidentiality, Environmental
GIJON-02-01	*"Control"* *"The state monitors"* *"Security risks"* *"Could be safer"*	Data protection, Security, Usability
ERTZ-02-02	*"Identity theft"* *"Could be hacked"*	Management of VCs, Data protection, Security, Confidentiality
MOP-02-06	*"Leakage of personal data"* *"<...> leakage of data was mainly associated to lost/steal of the smart device."*	Data protection, Security, Confidentiality

Req. ID	User statement	Category
UC-02-02	*"How do photos get processed and stored?"* *"Using only photos can make identity theft easier?"* *"Where are my data stored?"*	Data protection, Security, Confidentiality, Transparency
UC-03-03	*"Photo must be stored in a safe and secure way"* *"<…> IMPULSE should make sure photos are not accessible from other then the owner <…>"* *"<…> photos should be dumped right after the usage of them (no photos storage)"*	Security, Confidentiality, Authenticity

The participants sought resource and time efficiency in IMPULSE usability features. The advantages were anticipated in a sense of facilitating the interactions between the citizens and service providers. The participants expected the environmental (organisational) changes for the user, associating it with the reduced necessity of a physical presence in the municipal premises when applying for public services. The common implications from IMPULSE usability and its environmental impacts are summarised in Table 13.

Table 13: User implications from system's usability.

Req. ID	User statement	Category
ARH-01-02	*"Digital inclusion of all citizens"* *"Citizens can access the document box in safe environments - not only municipal facilities"* *"Digital safety for both employees and citizens"* *"Fewer conflicts (with user group)"*	Compatibility, Environmental
GIJON-01-04	*"Motivating and very useful for electronic administration"* *"Minimization of documentation, and <…> streamlining of procedures"* *"<...> facilitate the performance with more or less rapid and trustful identification"* *"Fewer discharge processes"*	Environmental, Usability
ERTZ-01-02	*"Less people in the police station"* *"I will not move to the police station again"*	Environmental, Usability
MOP-01-01	*"It will save time"* *"It will not be necessary to visit the municipality physically"*	Usability, Efficiency
MOP-01-02	*"It will facilitate the digital interaction between citizens and municipality"* *"It is not bound with timeframes"*	Environmental, Usability
UC-01-01	*"No dependency to any third party"*	Environmental, Compatibility, Usability

In the Italian case study, where the target users were represented by the entrepreneurs and business officials, the participants were anticipating IMPULSE eID to provide with the functionality to operate with verifiable credentials by multiple electronic identities of the users on behalf of a common business organisation. These electronic identities should only be accessible by their respective owners, while the access control is managed by the "mentor" of the account system. The statements on enabling such user account system and access control mechanism are presented in Table 14 below.

Table 14: User need for account system and access control.

Req. ID	User statement	Category
UC-03-05	*"Extra field labelled "Mentor/Proxy" needed"* *"Proxy managed by the service itself and not by IMPULSE"* *"ACL integration and granular authorizations"*	Accountability, Operability, Usability

In some case studies, the participants envisioned the use of the IMPULSE technology as an electronic identification solution applicable across the European digital infrastructure. In turn, the "sceptical" users were more restrained, questioning the systems' interoperability with extant electronic identification scheme under local regulations. Therefore, the systems' uptake by the citizens and its upscale for public services are necessary for facilitating the adoption. These contrasts are reflected in Table 15.

Table 15: User statements on system's compatibility with the eID schemes.

Req. ID	User statement	Category
ARH-01-03	*"The possibility to use my eID in other EU countries"*	Environmental, Adaptability, Usability
UC-01-01	*"Useful to use when travelling in EU, to get access to services, hospitals, travel tickets, documents, hotel checkins…"*	Environmental, Adaptability, Usability
GIJON-01-03	*"<…> valid for all administrations and procedures of the EU"* *"Possibility of carrying out procedures in other countries"*	Environmental, Compatibility, Interoperability
MOP-01-04	*"It can be an alternative to the current eID solutions"*	Compatibility, Environmental
ERTZ-02-02	*"Similar tech already exist, why should I choose IMPULSE?"* *"Here in Basque Country, we needed to download BakQ, now this?"* *"Do I have to download a different app for each administration?"*	Environmental, Replaceability, Co-existence, Interoperability
ERTZ-03-02	*"The same tool for all the public system"* *"Normalization of using the app from citizens"*	Compatibility, Environmental

3.2 IMPULSE user requirements

The resembling features of the user needs and concerns identified in the cross-case analysis allowed for transforming the user statements into formal requirements. The general set from the first version (D2.2) was refined with the new findings which do not exclude the previous but rather complement and articulate them. Therefore, the requirements were validated by mapping them with ASRs and literature-based requirements. Table 16 contains the non-exhaustive IMPULSE requirements specification with the reference to the pilots and system's quality model dimensions.

Table 16: Refined specification of IMPULSE requirements

Req. ID	Description	System quality	Pilot reference	Featured ASR (D2.7)
1	The IMPULSE system shall keep users' personal data and location confidential	Data protection, Security	ARH-02-01, ERTZ-02-03, GIJON-02-01, MOP-02-06	FR-15, QA-04, QA-05, QA-06

Req. ID	Description	System quality	Pilot reference	Featured ASR (D2.7)
2	The IMPULSE system shall be interoperable with the legacy (national) e-ID schemes to ensure user uptake	Compatibility	ARH-01-03, ERTZ-03-02, GIJON-01-03, MOP-01-04, UC-01-01	FR-06, QA-18, DD-01, DD-03
3	The IMPULSE system shall allow reusing VC in the ecosystem	Compatibility	ARH-01-02, ERTZ-02-02, ERTZ-03-02	QA-18, DD-08
4	The IMPULSE system shall inform users about the processing of their data	Transparency, Security	ARH-01-01, UC-02-02	FR-12, FR-13, FR-16, QA-15, QA-16, QA-17
5	The IMPULSE system shall prevent unauthorised access and processing of user data	Data protection, Security	ARH-01-01, GIJON-02-01, MOP-01-03	FR-07, FR-09, FR-10, FR-14, QA-05
6	The IMPULSE system shall provide users with informed consent in a legal language and accessible with dedicated icons	Transparency, Usability	ERTZ-03-05	QA-16
7	The IMPULSE system shall allow users to control their data in a self-sovereign manner	Security	ARH-01-01, UC-02-02	FR-07, FR-14
8	The IMPULSE system shall reduce cognitive burden (remembering many user accounts and passwords) for users	Authentication, Usability	ARH-01-04, ERTZ-01-01, GIJON-01-02, UC-01-02	QA-10
9	The system should provide simple and well-guided user actions when collecting image samples for face recognition	Onboarding, Usability	ARH-02-02, MOP-02-03	QA-09
10	The IMPULSE system shall provide users with spoken and visual guidance and descriptions of the interface in their native language	Usability	ARH-02-03, ERTZ-03-03, GIJON-02-04, MOP-03-03	QA-08, DD-07
11	The IMPULSE system shall provide users with support and troubleshooting mechanisms available in their native language	Usability	MOP-03-03	FR-12, FR-13, FR-17, DD-07
12	The IMPULSE system shall detect forged or tampered attempts of generating VC or cases of using the actual VC by unauthenticated user	Security	ERTZ-02-01, ERTZ-03-04	FR-01, FR-02, FR-03, FR-05, FR-09, QA-01, QA-02, QA-13, QA-14
13	The system shall be able to recognise faces captured from images with different resolutions and illumination	Face verification, Usability, Reliability	ARH-02-02, MOP-02-04, UC-02-03	QA-01, QA-02, QA-07

Req. ID	Description	System quality	Pilot reference	Featured ASR (D2.7)
14	The system shall be able to recognise text from images of identity cards or passports of varying quality, illumination, resolution, and focus	Document verification, Usability, Reliability	UC-02-03	QA-01, QA-02, QA-03
15	The IMPULSE system shall remind users if the VC is getting expired in a near time due to long idle and therefore offer them to "retrain" the system or generate renewed VC (face appearance changes afftect True Positive Rate)	Face verification, Management of VCs, Performance Efficiency, Usability, Reliability	UC-03-01	FR-04, FR-05, FR-09
16	The IMPULSE system shall have reduced data usage so that it optimises network use via cellular and WiFi connection	Performance Efficiency	MOP-03-05	-
17	The IMPULSE system shall issue a challenge to verify that the user who is trying to authenticate is the owner of the VC (e.g., OTP via SMS or email)	Authentication, Functional Suitability, Reliability	ARH-03-01, GIJON-03-01, MOP-03-06, UC-03-06	FR-09, DD-05
18	The IMPULSE system shall send a presentation request to the PA in charge of the requested online service	Authentication, Document verification, Security	ERTZ-02-05, ERTZ-03-01, GIJON-01-06, GIJON-03-02	FR-11, DD-02
19	The IMPULSE system shall store user's VC and the public-private key pair in the user's control in their own device to be operable regardless of the internet connectivty state	Management of VCs, Functional suitability	MOP-02-01, MOP-03-01, UC-02-01, UC-03-02	FR-07, DD-04
20	The IMPULSE system shall provide users with the ability to transfer their data to another personal mobile device	Management of VCs, Portability, Reliability, Usability	ERTZ-02-04, MOP-03-01, UC-02-01	CC-01
21	The IMPULSE system shall be available on different interfaces for accessing the public service on-site	Management of VCs, Authentication, Portability, Usability	ARH-02-04, ARH-03-01, GIJON-02-02, UC-03-02	CC-01
22	The IMPULSE system shall have integrated ACL mechanism to use a particular e-ID if multiple VCs are stored on the user device for accessing a public service	Management of VCs, Functional suitability, Security, Usability	UC-02-04, UC-03-05	FR-18, DD-06
23	Biometrics and other personal identity data should be encrypted and deleted from device storage after being processed	Data protection, Security	MOP-02-06, UC-03-03	QA-06

4 Conclusions

The first version of the IMPULSE requirements specification (D2.2) was produced based on the findings from the literature review and the workshop conducted internally with the members of the Consortium. These activities delivered the general set of requirements for the eID solution that was subsequently adapted and refined to the specifics of pilots that are planned in M19–M21.

To accomplish this, the second version of the IMPULSE specifications set the objective to uptake the co-design practices in the requirements elicitation process and upscale the user-centred design approach to six case studies. It introduced the co-creation workshop template developed by the research team (LUT) for eliciting the IMPULSE requirements together with the prospective users of the eID technology. The workshop was structured to encourage the participants who were representing various groups of citizens and service providers to take up the role for designing the solution that should closer suit their needs. To enable this, the participants followed a step-by-step process aimed at capturing those needs from three different perspectives on the eID technology: positive expectations, user pain points, and possibilities for enhancing solution design.

The partnering organisations adopted a framework for executing co-creation activities to conduct the workshops in different instances of the pilots (see Figure 5). LUT and public administrations negotiated and set out necessary preparations that were aligned with the pre-piloting stage plan (D2.5). The front-end phase of these preparations comprised planning, resourcing, and recruiting activities. Following the DPA between LUT and Case Study Owners, the municipalities arranged data management facilities for storing the data collected from the co-creation sessions with the prospective eID users. In turn, LUT disseminated the workshop template provided with the training sessions for facilitators from the public administrations.

The co-creation workshops were conducted in local languages of the respective case studies and the data, such as the audio and video recordings, was collected with the participants' consent. The English translations provided by the public administrations allowed for performing a cross-case analysis of the workshop outcomes and transforming the findings into formal set of the IMPULSE requirements.

While the latter activities essentially amount to the back-end of the co-creation methodology framework in IMPULSE, the results allowed for revisioning the second iteration of requirements elicitation and acknowledging the limitations which are discussed in the following subsection.

4.1 Limitations and future considerations

Similarly to the first iteration, the co-creation workshops were primarily aimed at remote interactions of participants mediated with online digital tools. Although at first this decision was justified by the extant restrictions imposed in municipalities due to coronavirus epidemic, not all the public administrations chose to conduct the sessions in a virtual setting given the positively changing epidemic situation at the time. These alternations in the workshop arrangements entailed some optimistic prospects for data collection allowing for direct interactions between the participants. The cooperative activities in a physical presence are prompting for empathising, communicating the problems, and articulating the concepts. At the same time, it was limiting remote observation of the workshop performance.

Nevertheless, the workshops were conducted in local languages of the respective case studies which already posed a barrier for direct participation of the researcher. Therefore, it was accepted that the data collected from the workshops is the subject to several levels of interpretations, i.e., first, it was the user needs identified by facilitators from the public administrations, and second, it was translated from the local language into English which could result in different stylistic representation of the initial statements.

Given the contextual differences of the pilots, the workshop template had to be designed more as the general exploratory activity for capturing user needs. To make it suitable for both physical and virtual environments with optimal resourcing, the selected methods constituting the exercises' structure could produce less personalised user statements. Hence, the quality of those statements was mostly dependent on the overall number of the workshop participants and their level of expertise in user interactions with the technology.

In general, the recruitment was rather steep for the workshops. For example, only eight persons registered in Aarhus (ARH) but the workshop went forward nevertheless with additional members of the partner team. The Reykjavík case (RVK) did not manage to get enough participants registered in time for the workshop to go forward, in spite of careful preparations, even postponement in attempt to improve the numbers. Both cases are centred on questions concerning vulnerable persons, issues of accessibility, usability, and usefulness, as

well as aiming for the involvement of vulnerable people as participants in the pilots later in the year. This raises the conclusion that researchers may have to rely on gate keepers, good will and personal connections to access certain target groups, especially vulnerable groups, and their spokespersons, as well as initiating communication and networking at early stages for a proper involvement and representation.

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Annex A Workshop enrolment templates

A.1 Invitation to the online workshop

Co-creation workshop invitation

[Dear person (if known)],

We would like to inform you about the initiative of [public administration] to participate in the research of the project "Identity Management in PUbLic Services" (hereinafter "IMPULSE" or "Project") www.impulse-h2020.eu . IMPULSE is funded by the Horizon 2020 Programme of the European Commission.

The project is aimed at designing electronic identification solution together with the prospective users: [citizens and business organisations – depending on the case study]. The users can take advantage of this technology when accessing public services. IMPULSE solution will allow the users to control their data provided to the public authorities [in case] and prove their identity across all European countries. By showing the face and ID document on the camera of their (mobile) device user can quickly and in a highly secure mode access their digital identity as well as manage their data.

[Public administration] being a member of the IMPULSE project consortium is delighted to invite you to join the Co-creation workshop. The event will take place [date] and will be **completely virtual**.

Objectives

The objective of this Co-creation workshop is to elicit requirements for the future IMPULSE system by envisioning its design together with the citizens and business organisations who can benefit from it.

You are **invited to share and discuss your ideas and expectations** of what the final IMPULSE solution should be like. Your experience, suggestions and feedback are very valuable for IMPULSE.

The ideas produced during the workshop will be transformed into requirements for the IMPULSE consortium in order to create a more suitable solution for potential users. Your support will contribute to the design of the future technology!

Structure

> **Format:** Brainstorming and discussion sessions
>
> **Location:** Online, Zoom/MS Teams and Miro board
>
> **Duration:** 1,5 – 2 hours

During the Co-creation workshop, firstly you will be introduced to the concept of IMPULSE solution and what are the technologies behind its implementation.

Secondly, you will be invited to devise the features of the IMPULSE solution that you, as a potential user, would want to use.

Finally, discussions will follow to flesh out these features and share different opinions on how it can make IMPULSE solution more appealing.

The results of the workshop will only be dealt within the framework of the IMPULSE consortium and will under no circumstances be passed on to third parties.

We would highly appreciate your attendance and feedback. If you are interested in taking part in the IMPULSE Co-creation workshop, please reply to this email and we will send you the registration instructions. The workshop agenda will be sent nearer the date along with links to the session.

Thank you for your interest!
For further information please contact [organiser's email].

A.2 Registration and consent form template

Workshop participant registration and consent form

Dear participant, to enrol for the workshop session, please, fill out the registration form below and familiarise with the terms of data collection and processing before giving your consent on the final page of the present document.

Name

Contact email

Job title/Occupation

Age group

☐ 18-34 ☐ 35-54 ☐ 55-64 ☐ 65+ ☐ Prefer not to answer

Gender

☐ Female ☐ Male ☐ Prefer not to answer ☐ Prefer to self-describe _____

Permission for the follow-up contact

☐ Yes ☐ No

- *****

1. Contact information

Data Protection Officer (PA)	**Ethical Manager (IMPULSE)**
Name	Francesca Morpurgo
Email	f.morpurgo@cyberethicslab.com
Phone	

2. Aim and goals of the research project

This research is conducted by the team members of the project "Identity Management in PUbLic Services" (hereinafter "IMPULSE" or "Project") www.impulse-h2020.eu . IMPULSE is a 36-month research project funded by the Horizon 2020 Programme of the European Union. The Project is composed by 16 European partners (hereinafter the "Consortium") and its goals are:

(1) Understanding the landscape of existing eID solutions in different European countries. eID refers to the different ways a person may prove their identity to access and use online services.

(2) Evaluating the adoption and impact of eID solutions based on Artificial Intelligence (AI) and Blockchain (BC). AI and BC are two different types of technology proposed to make eID safer and more trustworthy for people.

To achieve these research goals, the Consortium will study 6 pilot cases in the following countries: Bulgaria, Denmark, Iceland, Italy, and Spain. Each case will be designed using the data from questionnaires, interviews, and workshops.

3. Rights of the participant

We would like to emphasise that:

- your participation is entirely voluntary.
- you are free to withdraw at any time.
- you can review the data we collect from you and request its deletion anytime.

The data collected during this workshop session will remain anonymous, so it cannot be traced directly or indirectly back to you. It may be discussed with the members of our study research group, or in case an external quality assessment takes place, with evaluators under the same confidentiality conditions. Workshop excerpts which include **written notes** and **transcriptions of oral discussions** of the workshop participants from the **audio and screen recordings** and key concepts may become part of one or more publications, but no personal data such as names will be included, unless you explicitly authorise it.

4. Data Controller

The Data Controller of your Personal Data will be [public administration].

Personal Data processing and lawful basis

The Controller will only process the Personal Data that you will voluntarily and directly decide to provide and/or disclose to the same Controller in connection and/or related to the workshop and that you agreed to answer by granting your consent via the Information Sheet. The Controller will collect and process Personal Data such as, for example, some of your data concerning your name, contact information, etc. The lawful basis pursuant to which the Controller will process your Personal Data shall be your freely and informed consent to the data processing itself given by you by ticking the "consent boxes" provided at the end of the present form. Please note that you are free to give your consent as well as to deny it.

Purpose of the data processing

The Processing of your Personal Data will be limited to the extent necessary to perform the research activities indicated in the Information Sheet you were presented on the previous page, and for which you gave your freely and voluntary consent. Any other further processing of your Personal Data will be excluded without your previous consent.

Recipients of Personal Data and Personal Data transfer

Your Personal Data may be shared, for the purposes referred to section "Personal Data processing and lawful basis" above mentioned, with:

- Subjects, bodies, or authorities to which the Consortium and/or its partners are obliged to communicate their personal data pursuant to any applicable law.
- We may also share your information with the European Commission or with competent legal and/or fiscal authorities for legitimate reasons.
- Your Personal Data will not be shared with countries outside the European Economic Area.

Data Retention and Data Security

Those Personal Data processed for the purposes set out in section "Purposes of the data processing" will be kept for the time strictly necessary to achieve the purposes stated therein. In any case, we will delete your Personal Data at the end of the Project. In any case, to ensure the best level of protection of your Personal Data we will apply all the best physical and logical security measures internally, and our servers are subscribed from the most established cloud providers and protected through state-of-the-art security measures.

Data Subject rights

Pursuant to Chapter 3 of the GDPR, you have the following rights concerning your Personal Data:

- The right to be informed
- The right of access to data concerning the data subject (article 15)
- The right to rectification of data (article 16)
- The right to erasure of data (article 17). The right to erasure shall not apply if the processing is necessary for archiving purposes if the right to erasure prevents or significantly hinders the data processing
- The right to restrict processing (article 18)
- The right to data portability (article 20)
- The right to lodge a complaint
- The right to withdraw consent
- The right to object to processing

If you wish to exercise any of these rights, or you wish to be provided with more information in this respect, please contact our Data Protection Officer using the contact details set out above.

5. Informed consent

By signing this document, the participant gives consent to [public administration] to use for this research project the collected data, audio and video recordings, and written transcripts from the workshop session, processed in compliance with the EU General Data Protection Regulation no. 2016/679 ("GDPR"). The participant grants permission to use this material in future scientific publications. The data will always be treated as confidential and personal information will never be made public. The information will be securely stored and retained for the duration of the project and safely deleted afterwards.

I confirm that I have read and understood the project aim.	☐
I understand that my participation is voluntary and free-of-charge.	☐
I agree to take part in the above research activities.	☐
I agree to the use of anonymised quotes in publications.	☐
I agree to being audio/video recorded for later analysis and transcription of the discussions, as well as for assessing the effectiveness of the research methods.	☐

6. Agreement

By signing here, I declare to have read the information above and accept participating in the workshop session in the context of the project "Identity Management in PUbLic SErvices (IMPULSE)". By doing so, I grant permission to use the data collected from the registration form and during the workshop session and to summarise the results anonymously in scientific publications.

I have had the opportunity to have all my questions answered to my satisfaction. At any moment, it is possible to withdraw my agreement, without any consequences or having to account for my decision.

I agree to be kept updated with IMPULSE project activities and results through my contact below (optional):

e-mail _____

A dated copy of the information sheet and this signed consent form will be given to the signee.

Date (day/month/year):_____

Name and signature of the participant: Name and signature of the organiser:

_____ _____

Annex B Workshop script material

IMPULSE Co-creation workshop script

Use:	To prepare and run co-creation workshop with the objective to collect and refine the requirements for IMPULSE e-ID solution
Who should use it:	Partnering Lead and Workshop Facilitator
Tool type:	Guidance
How to use it:	Reference for running the workshop and working on exercises

Scope and purpose

Co-creation workshop is aimed at eliciting the requirements for IMPULSE solution with the prospective end-users. It is a structured step-by-step process designed to help participants share their vision of what IMPULSE should be like.

Co-creation workshop template is run online using Miro digital whiteboard and Zoom for voice communication. It allows the workshop participants to collaborate, generate and discuss their ideas by completing the exercises.

Each exercise helps to share expectations and visions of IMPULSE. Completing these exercises participants contribute to the design of the future solution.

Oral discussions of the workshop participants are recorded in Zoom by Hosts and stored in their local domains for further research activities.

Co-creation workshop is designed to complete the exercises in **around 80-90 minutes**. This estimation includes time for introduction, training participants, explaining tasks, and discussions. Workshop can be finished earlier if the tasks are considered completed and objectives are achieved.

Structure

The Co-creation workshop template is set on Miro digital whiteboard. The board is divided into different areas called **Frames**. These areas form a structure of the workshop.

Frames are used by Facilitator to **navigate** the workshop. Frames can be found by opening sidebar at the bottom-left corner (see Figure 1a).

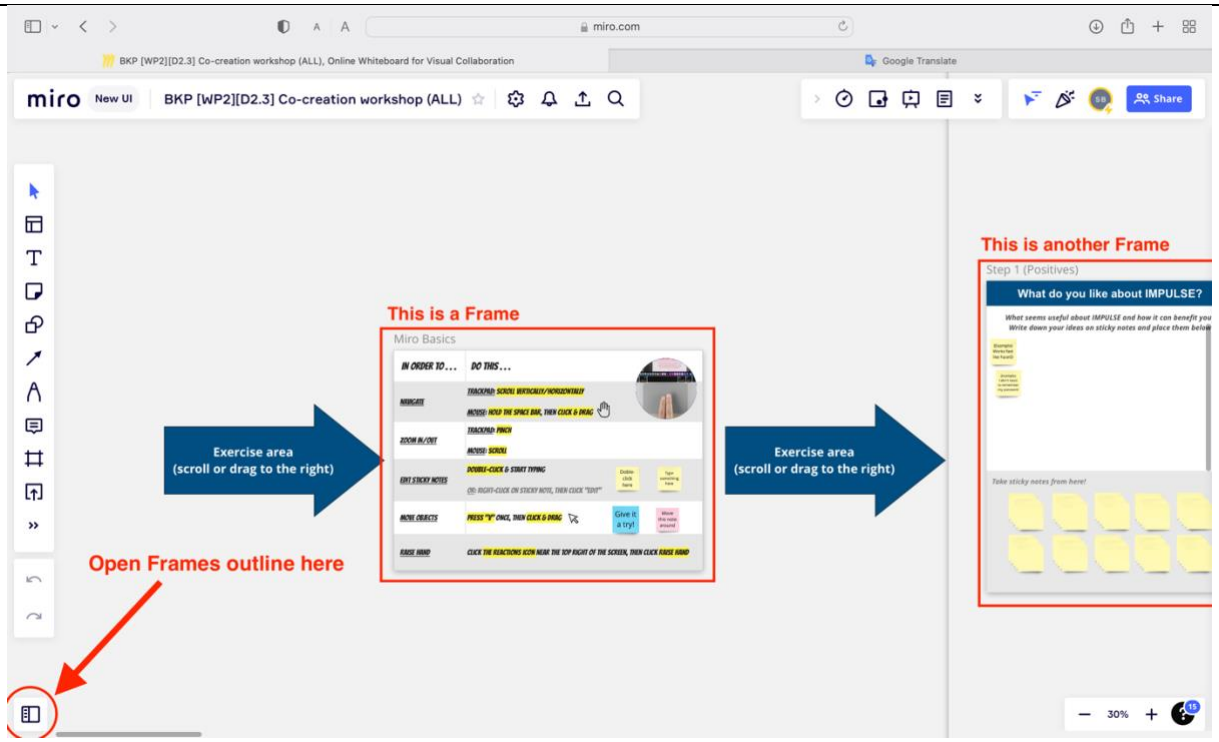

Figure 1a. Frames button in menu

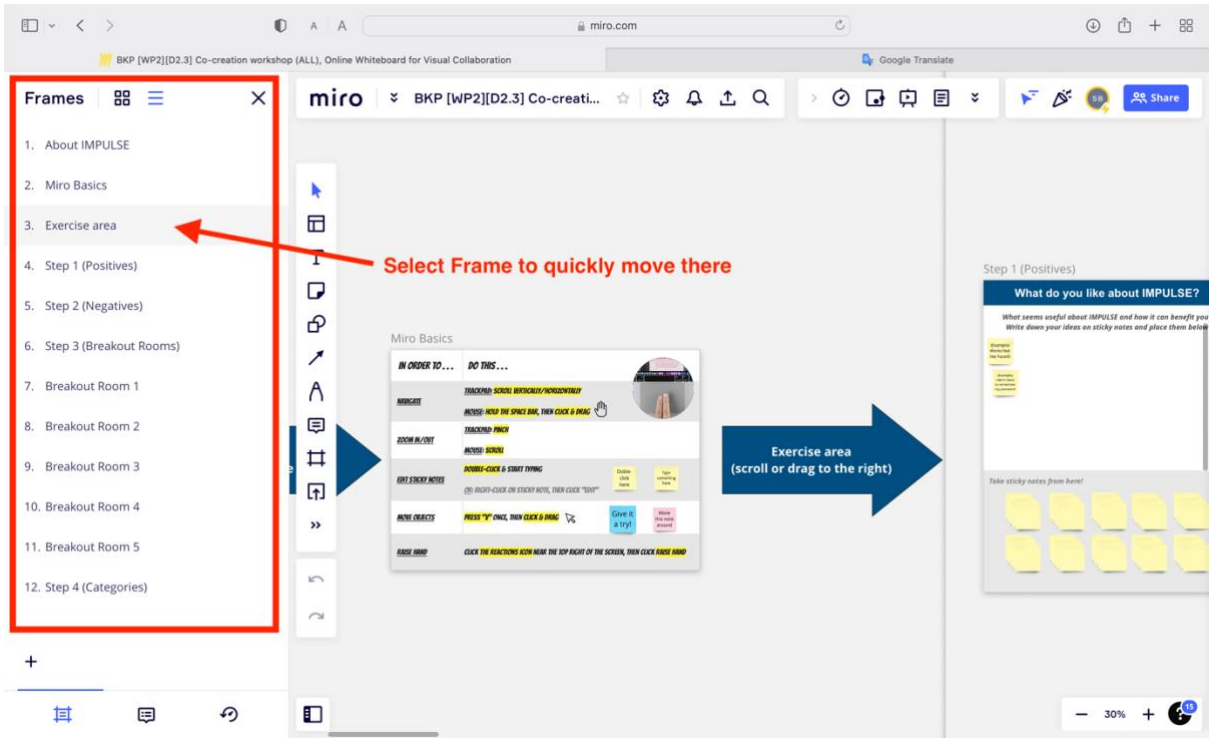

Figure 1b. Frames outline in workshop template

There are 12 Frames that are used in the workshop (see Figure 1b). They are ordered chronologically based on the workshop script and followed from left to right. Clicking on the Frames from the list allows Facilitator to **quickly switch between the areas** of the workshop.

In general, there are three main areas of the template:

1. About IMPULSE
2. Miro Basics
3. Exercise area

Exercise area (Frame 3) consists of smaller frames which are different steps of the workshop exercises.

Frames contain **Dashboards** - visual interfaces of the exercises where participants collaborate.

The template areas reflect stages of the workshop outlined in the following sections.

Stage 1. About IMPULSE (6 mins)

On the **first stage**, the workshop Facilitator:

- Welcomes participants
- Introduces Facilitators and Hosts of the workshop
- Informs the participants that the session will be recorded
- Shares the screen in Zoom to participants
- Introduces IMPULSE research project (presenting "About IMPULSE" dashboard)
- Presents video of IMPULSE demo with comments (link to the video)
- Explains the aim of the workshop
- Introduces Miro board

After welcoming the participants to the workshop, Facilitator **shares the screen** in Zoom to introduce IMPULSE project and explain the objective of the workshop.

On the shared screen, Facilitator presents "About IMPULSE" dashboard which provides the participants with the **concept** of IMPULSE (see Figure 2). The textual info on the right side summarises it in three points: What? How? and Why? There are **no interactive elements** on the dashboard.

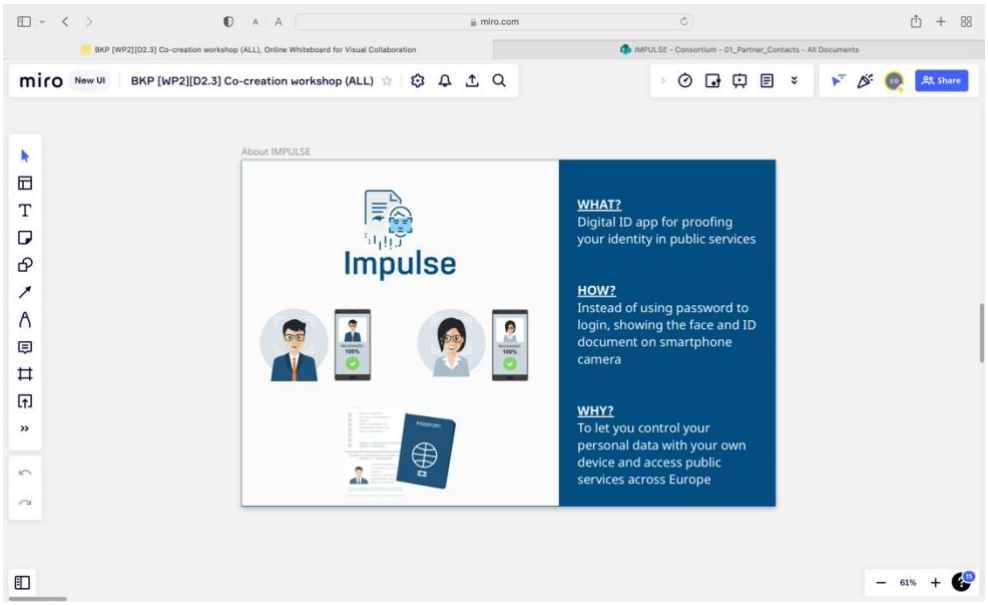

Figure 2. "About IMPULSE" dashboard as introduction

Following the Dashboard presentation, Facilitator proceeds to demonstrating IMPULSE prototype on a video (link to the video).

The video of **IMPULSE demo** shows:

- An example of digital public service - police complaint in Spain (left side) and IMPULSE prototype (right side)
- A person providing his credentials (0:03-0:33), face (0:34-0:39) and document photographs (0:40-0:52) to onboard identity

- Once identity onboarding confirmed with email (1:10-1:26), a person accessing police complaint service proofing his identity with the face (1:29-1:50)

Demonstrating IMPULSE prototype on the video should provide the participants with **tangible concept** about the technology.

Facilitator finalises the first stage **explaining the objectives** of the workshop:

- Sharing ideas and expectations from IMPULSE by the participants
- Completing a set of collaborative exercises in Miro board to share these ideas
- By doing so, the participants will help the project partners to make the requirements for technical implementation of IMPULSE

Stage 2. Miro Basics (6 mins)

> On the **second stage**, the workshop Facilitator:
>
> - Shares Miro board link and password (IMPULSE2022) in Zoom chat for participants to join
> - Explains the basics of working with Miro board
> - Makes sure the participants understand how perform the activities

To join the Miro board via link, participants do not need to have an account for Miro. They will only need to (1) enter the password **IMPULSE2022** and (2) their name (see Figure 3).

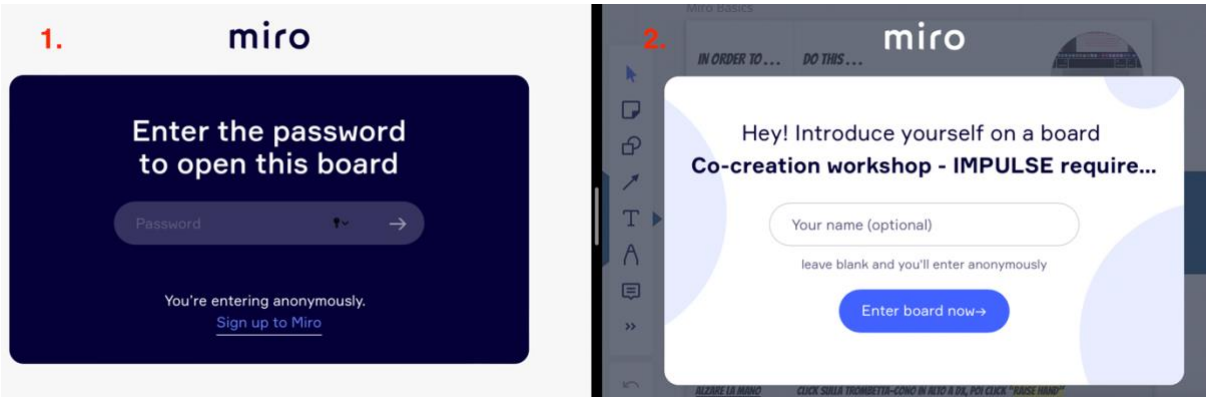

Figure 3. Screen when joining Miro board

The "Miro Basics" dashboard provides the participants with general **instructions** in a form of table on how to interact with Miro board and its elements (see Figure 4).

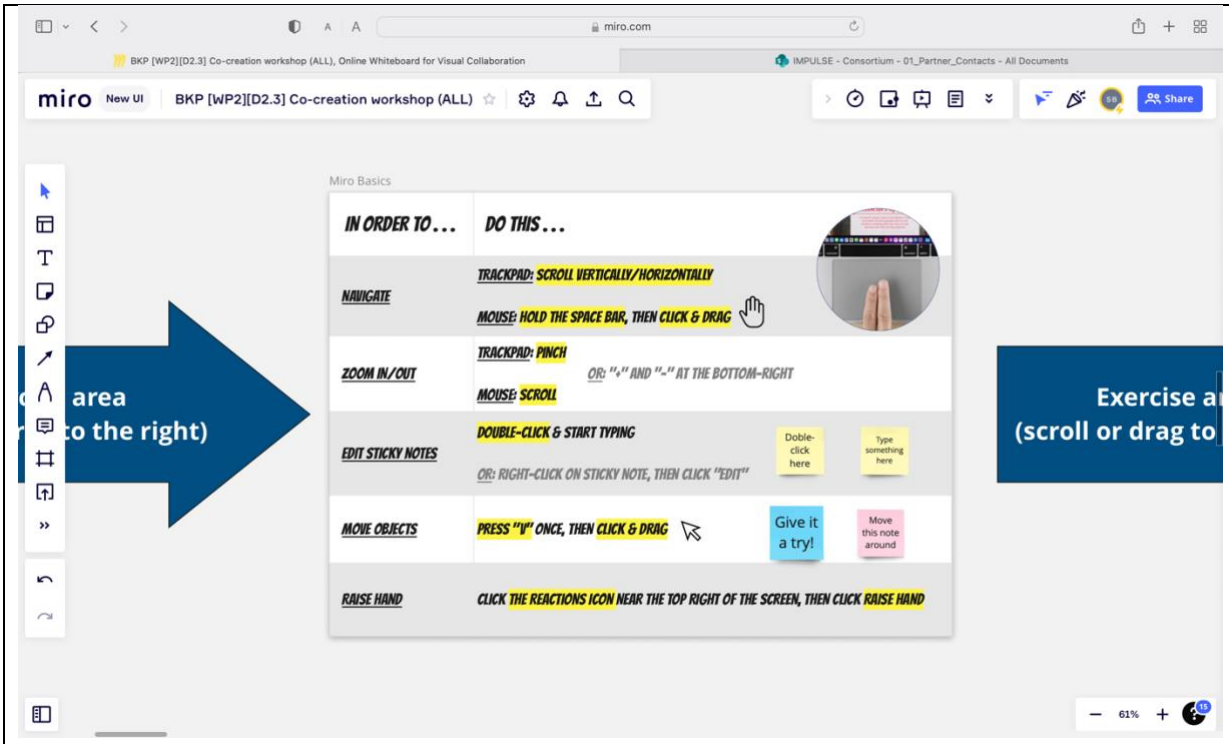

Figure 4. Miro Basics dashboard - starting point

The first column of the table lists the **activities,** and the second column explains **how to perform** them.

These are the only activities that would be required for completing the workshop exercises:

- *Navigating* Miro board using trackpad (as shown on the dashboard figure) or mouse
- *Zooming In / Out* using track pad or mouse, or "+" and "-" at the bottom-right corner
- *Editing sticky notes* for sharing ideas
- *Moving objects* to vote for the ideas
- *Raising hand* to ask Facilitators for help (e.g., the participant got lost on Miro board)

There are interactive elements for the participants to **try out** editing sticky notes and moving them. Those are placed next to the respective activities and can be used freely.

The Miro Basics dashboard is set in-between two **arrows** pointing to the exercise area. Similarly, these arrows are placed in different areas of the workshop template to help the participants **find the exercise dashboards** if they get lost on Miro board.

Once the participants are used to performing the basic activities in Miro, the workshop can move on to the next stage.

Stage 3. Exercise area

On the **third stage**, the workshop Facilitator:

- Introduces participants to the exercises and explains the objectives
- Guides the participants to make sure they understand how to perform the tasks
- Records the discussions of participants in Zoom
- Helps the participants and encourages them to ideate and trust the workshop process
- Manages groups of participants (breakout rooms) in Zoom
- Follows the workshop timeframes for completing the exercises

Exercise area consists of **four steps** outlined in the following subsections.

Step 1. Positives (7 mins)

> The **first step** of exercises:
>
> - Participants are given a set of sticky notes
> - Facilitator asks the participants to share their **positive expectations** from IMPULSE (at least three by each participant)
> - All participants write their statements **one per sticky note** anonymously
> - Participants do not need to comment on them
> - It is fine if there are repetitions: participants can move closer the sticky notes they deem similar or ask Facilitator to do it
> - Once the time is up, Facilitator informs the participants and Step 1 is complete

This exercise step is framed as "What do you like about IMPULSE?" and set on a single dashboard (see Figure 5). This is mainly a warm-up exercise.

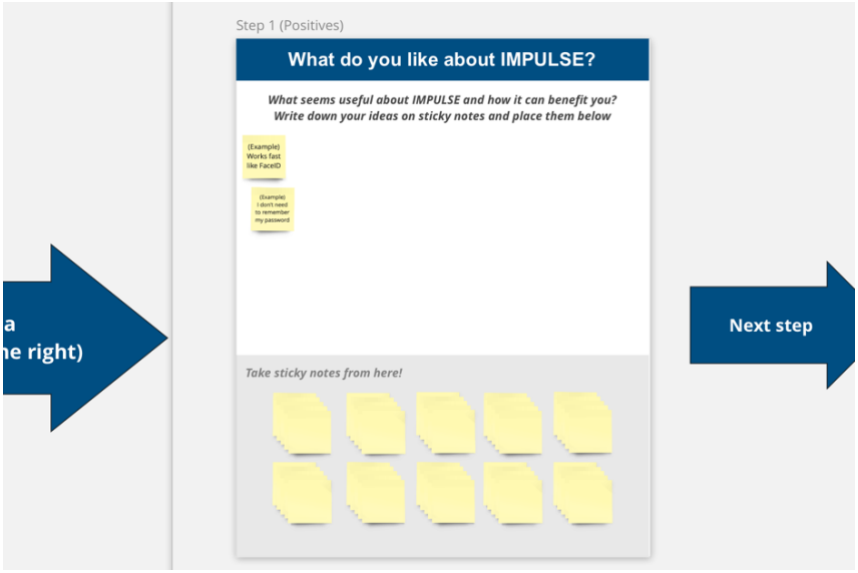

Figure 5. Step 1 dashboard

Participants need to drag yellow sticky notes from the stacks and place them on the whiteboard above to write down their ideas.

Each participant should write **one statement per sticky note** and at least three statements in total (preferably, as much as possible). There are two sticky notes with examples.

Participants share their ideas and anticipations anonymously, without comments to enable open-minded and brainstorming environment.

If the participants notice repetitions, they can ask Facilitator to move closer the sticky notes with similar statements.

Once time is up and participants finish the writing, Step 1 is complete. Facilitator asks the participants to move to Step 2 following the arrow to the right.

Step 2. Negatives (total 20 mins)

> The **second step** of exercises:
>
> - In **Task 1** (7 mins) all participants write down their **concerns and negative expectations** from IMPULSE (similarly to Step 1, i.e., at least three ideas, one statement per sticky note, no commenting, grouping repetitions)
> - In **Task 2** (3 mins) the participants **vote** for the concerns they deem important using red voting dots
> - Each participant has **three voting dots** to place on the sticky notes
> - Participants can vote for their own ideas or other's by placing one, two or all three dots on same the sticky note
> - In **Task 3** (10 mins) participants **discuss** the top voted concerns explaining their priorities and elaborating on the statements

Task 1. Write down (7 mins)

This exercise step is framed as "What can go wrong with IMPULSE?" and is set in single dashboard (see Figure 6a). Similarly to Step 1, the participants are asked to share their concerns and issues they might have with IMPULSE.

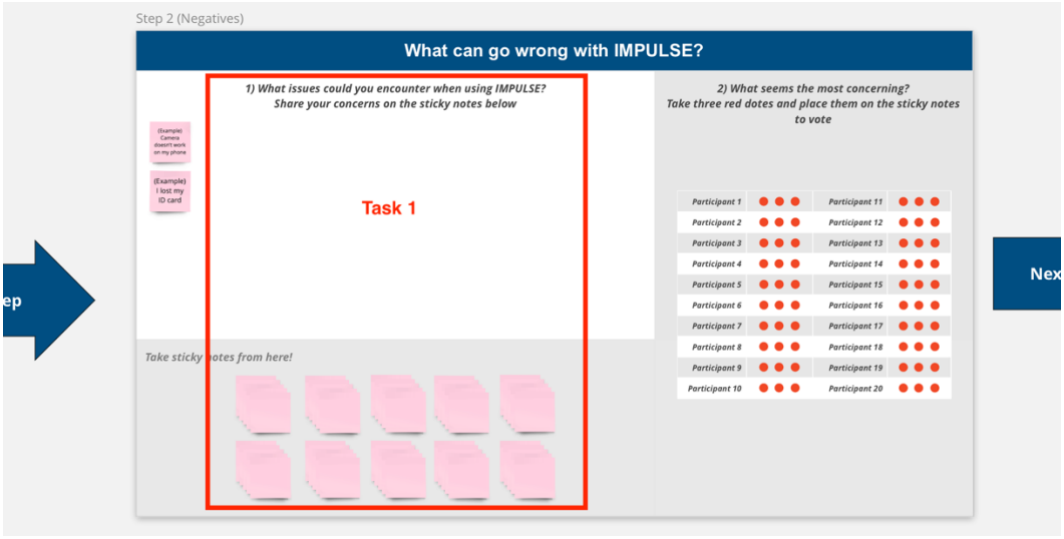

Figure 6a. Step 2 dashboard at the beginning of Task 1

Participants need to drag pink sticky notes from the stacks and place them on the whiteboard above to write down their ideas.

Each participant should write **one statement per sticky note** and at least three statements in total (preferably, as much as possible). There are two sticky notes with examples.

Participants share their ideas and anticipations anonymously, without comments (yet) to enable open-minded and brainstorming environment.

If the participants notice repetitions, they can ask Facilitator to move closer the sticky notes with similar statements.

Once time is up and participants finish their writing, Facilitator informs that Task 1 is complete.

Task 2. Vote (3 mins)

This task is aimed at prioritising the users' concerns.

The right side of the Step 2 dashboard contains red voting dots.

Each participant has **three voting dots** they need to place on the sticky notes with the statements from Task 1 (see Figure 6b for the expected result).

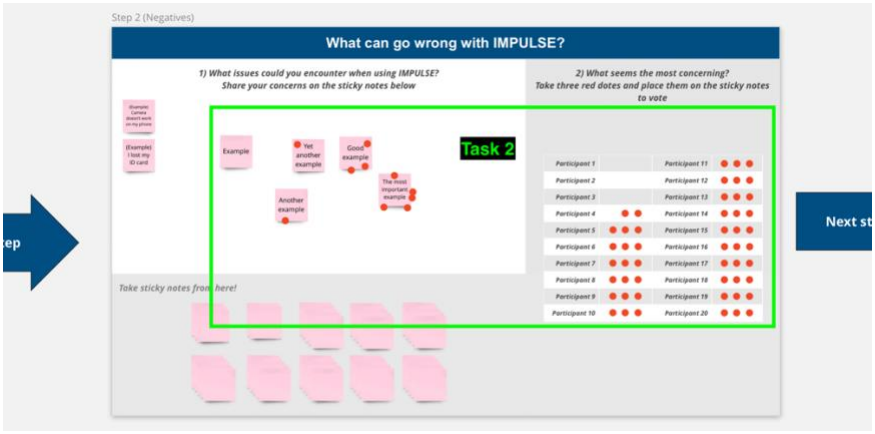

Figure 6b. Step 2 dashboard after participants voted for their concerns

It is fine if the number of the workshop participants is less than 20, the rest of the voting dots remain in place.

Participants can vote for their **own ideas or other's** placing one, two, or all three dots on the same sticky note.

Once the voting is done (approx. in 5 mins), Facilitator informs the participants that Task 2 is complete.

Task 3. Discuss (10 mins)

Having voted on their ideas, the participants are asked to elaborate on the top voted concerns and **explain their priorities**.

All participants in Zoom are encouraged to **discuss** their choices with the others. Facilitator can ask questions such as "What do you mean by this concern?" or "Why did you vote for this concern?" to initiate the discussion.

It is fine if the discussion is exceeding estimated time by 3-5 mins more as long as the participants share **meaningful comments**. The **discussions should be recorded** in Zoom by Facilitator.

Once the time is up and the participants shared their comments, Facilitator asks the participants to move to Step 3 following the arrow to the right.

Break and Step 3 preparations (5 mins)

- After Step 2, Facilitator can offer the participants to make a short 5 min break
- All participants should have Miro board open on their devices and stay in Zoom call while on break

Meanwhile, Facilitator makes necessary preparations for Step 3:

1. **Assigns** (but *not* open them yet) participants to **five breakout rooms in Zoom** in equal numbers if possible (e.g., if there are 10 participants, then 2 participants in each breakout room)
2. **Copies** five top voted sticky notes from Step 2 (see Figure 7)
3. **Places** those copies in Step 3, **one per each** Breakout Room dashboard

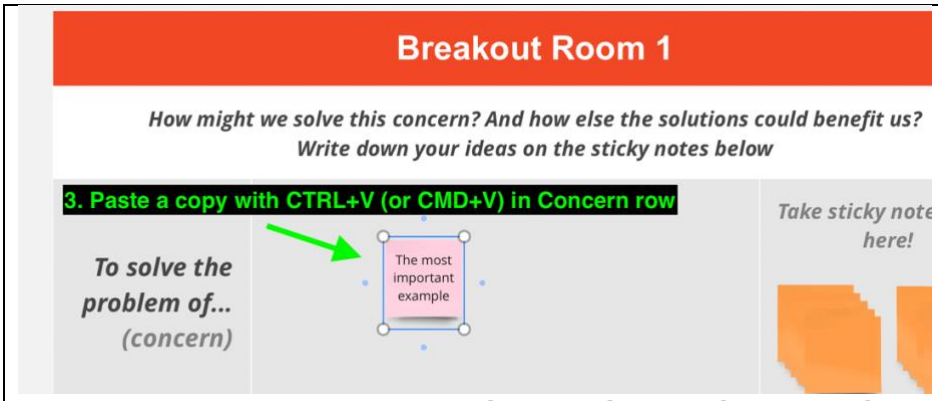

Figure 7. Copying top voted notes and pasting them in Breakout Room dashboards

Step 3. Breakout rooms (total 20 minutes)

The **third step** of exercises:

- The exercise is done in **two rounds**
- Five top voted notes from Step 2 serve as inputs for the exercise
- Facilitator explains the task with example on "How might we...?" dashboard
- To overcome the ***Concerns*** (from Step 2), participants will need to devise the ***Solutions,*** and think of the ***Benefits*** they can get from them
- Participants are assigned to **five Breakout Rooms in Zoom** and work in **groups**
- Each group **works on one** *Concern* in their **Breakout Room dashboard**. They proceed there by clicking the arrow button next to the number of their room

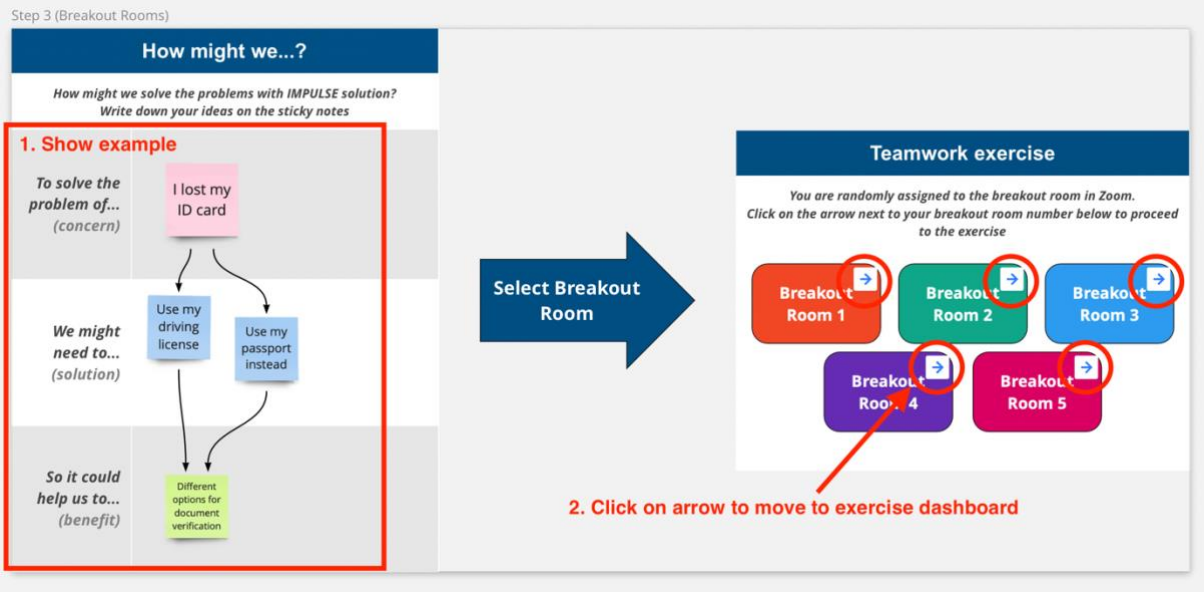

Figure 8. Step 3 dashboard - exercise example, and go-to buttons

Facilitator **explains the exercise** (1) with the example on dashboard (see Figure 8):

- Participants will work in groups in two rounds
- Each group has one problem (row "*Concern*") to solve that is taken from previous step
- In Round 1, participants need to think of possible solutions for their problem (row "*Solution*")
- In Round 2, participants will be switched between the groups and think about the *Benefits* they can get (also some new *Solutions*)
- Finally, using the voting dots, participants need to point on most appealing solutions

After presenting the example, Facilitator asks the participants to move to the dashboard on the right to select Breakout Room (see Figure 8).

Participants should **be informed about the number** of the Breakout Room they have been assigned in Zoom. Facilitator **opens breakout rooms** in Zoom meeting, and the participants will see the pop-up window with the room number in Zoom to join.

Participants need to click on the white square with blue arrow in the top-right to **proceed to their respective Breakout Room dashboard** (2) to do the exercise (see Figure 8).

Facilitator needs to check every room in Zoom by joining it **to ensure the participants found** their dashboard and can start working on exercise.

Once in a Breakout Room in Zoom, participants engage in discussions and work on **one problem** together. They are not heard and cannot hear the discussions from the other rooms in Zoom.

To ensure the discussions are ongoing, Facilitator can switch between the Breakout Rooms both in Zoom and Miro (using Frames), periodically.

Round 1 (10 mins)

- Participants **devise on solutions** and write down their ideas on sticky notes (placed in "Solution" row, as many as possible)
- Participants **discuss** the solutions between themselves in Breakout Rooms in Zoom
- Once time is up, participants are moved to another room in Zoom and **proceed to "Next problem"** in Miro

See Figure 9 for the expected result.

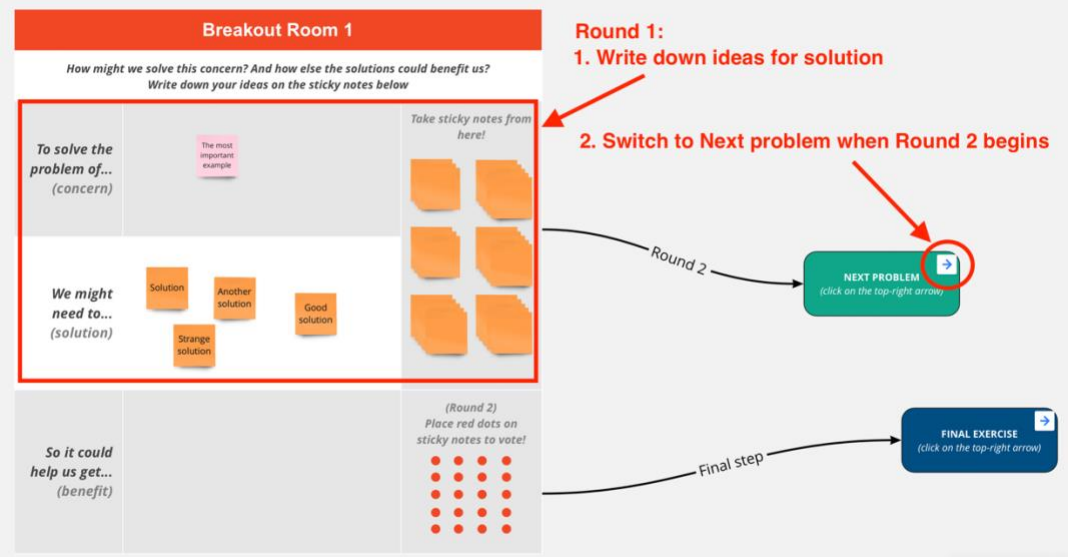

Figure 9. Round 1 of breakout room exercise

Similarly to Step 1 and Step 2, participants take sticky notes from the stack and write down their ideas **how to solve** the problem (1). They need to write down as much solutions as possible.

Facilitator can join the groups in Zoom anytime to ensure collaboration is ongoing and help with own idea about solution.

Once time is up, Facilitator **informs every group** by switching between the rooms in Zoom that it is time for Round 2 where:

- **One participant will stay** in the same group and dashboard
- The **others will be moved** to another room in Zoom (they will be notified in Zoom)
- Those who will be moved will need to **proceed to "Next problem"** by clicking arrow button (2)

Figure 10 shows the **order** how participants are switching between Breakout Room dashboards in Miro and rooms in Zoom.

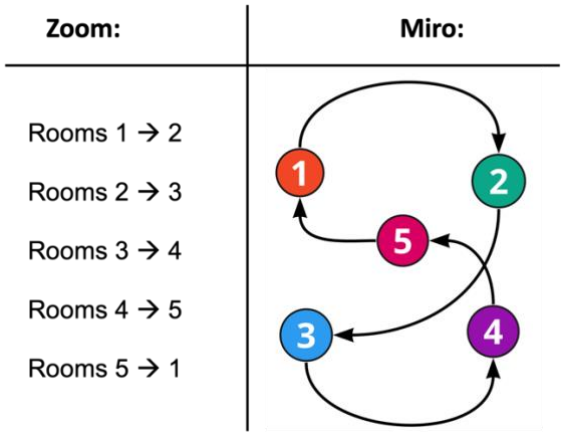

Figure 10. How participants switch between the Breakout Room dashboard in Miro and Zoom

The same order participants are moved to another rooms in Zoom (e.g., from Room 1 to 2, from 2 to 3, etc.).

Facilitator needs to check every room in Zoom by joining it **to ensure the participants found** their dashboard and can the exercise in Round 2.

Round 2 (10 mins)

- **One participant stays** in the same room in Zoom and Miro
- Other participants joining the room **think of the *Benefits*** they can get from presented *Solutions*. They can list add new *Solutions* as well
- Participants **vote** for most appealing *Solutions* placing the voting dots

See Figure 11 for expected result.

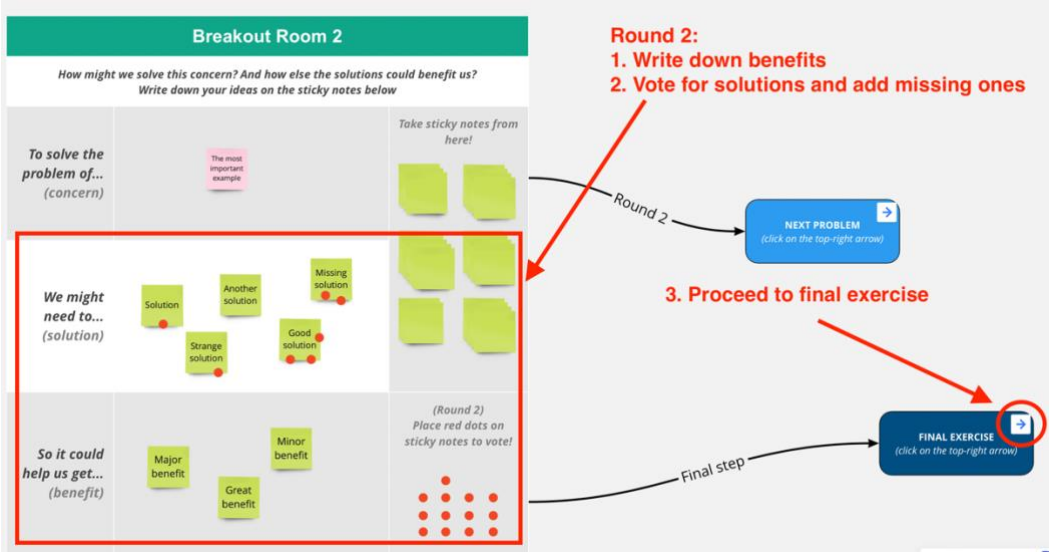

Figure 11. Round 2 of breakout room exercise

In new groups, participants can see the solutions devised in previous round. They need to think of the *Benefits* they are getting from them besides solving the initial problem.

Similarly to previous steps, participants take sticky notes from the stack and write down their ideas about **what benefits** they get from the solutions (1). They need to write down as much ideas as possible, one per sticky note.

During the discussion, participants can also add some new solutions. Finally, they need to vote for **most appealing solutions** using the voting dots (2).

Facilitator can join the groups in Zoom anytime to ensure collaboration is ongoing and help with own idea about benefits.

Once time is up and participants finish their writing, Facilitator:

- **Closes** breakout rooms in Zoom (all participants are back in common meeting)
- Asks participants to move to the **Final exercise** (Step 4) by clicking arrow button (3)
- **Copies** all notes with benefits and prioritised solutions from all the Breakout Room dashboards and **pastes** them in Step 4 dashboard (as it was shown in Figure 7)

Step 4. Categories (15 mins)

The **fourth step** of exercises:

- Benefits and prioritised solutions from Step 3 serve as inputs
- All participants **discuss** these ideas in common Zoom meeting
- Participants **group** the ideas that seem similar
- Participants **label** those groups as **categories** using sticky notes from the stacks

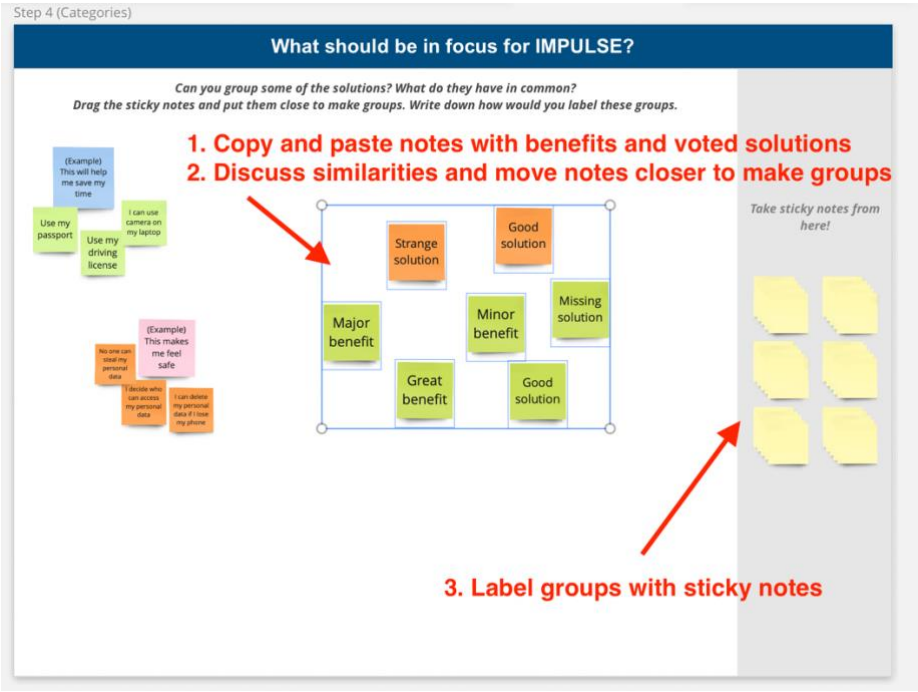

Figure 12. Step 4 dashboard for categorising solutions and benefits

Before exercise begins, Facilitator need to **copy** sticky notes with listed **benefits** and **prioritised solutions** from all Breakout Room dashboards in previous step and **paste them** (1) on Step 4 dashboard (see Figure 12).

This exercise is an **open discussion** about the benefits and solutions that the participants voted for in previous step. Participants overview the statements and find **similar ideas to group** them together by moving sticky notes closer (2).

The **discussion should be recorded** in Zoom by Facilitator.

Facilitator can initiate the discussion by asking questions "Why did you choose these solutions?" or "How would these benefits make you feel about IMPULSE?".

There are **two examples** of groups with solutions/benefits on the left side of dashboard (blue and pink sticky notes).

Participants can move sticky notes with their ideas they deem relevant to the groups with examples.

Participants can **label** new groups using sticky notes (3) from the stack and writing down their statements about feelings and thoughts.

This exercise is aimed at identifying **user experience requirements** for IMPULSE.

Once time is up and participants finish sharing meaningful comments about their ideas, Facilitator can conclude the workshop session.

Closing co-creation workshop

As participants should have **tangible expectations** from IMPULSE, Facilitator **reminds them about the goal** of this session which is to share ideas and vision about the technology by the prospective users.

The ideas participants produced in workshop will be analysed and **transformed into requirements** for the technical partners to implement IMPULSE solution.

By taking part in the co-creation workshop, **participants contributed to the design** of future technology.

Facilitator thanks the participants for their **time and commitment** and shares the link to IMPULSE project website (link) in Zoom chat to learn more.

Participants are now free to **ask any question** regarding the project and may leave the Zoom meeting and close Miro board.