Impulse

Identity Management in PUbLic SErvices

D4.1 Report on social perception and recommendations - V1

Lead Author: Thomas Jackwerth-Rice
With contributions from: Nicholas Martin, Diana Silvestru, Liliya Pullmann, Knut Blind
Reviewer: Javier Gutierrez Meana, Antero Kutvonen

Deliverable nature:	R (report)
Dissemination level: (Confidentiality)	PU (public)
Delivery date:	02-10-2023
Version:	1.0
Total number of pages:	33
Keywords:	eID solutions, SSI solutions, acceptance, adoption

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004459

Executive summary

This deliverable summarizes the activities that were conducted as part of WP4 "Socio-economic/political impact analysis". Task T4.1 assesses the socio-political barriers to the usage and further diffusion of eID solutions in general and SSI solutions such as IMPULSE in particular.[1] The work in T4.1 was divided into a conceptual and an empirical part. This deliverable refers to the first part, describing how a pan-European online survey as well as focus groups are being designed and conducted in order to systematically collect survey data on the socio-political barriers of using and diffusing eID solutions.

The results of T4.1 can be used to tailor IMPULSE to specific needs of citizens and especially to those social groups who are most vulnerable to social exclusion. The research activities are intended to answer the following research questions:

1. *Which socio-political factors that drive or hinder the acceptance and adoption of eID solutions for public services should be given particular attention?*
2. *To what extent could eID solutions in general and IMPULSE in particular contribute to excluding or including social groups from using public online services?[2]*
3. *Which response strategies or policies can overcome the identified barriers against the inclusion of social groups as well as the further diffusion of IMPULSE for public services?*

To find answers to these questions, an excerpt of the literature analysis conducted in the context of WP4 is used here to derive socio-political factors influencing the usage and diffusion of eID solutions in general and SSI solutions in particular. As a first result, we systematically distinguish between acceptance and adoption because this allows a systemic assessment of the individual habits and perceptions of eID solutions (acceptance) as well as the institutional and organizational levers for the diffusion of such solutions (adoption). This distinction has direct consequences for the design of the data collection instruments. The survey primarily targets acceptance factors while the expert focus groups primarily cover factors relating to adoption.

From the literature, four acceptance barriers can be derived: 1) an unclear added value of IMPULSE for the citizen; 2) citizens' habit to use public services rather analogously; 3) the perceived low security, privacy and control of personal data (lack of trust); 4) a lack of knowledge of how to set up and operate the solution. In addition, four adoption barriers were identified: 1) negative experiences of citizens with eID solutions or having reports; 2) insufficient trust in the actors developing and implementing new eID solution; 3) an insufficient interoperability of a new eID solution with other online services; 4) a small number of additional use cases.

This deliverable describes in detail how these acceptance and adoption barriers were incorporated into the design of the survey as well as the focus groups. These two data collection instruments are intended to gather empirical data in the nine partner countries, namely Bulgaria, Denmark, Germany, Spain, Finland, France, Iceland, Italy, and Austria in order to identify levers and strategies aimed at promoting both acceptance and adoption in each country.

[1] As we understand the terms "eID", "electronic ID", "digital ID" and "digital identity" are synonyms and are used here accordingly.

[2] Here, the term 'public online services' is understood as a synonym for 'public e-services'.

Document information

Grant agreement No.	**101004459**	**Acronym**	**IMPULSE**
Full title	**Identity Management in PUbLic SErvices**		
Call	DT-TRANSFORMATIONS-02-2020		
Project URL	https://www.impulse-h2020.eu/		
EU project officer	Giorgio CONSTANTINO		

Deliverable	**Number**	D4.1	**Title**	Report on social perception and recommendations - V1
Work package	**Number**	WP4	**Title**	Social and Economic Impact Assessment
Task	**Number**	T4.1	**Title**	Socio-political impact assessment

Date of delivery	**Contractual**	M24	**Actual**	M24
Status	version 1.0		☒Final version	
Nature	☒Report ☐Demonstrator ☐Other ☐ORDP (Open Research Data Pilot)			
Dissemination level	☒Public ☒Confidential			

Authors (partners)	Nicholas Martin, Diana Silvestru, Liliya Pullmann, Knut Blind			
Responsible author	**Name**	Thomas Jackwerth-Rice		
	Partner	Fraunhofer ISI	**E-mail**	thomas.jackwerth-rice@isi.fraunhofer.de

Summary (for dissemination)	*Conceptualizing and surveying the socio-political barriers to the usage of eID solutions in general and IMPULSE in particular*
Keywords	*eID solutions, SSI solutions, acceptance, adoption, literature review*

Version Log			
Issue Date	**Rev. No.**	**Author**	**Change**
31.01.2023	0.1	Thomas Jackwerth-Rice	
03.02.2023	0.2	Thomas Jackwerth-Rice	Integration of the comments of the second reviewer
10.02.2023	1.0	Thomas Jackwerth-Rice	Final corrections based on the second review

Table of Contents

List of Figures

List of Tables

Abbreviations and acronyms

D4.1	*Deliverable 4.1*
D4.2	*Deliverable 4.2*
EFS	*Enterprise Feedback Suite*
eID	*electronic identity*
IMPULSE	*Identity Management in PUbLic SErvices*
M#	*Project month # (e.g. M24 is project month 24)*
NGO	*Non-governmental organization*
SSI	*Self-Sovereign Identity*
SSO	*Single Sign-On*
T4.1	*Task 4.1*
WP	*Work Package*

1 Introduction

The IMPULSE project develops and pilots new eID management solutions that provide users with a self-sovereign identity (SSI). For a more targeted tailoring of the IMPULSE solution to user needs and to facilitate its wider diffusion at least within the nine project countries (Bulgaria, Denmark, Germany, Spain, Finland, France, Iceland, Italy and Austria), T4.1 assesses the socio-political barriers and drivers of using eID solutions for public online services. The empirical analysis, which will be conducted throughout the duration of the IMPULSE project, is intended to answer the following questions:

1. *What socio-political factors that drive or hinder the acceptance and adoption of eID solutions for public services should be given particular attention?*
2. *To what extent could eID solutions in general and IMPULSE in particular contribute to excluding or including social groups from using public online services?*
3. *Which response strategies or policies can overcome the identified barriers against the inclusion of social groups as well as the further diffusion of IMPULSE for public services?*

To answer these questions, the activities in T4.1 were divided into two different components that are described separately in two reports (deliverables). As shown in Figure 1, the first report dealing with social perceptions and recommendations (V1) mainly describes our framework of socio-political barriers to the usage of eID solutions as well as the design of an online survey. In addition, this document explains the design and intended execution of the focus groups.

The second report (V2) will summarize the results and formulate answers to the research questions introduced above. Here, the researchers will draw on all available data sources which comprise the web survey, the focus groups as well as the pilot case studies that were conducted within WP2. This triangulation of data is expected to increase the validity of our conclusions.

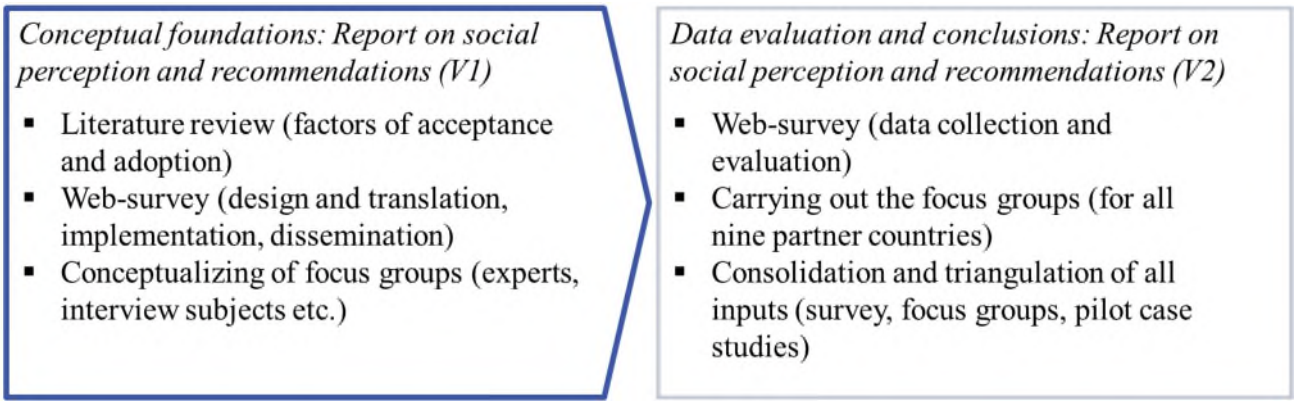

Figure 1: Division of labour within T4.1.

As Figure 1 shows, the activities undertaken in WP4 are temporally divided into three phases. In a *first* phase, a literature review was conducted. Barriers against the acceptance and adoption were extracted from scientific articles, studies and surveys that the authors of this report identified as most relevant for assessing the IMPULSE solution.

In a *second* phase which has been running since April 2022, a Europe-wide web survey was designed and conducted based on the literature analysis which is expected to provide additional quantitative data for answering the research questions, especially questions one and two.

In the current *third* phase, focus groups are being conceptualized. They are expected to be conducted by the end of June 2023 and aim to contribute to answering research question three.

Finally, in the *fourth* phase, the results from all data collection rounds will be evaluated, consolidated, compared, and triangulated to find bundled answers to all three research questions.

Year	2021	2022				2023			
Quarter	4	1	2	3	4	1	2	3	4
1) Survey conception									
Literature review									
2) Web survey									
Survey design and translation									
Implementation using the ESF tool, testing									
Survey dissemination and data collection									
Data consolidation and evaluation of interim results									
3) Focus groups									
Selection criteria, country experts, interview guide									
Carrying out the focus groups, written summaries									
4) Evaluation, conclusions and reporting									
Consolidation, triangulation (survey, focus groups, pilot cases)									
Evaluation and conclusions for IMPULSE									WS
Reporting: Deliverables D4.1 (V1, V2)						31.01.			30.11.

Figure 2: Work plan for T4.1.

This deliverable now describes our framework of the socio-political barriers against the usage of eID solutions based on a literature analysis (*Chapter 2*). It also explains the design and technical implementation of the web survey as well as the planning of the focus groups (*Chapter 3*). Finally, the text explains the methodological approach to be applied during the focus group interviews (*Chapter 4*).

2 Barriers against the usage and diffusion of eID solutions

In order to design a web-survey that collects data on how people actually use public services and eID solutions, a literature analysis was conducted to derive socio-political factors that are particularly relevant for eID solutions and which could make it easier or more difficult for social groups or public authorities to use such solutions. This task thus collects research findings according to which some social groups, such as older people or people with a migration background, a low level of education and/or a low socio-economic status, are less willing than other social groups to provide their personal data to an application in order to register online for public services (Watson et al., 2017).

The literature which is used in this deliverable is an excerpt of the literature analysis which was conducted within WP4, which also assesses the economic benefits of IMPULSE. The latter are described in deliverable D4.2. Here, the authors report on the literature that deals with the socio-political impact factors of eID solutions.

2.1 Literature review

In order to promote the usage of IMPULSE for the largest possible number of individuals from different social groups as well as its further diffusion, the literature analysis looked for the most relevant socio-political factors that influence the usage and diffusion of novel eID solutions (see question 1 above). In particular, it analysed the potential benefits, threats and challenges associated with eID management solutions in general and SSI solutions in particular.[3]

In order to assess which socio-political factors drive or hinder the usage and diffusion of eID solutions, the authors of this deliverable differentiate between the acceptance and adoption of eID solutions because both terms have different implications for the analysis.

As established by acceptance models, *acceptability* refers to the behavioural intention of using eID solutions (Davis et al., 1989; Venkatesh et al., 2003). This means that acceptance puts the reader in the shoes of the individual and asks which socio-economic backgrounds, usage habits, or utility considerations for new technologies drive or hinder the usage of new eID solutions (cf. Davis et al., 1989; Im et al., 2008; Venkatesh et al., 2003). From this perspective, individuals can be both drivers and barriers to new e-services.

Adoption, on the other hand, refers to a social change process which can be driven or hindered by organizations. Organizations decide to apply a new eID solution for their services, thus altering how citizens can gain access to a public service (Rogers, 2003, p. 225). From this perspective, it can be asked which factors might drive or hinder public sector organizations to apply eID solutions for their services.

While the data collection on acceptance factors within WP4 will be largely covered by the survey, insights on adoption factors are expected to be discussed in the focus groups. That is why this deliverable distinguishes between factors of acceptance and adoption, in accordance with the literature.

The review was carried out under the responsibility of Fraunhofer ISI and in close cooperation with the Agency for European Integration and Economic Development (AEI.AT). These activities took place between November 2021 and March 2022. The researchers used "Scopus" as a database for bibliographic data on scientific literature, but restricted this search to the subject areas of Economics and Social Sciences. The following keywords in title and abstract were used: self sovereign, sovereign identity, SSI, digital identity, digital personal identity, electronic identity, e-government, e-government AND identity.

In December 2021, the search resulted in more than 360 documents for Economics and about 430 documents for Social Sciences. Among these nearly 800 documents, about 80 were selected as particularly relevant to IMPULSE based on a review of the abstracts. The references of these documents were screened for relevant further studies, including grey literature (which commonly is not contained in Scopus). In total, about 170 articles or reports were analysed.

[3] Since IMPULSE will be an SSI solution, the literature review concentrated on research that deals with this particular type of eID. However, the term “SSI” remains inconsistently defined, which is why the authors adopted the following definition: an "*SSI management system allows users to fully own and manage their identity without having to rely on a third party*" (Kulbach & Sellung, 2021, p. 143). However, since the review revealed that little is known about the socio-political or socio-economic impact of SSI solutions, the authors mainly drew on the broader notion of eID solutions and adjusted their conclusions to the specific case of SSI solutions.

2.1.1 Factors of social acceptance

Although the researchers aimed at adopting classical influencing factors for the design of the survey (cf. Davis et al., 1989; Venkatesh et al., 2003), the classical technology acceptance models could not be fully applied because of four reasons.

First, research on technology acceptance models focuses mostly on the application of IT within organizations or consumer electronics. Both fields of application are less relevant for IMPULSE. *Second*, individual influencing factors such as hedonic pleasure and the enjoyment of using new technologies are also of limited relevance for IMPULSE. *Third*, in some studies, the researchers found strong evidence that factors such as education, age and place of residence have a strong influence on the usage of eID solutions (fortiss & Initiative D21, 2018, 2019; TUM & Initiative D21, 2018, 2020, 2021). *Fourth*, the survey was designed to collect economic impacts as well.

Following the distinction between acceptance and adoption introduced above, this chapter now presents factors of acceptance in the literature that were identified as most relevant for IMPULSE:

a) Usability and usefulness;

b) Privacy and security considerations;

c) Factors outside the solution.

2.1.1.1 Usability and usefulness

According to the literature, usefulness and user-friendliness appear to be key factors for wide acceptance (Ehrlich et al., 2021; Pöhn et al., 2021). In consistence with established models of technology acceptance, the literature underlines that the **usefulness and user-friendliness** of a new eID solution and how it is actually perceived by the user influences the extent to which the solution itself is used (Gustafsson & Elin, 2013; Hedström et al., 2016).

While user-friendliness relates to easy-to-use issues, usefulness is primarily linked to the simple requirement that a new solution provides a clearly recognizable **added value** for future users (Kulbach & Sellung, 2021; World Bank Group 2018a, 2019). In Germany, for example, the German electronic ID card has not yet been widely adopted, particularly because citizens do not see any clear added value compared with the previous analogue solution.

However, the literature reveals that the personal assessment of an eID solution's usefulness depends on the concrete **use cases** for which the user requires the solution. Other factors such as knowledge about other possible use cases play a secondary role (TUM & Initiative D21, 2020). There also appears to be a clear trend that users prefer to carry out complex processes such as writing texts on their desktops, while simple processes such as uploading documents can easily be carried out by mobile means.

The literature shows clear evidence that the **perceived ease of use** increases if a solution can easily be used for other attractive services as well (TUM & Initiative D21, 2021, 2020). The example of the German eID (e-Personalausweis) confirms that cumbersome registration and activation processes or expensive but technically immature card readers tend to discourage users from applying new eID solutions. Studies dealing with British eID solutions also show that complicated procedures contributed to the failure of "GOV.UK Verify" (Echikson, 2020). Biometric recognition procedures could therefore increase the propensity to use public e-services.

Overall, it can be gathered from the literature that ease of use seems to be the decisive factor. The potential adaptability of a solutions to other cases is less relevant. Eaton et al. (2018), for example, conclude that the simplest solution is more likely to prevail if multiple eID processes exist in parallel. Thus, the IMPULSE **authentication procedures** should be as easy as possible in order to increase its acceptance, which could be achieved by the wallet or smartphone-based design of the application.

2.1.1.2 Privacy and security considerations

The literature also strongly relates the acceptance of eID solutions to the personal assessment of how eID solutions **process or share users' personal data**. In general, assessments regarding data security and privacy of use are likely to influence citizens' personal trust in eID solutions (Gustafsson & Elin, 2013; Hedström et al., 2016).

With regard to IMPULSE, there is some evidence in the literature that citizens express a strong desire to always **keep control of their personal data**. This means that the use and disclosure of their own data should always be transparent, with users being able to decide which personal data to share while also being able to revoke this consent at any time (TUM & Initiative D21, 2021).

However, other studies indicate that citizens tend to reject the idea of storing all personal data and documents in a central register, e.g., a "citizen account" (TUM & Initiative D21, 2018). Increasing data security, by contrast, does not translate into higher acceptance and diffusion. Studies show that single sign-on (SSO) solutions, such as those used by Google or Facebook, are still the most widely used, while other techniques that take greater account of user privacy, such as CardSpace or Uprove, are hardly used at all (Kulbach & Sellung, 2021). Apparently, other factors such as **usefulness seem to override data security** considerations.

For IMPULSE, it can be noted that personal security assessments, for example with regard to IMPULSE's e-wallet, are likely to significantly influence its acceptance. However, it remains questionable to what extent the user can **convince himself or herself of the actual data security** or privacy provided by the technical solution (European Commission 2020a, 2020b).

IMPULSE must therefore deal with the paradoxical requirement that the technical solution should process personal data **as securely and as transparently as possible**. At the same time, IMPULSE must take into account that users generally want solutions that are as inexpensive as possible and that most users lack the knowledge to verify the actual security of personal data.

It is therefore largely the responsibility of the developers to strengthen **trust in eID solutions**. Some ways of dealing with this could be to distinguish between different types of data and to ensure a high level of security and transparency for critical data types. Another approach could be to differentiate by media and, for example, to not store personal data on the cell phone.

2.1.1.3 Factors outside the solution

In contrast to classical technology acceptance, the usage of IMPULSE must strongly take into account acceptance factors which are located outside of the social context in which the technical solution itself is used. In fact, the literature discusses three categories of such external acceptance factors.

1) Users' demographic characteristics influence their personal attitudes toward a new solution

According to the literature, **education** is recognized as the most important demographic factor. It appears that well-educated users are more likely to use digital channels, while less well-educated users tend to prefer personal contact. This finding might be related to the fact that well-educated users tend to be better informed about new solutions than users with less education. Also, less well-educated users are more prone to be deterred by the fear of using a solution incorrectly and making mistakes. This again points to the need to simplify eID solutions.

Studies have also identified **age** as an important acceptance factor, albeit to a lesser degree than education. At the same time, the literature does not provide a clear picture. Older people seem to prefer personal contact with public authorities because they rate analogue processes as more convenient and faster. They also tend to be more sceptical about storing their personal data on a smartphone.

Yet again, this picture applies to Germany and Switzerland, for example, but hardly to Austria. Moreover, young people also have high concerns when it comes to storing health data on smartphones (TUM & Initiative D21, 2018), although younger people generally seem to be more open to "digital-only" solutions. At the same time, they place higher demands on new solutions such as few media breaks, consistency of data and completeness of services.

2) *Users' personal experiences (habits) influence expectations*

Negative user experiences can keep users away from new solutions. At the same time, studies also indicate that users are unlikely to return to analogue processes once they have tried digital solutions. However, usage habits are likely to be strongly influenced by age. Especially older people are used to analogue processes and find them easier and quicker while younger users are more often socialized in digital solutions (TUM & Initiative D21, 2021, 2020; Vassil, 2016).

The threshold beyond which users switch **from analogue to digital processes** could heavily depend on the nature of the services to be accessed with an eID solution. For example, there is clear evidence that personal contact is preferred for those services that require a high level of commitment, such as building permits (TUM & Initiative D21, 2021).

3) The costs of using a solution as an external acceptance factor

It is obvious that the willingness to pay for new eID solutions is low. The costs associated with their introduction and widespread use would therefore have to be borne by the service providers.

For IMPULSE and the analysis of factors influencing the inclusion or exclusion of socially marginalized groups, these external factors are of high interest. However, it is not clear from the literature how influential the individual factors really are for the use of eID solutions.

It appears that education is likely to promote the usage of IMPULSE. For other variables such as age and habits, the results are less clear and the literature points to significant differences between countries. It also remains an open question how the variables interrelate with each other.

2.1.2 Factors of adoption

This chapter discusses factors that promote the adoption of eID solutions in general and SSI solutions in particular. A widespread adoption occurs when a significant volume of intensively-used services are available and thus have been implemented by public sector organizations.

Compared to the acceptance factors presented above, adoption has less to do with the immediate usage of new e-ID solutions. The authors of this deliverable consider adoption to be mainly driven or hindered by organizations such as authorities or service providers who decide to implement an existing eID solution so that citizens can access public e-services more easily. Consequently, adoption influences the further diffusion of new eID solutions and the emergence of an ecosystem of public e-services.

The literature shows that a widespread adoption of new eID solutions has only taken place in a few European countries. Estonia as well as the Scandinavian countries are among the pioneers of this development, while other countries such as Germany, Austria and Switzerland are adopting such solutions rather slowly (TUM & Initiative D21, 2021). Nevertheless, the literature reveals the following adoption factors that contribute to the further diffusion eID solutions as well as the emergence of an ecosystem of e-services:

a) The quality and quantity of e-services;
b) The inclusion of private actors;
c) The interoperability of e-services;
d) Regulation and incentives.

2.1.2.1 The quality and quantity of e-services

The literature shows that the quality and quantity of e-services are important factors for the adoption of new eID solutions. However, the criteria used to assess the quality of e-services differ greatly between stakeholders. For example, Axelsson et al. (2013) point out that public authorities tend to base quality on the efficiency of new services, while citizens tend to relate quality to their interactions with public authorities.

The literature shows that primarily **high-quality e-services** from the private sector have driven the adoption and further diffusion of such services. With regard to new types of eID solutions, technical capabilities such as e-signatures can significantly increase the quality of e-services.

Other studies have pointed out that technical capabilities can be a barrier to adoption. For example, the introduction of e-signatures in Germany was more likely to contribute to the failure of the German eID card solution (BCG/Nortel, 2020). At the same time, integrated online processes and applications such as voice assistants or chat functions are still largely untapped by public administrations, which is why e-government tends to remain a collection of isolated solutions (TUM & Initiative D21, 2021).

The **quantity of e-services** is also a key factor here, as citizens use private services, e.g. for air or rail tickets or online banking, far more frequently than public services such as tax returns, residence registration or driver's license issuing (Domeyer et al., 2020; Eaton et al., 2018; Echikson, 2020; Mahula et al., 2021).[4] Thus, the quantity of e-services is an important adoption factor because this makes it easier for citizens to get used to new applications and have less difficulties when using similar technologies for e-services (Felden et al., 2020; Echikson, 2020; Domeyer et al., 2020; Vassil, 2016).

In fact, studies imply that the sheer number of use cases influences adoption more than their individually perceived user-friendliness. For example, the extension of the German e-ID card to mobile use did *not* lead to higher adoption of the solution (TUM & Initiative D21, 2021, 2020). Similarly, Estonia initially used simple e-card readers, but still saw rapid uptake of its eID solution (Vassil, 2015).

[4] For companies, quality is likely to be derived primarily from economic cost-benefit calculations. Felden et al. (2020), for example, show that Norwegian banks save up to 150 million Euro per year due to the widespread use of digital signatures for loan applications. It must be noted that the digital signature is not a key component of eID solutions, but a technical capability for legally binding declarations to be communicated via the Internet.

A widespread adoption of eID tends to occur when a significant volume of intensively used online services are available and implemented by public sector organizations. The literature highlights such **network effects** as important adoption factors (Ehrlich et al., 2021; Kubach & Sellung, 2021). However, the usage of new eID solutions only seems to increase once a critical mass of users has emerged (chicken-and-egg problem). That is why the state could provide support by **mandating or facilitating** the usage of e-services by public authorities or companies. This, in turn, could create institutional users of e-services, which could further drive the take-up (European Commission, 2020a, 2020b).

2.1.2.2 Inclusion of private actors

E-service providers include all **public and private sector organizations** such as companies or government agencies who offer services and rely on eID solutions to do so. The distinction between public and private service providers is important because they differ significantly in terms of their interests in e-services, their resources for the introduction of such solutions and their role in the adoption of new e-services.

With regard to private e-service providers, **banks** but also **telecommunication companies** have played a major role in the development, introduction and adoption of new eID solutions. The literature considers the inclusion of banks an important adoption mechanism because they have often been pioneers in the introduction of new eID-based services and often invested in user support to establish their new solutions in the industry (Felden et al., 2020; Vassil, 2016).[5]

The inclusion of private actors might increase the number of suitable use cases for e-services that citizens use per year. With regard to Germany, Switzerland and Austria, for example, studies show that public e-services in these countries are used only 3.1 to 3.5 times per year (TUM & Initiative D21, 2018). The **increased quantity of used e-services**, in turn, promotes the further spread of such solutions.

For IMPULSE, it can be noted that the **involvement of private service providers** is a key adoption factor because this makes it easier for citizens to adopt new e-ID solutions. In fact, use cases from private actors have often been developed in close cooperation with government agencies. The former often act as a reference model for innovative eID solutions because they set standards for how such solutions can be implemented in a user-friendly way (TUM & Initiative D21, 2020).

By comparison, **public service providers** have so far taken a less active role in the adoption of new eID-based services. Instead, they are more likely to be obligated to implement such solutions by mandates from government or other higher-level bodies.

2.1.2.3 Interoperability of e-services

Given that the number of eID solutions in Europe increases, their interoperability is another key adoption factor. In the IMPULSE context, interoperability would refer to all **technical and regulatory requirements** to enable EU citizens to use their national digital identities and technical eID solutions in other countries of the European Union, as envisaged in the "Gaja-X" project (Felden et al., 2020; Ølnes & Jansen, 2018). Thus, a better interoperability of eID solutions could promote adoption through an **increased number of possible use cases** for e-services in other countries.

At the same time, interoperability makes it easier for **ecosystems of e-services** to emerge in which different e-services build on one another and citizens only have to enter their personal data once (Vassil, 2016). Interoperability is a key adoption factor especially when several proprietary solutions already exist and private and public solutions for e-services must be linked, for example (Domeyer et al., 2020).

These findings imply that IMPULSE developers should also focus on the extent to which the new solution can be integrated into **existing technical and regulatory infrastructures** rather than building new ones (Felden et al., 2020). As an example, empirical studies on Spain show how the traditional infrastructure of the decentralized, paper-based issuance of ID cards can be used to distribute digital IDs (Heichlinger & Gallego, 2010; Houtan et al., 2020).

2.1.2.4 Regulation & state incentives

The state has a number of options to promote the adoption of new e-ID solutions.

[5] However, the private service providers' main interest is obviously not so much in the widespread use of new e-ID solutions, but in the development of more proprietary solutions in order to gain competitive advantages. They are interested in not losing investments already made in their own solutions by offering them to outsiders (sunk costs) and thereby risking competitive disadvantages. Hence, they may be reluctant to join a universal eID solution such as IMPULSE, especially if it makes it easier for their existing customers to switch to other service providers.

1) *The state can support the development of platforms linking different e-services*. The example of the Estonian platform "X-Road" shows how public and private services were technically linked. In fact, "X-Road" is an exchange platform which links all Estonian government e-services with databases from the private sector.[6]

Here, the state is involved in **trust-building**. It has a responsibility to provide a secure and reliable environment for platform actors to offer services, upload confidential data, or develop new applications. That way, the state contributes to ensuring that new eID solutions enjoy a higher level of trust. Trust, in this sense, is attributed less to the solution itself and the way in which it secures personal data, but to the actors who develop and offer such solutions (Janssen et al., 2020).

2) The state can also ***nudge citizens*** *to use e*-services, for example by offering the faster processing of tax returns if they are submitted electronically (Vassil, 2016).

3) *The* ***mandatory use*** *by the state could strengthen the adoption of eID solutions* (Wang & Filippi, 2020). Conversely, studies on the British eID solution "GOV.UK Verify" show that the purely voluntary use of such solutions by the authorities hardly contributeed to their wider dissemination. On the contrary, siloed eID solutions for health (NHS), insurance or tax, for example, remained in place and did not become better integrated (Echikson, 2020)

4) *The state can reduce the costs of new eID solutions for businesses*, indirectly **incentivizing** the development and adoption of eID solutions. For example, the Estonian state subsidizes the introduction of e-signatures in new services and orders its authorities to accept them as well. This reduces the related costs and increases the benefit of e-signatures. **State subsidies** for individual components of eID solutions, another example being card readers, could also contribute to eID solutions' adoption. According to some studies, the high costs are central reasons why banks, for example, shy away from the electronic ID card (Domeyer et al., 2020; Felden et al., 2020).

[6] From a purely technical point of view, such platforms can facilitate the usage of e-services because citizens can simply retrieve their personal data again once they are already stored in other databases.

2.2 Interim conclusions for IMPULSE

This chapter summarizes the interim conclusions that can be derived from the literature review. Table 1 summarizes factors that could be identified as acceptance barriers that appear to be relevant for eID solutions in general and SSI solutions in particular. In addition, the Table presents how the IMPULSE project might deal with these barriers to acceptance.

Barriers	How to deal with them?
1) Unclear added value of IMPULSE for the citizen	• IMPULSE's identification and authentication process must considerably simplify previous procedures[7]
2) Habit of citizens to use public services rather analogously	• nudging (give citizens benefits if they use IMPULSE for e-services) • make IMPULSE usage mandatory, e.g. for service providers • increase the number of possible use cases (sheer number tends to override the quality of eID solutions)
3) Perceived low security, privacy and control of personal data (lack of trust)	• usage of e-service and personal data is based on regulation by law • users can withdraw their consent to the utilization of personal data • especially for the older and less educated, IMPULSE should explicitly strengthen trust in data security (e.g., by information sharing on location of personal data, access to them and how they are processed, consequences of loss of the smartphone)
4) Lack of knowledge of how to set up and operate the solution	• integrate easy-to-use technical capabilities such as voice assistants, chat functions, e-signature into IMPULSE • IMPULSE' wallet may be a component for offering additional services • simplify IMPULSE as much as possible to include less educated users

Table 1: Barriers of acceptance.

In contrast to the acceptance of new solutions which is directly related to the individual assessment of a solution by the user and which can be analysed only through personal consultations (survey, interviews), **adoption** is a social change process which is largely driven or hindered by organizations. In short, a widespread adoption of e-services has occurred once a significant quantity of intensively-used services are available and implemented by public sector organizations.

For the IMPULSE project, it remains a particularly interesting question to what extent the IMPULSE solution itself facilitates this social change process in the partner countries. Therefore, **Fehler! Verweisquelle konnte nicht gefunden werden.** summarizes the barriers against the adoption of eID solutions that were found in the literature, as well as ways how to deal with them.

Barriers	How to deal with them?
1) Negative experiences of citizens with eID solutions or negative reports on such solutions	• information campaigns targeted to specific demographic groups • clearly and sufficiently explain the application (e.g., benefits, added value, how to use it, handling of personal data) • for public authorities, the IMPULSE' added value (quality) rather refers to efficiency gains → *to be further discussed in the focus groups*
2) Insufficient trust in the actors developing and implementing new eID solutions	• integrate IMPULSE into the legacy of traditional ID solutions, e.g. in terms of data protection • it should be clear to the user that eID solutions were developed under government responsibility

[7] IMPULSE' smartphone-based identification and authentication process should increase acceptance. It might also facilitate the management of multiple IDs or logins.

	• it should also be made clear which role private actors played → *to be further discussed in the focus groups*
3) Insufficient interoperability of a new eID solution with other e-services (also in other EU countries)	→ *to be further discussed in the focus groups*
4) Small number of additional use cases, e.g. for public and private e-services	• identify potential application areas for IMPULSE → *gathered in the web-survey*

Table 2: Barriers of adoption.[8]

Only for the first two adoption barriers, suitable ways of dealing with them could be derived from the literature. In the further course of the work of WP4, the focus groups will be used to critically reflect on these adoption barriers and to discuss further ways of dealing with them.

For the IMPULSE project, the political question remains open as to *how the state might promote the adoption of IMPULSE*, for example by nudging its citizens to use new e-services, creating new incentives for their use or making its use mandatory. This question will be the main subject of the focus groups (see Chapter 4).

[8] These four factors have been identified to be particularly relevant as socio-political barriers against the usage of eID solutions. They could be further discussed in the course of the survey evaluation and the focus groups. In addition, two other more economic factors have been found: a) the high costs for components, e.g. e-signatures capability, accruing in many high-value use cases; b) the high (sunk) costs of private service providers for already implemented proprietary solutions.

3 Web survey

In order to better tailor IMPULSE solutions to the needs of future users, a pan-European web survey was designed and conducted as part of WP4. The aim of the survey was to find out under which socio-demographic conditions citizens use new eID solutions to access public services. The aim is to make the IMPULSE solution more attractive to as many people as possible. This chapter describes the design, implementation, and distribution of the survey.

3.1 Survey design

The survey was designed on the basis of the literature analysis. The survey was to be designed in such a way that the data that would be later collected could be used to adequately answer the research questions. Also, the survey had to be designed as closely as possible to the state of the art in research on the acceptance of new (digital) technologies.

For this purpose, the authors of this deliverable studied the established models on the acceptance of new (digital) technologies and information systems mentioned above and explored further studies as well as surveys that were based on these models (e.g., European Commission, 2020b; Kostka et al., 2021; Kim & Garrison, 2009; Krol et al., 2016; Lai & Lee, 2020; Ritchie et al., 2021; Zhong et al., 2021). As a result, about 90 items were formulated and classified according to the acceptance dimensions established by the models mentioned above, which are of particular relevance for IMPULSE. This groundwork formed the basis for the detailed formulation and coordination of the survey with the project partners.

The questionnaire was developed in an iterative process between all project partners, coordinated by Fraunhofer ISI from April until October 2022 (see Annex A). That way, country-specific interests and preferences concerning the formulation of questions could be taken into account.

Finally, the questionnaire was based on, first, the variables that had emerged as potentially relevant from the literature review and, second, on hypotheses that the researchers had formed beyond the literature review. This procedure sought to align the survey items as closely as possible with existing survey instruments in order to increase the comparability of the survey results.

For the web survey, a total of 22 items were formulated, which were assigned to four survey topics (**Fehler! Verweisquelle konnte nicht gefunden werden.**). The items are aimed to cover different social groups, such as early adopters who drive technology diffusion and those most at risk of exclusion like, for example, seniors, socio-economically disadvantaged “e-illiterate” groups and people with a migrant background, among others, with careful attention to the gender dimension.

Survey topics	Items [number]
a) Demographic characteristics of users	[1] age, [2] gender, [3] education, [4] income, [5] nationality, [6] ethnicity, [7] residence
b) Users' personal experiences (habits) with eID solutions	[8] using new digital technologies (digital literacy); [14] handling of digital identities, [17] experiences with smartphone etc.; [18] experiences with digital identities; [19] preferred log-in technologies
c) Users' privacy and data security considerations	[9] data security and privacy concerns; [15, 16] control of personal data;
d) IMPULSE' usefulness and user-friendliness, added value	[10] selection of IMPULSE over other solutions; [11] reasons for non-usage of IMPULSE; [12] preferred online services for IMPULSE; [13] description of IMPULSE
Users' inclination to use online services (IMPULSE' potential application areas)	[20a, 20b] frequency of usage of online services; [21] usage of online public services (eGovernment); [22] reasons for not using public online services

Table 3: Design of the survey.

The survey started to be disseminated in the nine partner countries in December 2022 and is expected to run through April 2023.

During the survey, participants can watch a five-minute video that clearly explains the IMPULSE solution (see Figure 3). It serves the purpose of better collecting the participants' individual assessments regarding the planned IMPULSE solution.

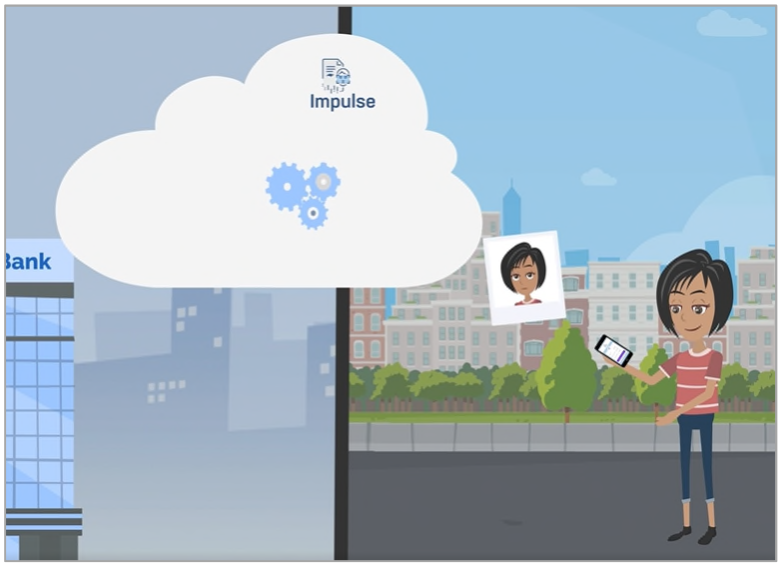

Figure 3: IMPULSE presentation (screenshot).

3.2 Survey implementation

The survey comprises a total of 22 items (see Annex A1). For each partner country, a survey was set up in the respective national language. The local partners significantly contributed to the formulation of items and their translation into their local languages.[9] A survey takes about 15 minutes.

The survey was implemented using Enterprise Feedback Suite (EFS) by Questback in the form of a fully anonymous web survey with a uniform link that could be sent out rather than a personalized survey which would imply higher data protection requirements.

Before the field phase, drafts of the survey were implemented and tested twice. An initial testing was carried out by researchers at Fraunhofer ISI. On this basis, another survey version was implemented, which was then tested within the consortium by the project partners. After this test, the survey was finalized. The assignment of variables and labels was executed automatically by the survey tool based on the selected type of questions.

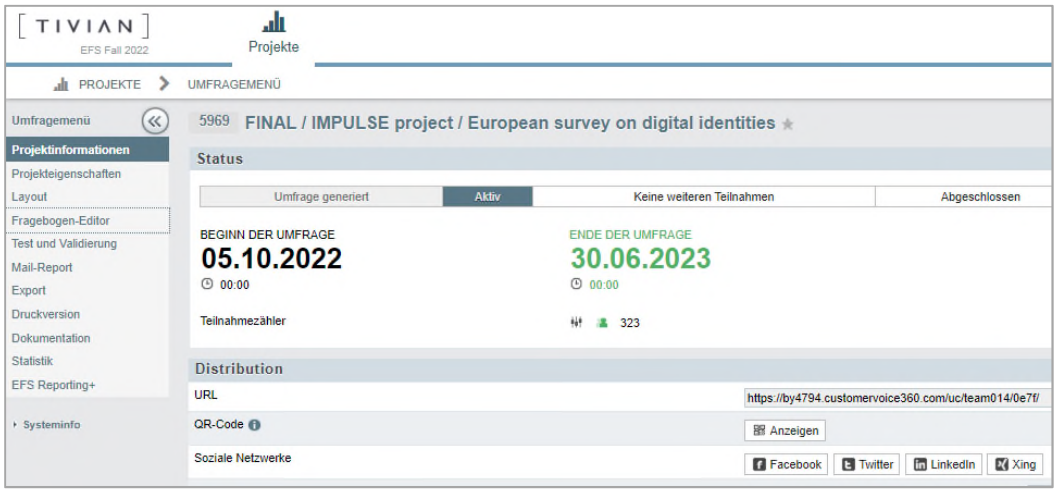

Figure 4: Enterprise Feedback Suite (EFS).

As is shown in the screenshot from the survey tool (4), the survey runs until June 30, 2023. The results can subsequently be read out using an Excel spreadsheet or an SPSS file.

[9] For Iceland, the survey was made available in English.

3.3 Survey dissemination

The dissemination of the survey started in December 2022 with the presentation of the dissemination strategy in the consortium. The goal is to obtain a total of approximately 800 to 1000 participants and to achieve a distribution of participants that is as balanced as possible across all countries. By the time this deliverable was completed, nearly 340 valid participations had been registered (cf. **Fehler! Verweisquelle konnte nicht gefunden werden.**).[10] This shows that currently more than 400 participants are still missing. The researchers from WP4 therefore regularly inform about the status of the survey in the consortium meetings in order to motivate the partner countries to recruit further survey participants.

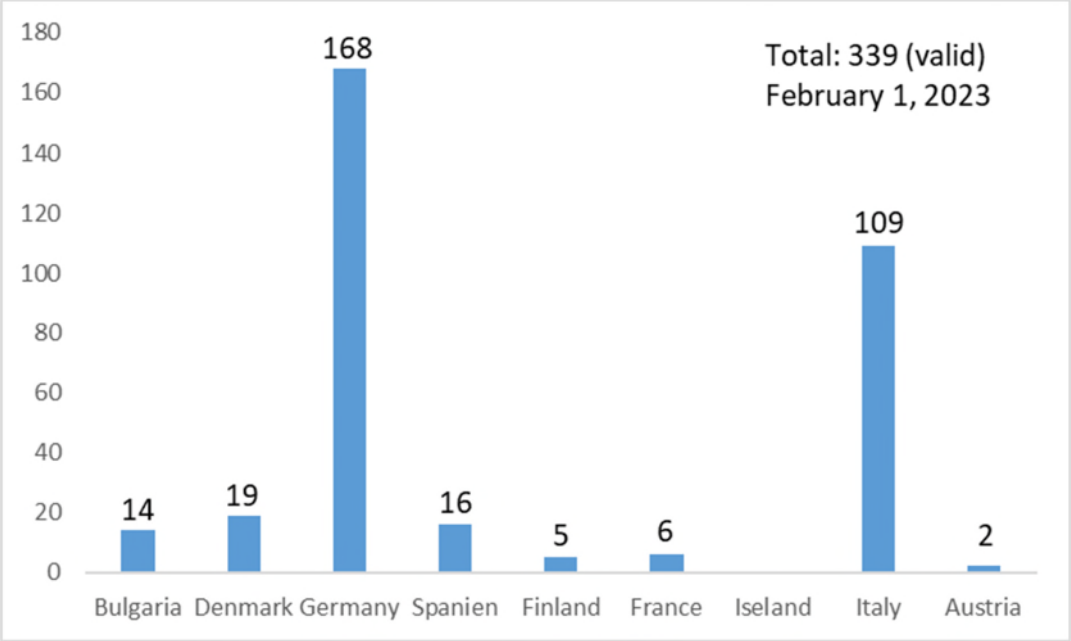

Figure 5: Survey status.

In order to make IMPULSE attractive to as many social groups as possible, the survey is to be distributed especially to those social groups that are potentially more excluded from using it than other social groups. Those social groups contain early adopters such as students, young adults etc., socially disadvantaged people (handicapped, seniors etc.) as well as women[11] and migrants. Various dissemination channels were used to reach these target groups (see Table 4). These initially included private contacts of all project partners (1.-4.):

1. Private social relations (family, friends, relatives, colleagues etc.)
2. Professional relations (partners from research projects, other professional acquaintances etc.)
3. Clubs, associations, institutions (sports/music clubs, other leisure clubs etc.)
4. Social media and private email lists (WhatsApp groups, Facebook groups, "Whats on in Gijon", Going out in Karlsruhe", Twitter)

In addition, in order to target all of the most relevant social groups with the survey, organizations covering these social groups were systematically researched, starting with the example of Germany. For each of these organizations, contact persons or departments were identified that have a particularly strong interest in digitization issues.

5. Education institutions (universities, colleges etc.) for early adopters
6. Organizations, associations or NGOs (related to women, elderly, migrants, minorities, disabled)

Social groups	Organizations
Early adopters	Universities, Universities of applied sciences
	NGOs
	Youth organizations of political parties, unions, economy

[10] Apparently, 21 survey participants broke off the survey.
[11] Classen (2012) found that aged women face specific challenges for technology adoption.

Socially disadvantaged, handicapped (in particular)	Social associations Association for the disabled etc.
Seniors	Several associations, e.g. German Senior League
Migrants[12]	Several associations and migrant organizations, e.g. Amnesty International or Turkish Community in Germany
Women	Several associations, e.g. Federal Association of Migrant Women

Figure 6: Dissemination channels (example of Germany).

Since December, project partners in their respective countries have been distributing the survey through a link via email or messages on social media. The survey will remain open until June 30, 2023.

[12] In Germany, there are only four national minorities, namely Danish, Frisian, Sorbian and the Sinti and Roma, who were not explicitly contacted due to their small share of the total population.

4 Focus groups

As part of WP4, the question of how to promote the diffusion of public online services will be further assessed. Therefore, in the third phase of this task, focus groups with experts will be conduct to address this question. In qualitative social research as well as organization science, focus groups are a well-established instrument for collecting rich empirical in-depth knowledge on specific questions (Liebig & Nentwig-Gesemann, 2009; Yin, 2009). This chapter presents the current status and next steps.

4.1 Research question and procedure

The focus groups will consist of guided interviews with experts in which the researchers will discuss the political and organizational levers of expanding the usage of public online services and how IMPULSE may support the diffusion of public e-services. Due to national particularities, the focus groups will be conducted with experts who have a deeper knowledge of public (online) services in the regions under study by IMPULSE – Spain, Italy, Denmark, Iceland, Bulgaria and Germany/Austria.

Organizing focus groups or expert interviews is intended to provide answers to the following question: *Which response strategies or policies can overcome the barriers against the inclusion of social groups as well as the further diffusion of IMPULSE for public services?*

In order to systematically discuss this question of the barriers and drivers to the adoption of eID solutions, the topics and questions that will be discussed in the focus groups directly link to the adoption barriers that were identified as part of the literature analysis (see Chapter 2). The results of the focus groups will also be used to validate the outcome of the online survey, e.g., regarding the social groups that are most affected by exclusion.

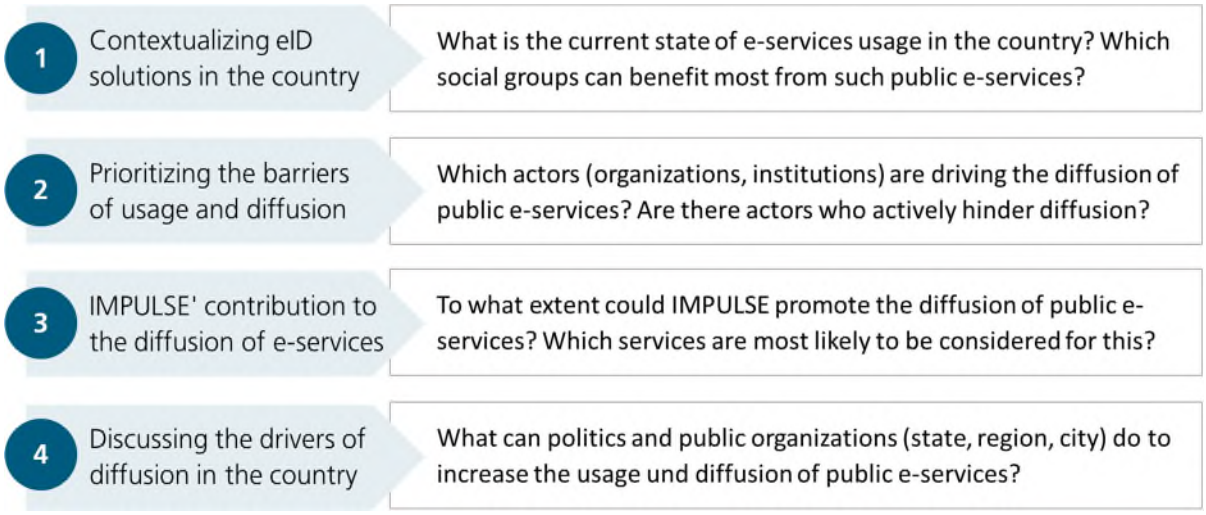

Figure 7: Contents and procedure of the focus groups.[13]

The third question, namely which concrete contribution IMPULSE can make to the further diffusion of e-services, is particularly important for the IMPULE project. In order to discuss this question in the interviews, the adoption barriers that were identified in the literature analysis and summarized in Table 2 can be presented as an input for discussion.

4.2 Selection of experts

Depending on the number of experts that can be mobilized for the focus groups, the focus groups will *ideally* be composed of several experts. However, it is also conceivable to conduct individual interviews if the breadth of the interviewee's expertise permits. Each interview or focus group should last approximately one hour.[14]

The experts shall have some deeper knowledge about the respective regions under study. Those experts could be active researchers, policy advisors or consultants working in field of public online services (e-Government)

[13] The measures in question could be political, organizational or technical in nature.

[14] For the purpose of facilitating the analysis and improving the quality of the evaluation, the interviews will be recorded after explicit consent has been obtained from the interviewees.

or SSI- or eID solutions or might provide deeper insights into the question of social inclusion or exclusion in the context of the application of eID solutions for accessing public services.

The focus groups or expert interviews are expected to take place starting in April 2023. In addition to proven country expertise, the expert should have knowledge of at least one of the following fields:

a) online public services, eGovernment, digital innovations in the public sector;
b) SSI or eID-solutions, national identity systems;
c) social groups (at risk of exclusion).

So far, 25 experts from twelve different European countries have been identified. On this basis, four focus groups with at least one expert could already be formed.

5 Next steps in T4.1

In the coming weeks, the plan of how to conduct the **focus groups** will be finalized and presented within the IMPULSE consortium. At the moment, the plan is to have completed the focus groups by the end of June 2023.

From the middle of this year, the survey will be stopped and data validation and cleaning will start. The raw dataset will be downloaded, along with the survey labels and stored in a secret folder to which only selected Fraunhofer ISI project team members have access.

In order to get reliable and high-quality survey data after the survey is closed, a thorough **data cleaning and validation** process is important. This process is also necessary because the survey tool counts anyone as a participant who clicks on the access link in the invitation mail and starts the survey, no matter whether the participant completed the survey or dropped out. To increase the validity of the survey data, the data set must be adjusted for those participants who do not meet certain quality criteria. This process includes four steps:

1. Cleaning of participants who only answered a portion of the survey;
2. Cleaning of participants speeding through the survey;
3. Cleaning of participants who “straight-line”;
4. Cleaning of participants who provide unrealistic and inconsistent responses or who offer nonsensical feedback in open questions.

Fraunhofer ISI will upload the relevant survey data (raw data set, cleaned data set and list of survey variables, labels and values) to the IMPULSE sharepoint for the duration of the project and thus make them available to the other partners of the project consortium. In addition, the process of survey data cleaning and validation will be presented in Deliverable 4.2 in order to ensure transparency about this process. Fraunhofer ISI will keep the data for scientific publications. However, all data will be finally deleted no later than five years after project completion, at the latest in January 2029.

From the beginning of the third quarter of 2023, **data evaluation** starts (phase 4). All results from the survey, the focus groups and the case studies which have been conducted as part of Work Package 2 will be evaluated with respect to the three research questions introduced above (see Chapter 1).

All results will be presented in the consortium to discuss the main findings and conclusions, and summarized in the second version of **Deliverable 4.1 (V2)** that will be given to the reviewers towards the end of November 2023.

6 Conclusions

This deliverable detailed the conceptual design and methodological approach for surveying the socio-political barriers against the usage and further diffusion of eID solutions in Europe. The below conclusions can be drawn from these mainly conceptual activities. On this basis, a pan-European online survey was designed and implemented and focus groups are being planned to collect empirical data.

a) The literature on the socio-political factors influencing eID solutions indicates that a distinction between acceptance and adoption must be made in order to better assess the barriers influencing the usage and diffusion of eID solutions and to systematically derive measures to reduce those barriers.

b) Four barriers of acceptance were derived from the literature that particularly discourage older people, less educated people, and those with negative usage experiences from using new eID solutions. Those factors include: 1) an unclear added value of IMPULSE for the citizen; 2) a habit of citizens to use public services rather analogously; 3) a perceived low security, privacy and control of personal data (lack of trust); 4) a lack of knowledge of how to set up and operate the solution.

c) To strengthen acceptance especially among the social groups mentioned above, particular consideration should be given to simplifying the identification and authentication process as much as possible and handling personal data on the basis of state regulations. Moreover, creating the greatest possible transparency regarding the personal data handling within the solution and enabling users to withdraw their data also promotes acceptance. Finally, the importance of keeping the whole application as simple as possible, e.g. by means of voice recognition, chat functions etc. must be highlighted.

d) Also, it can be concluded that acceptance is a very individual dimension. Here, usefulness, simplicity and trustworthiness strongly depend on individual habits and perceptions. Therefore, any attempt to assess these aspects must systematically elicit user habits, privacy and security needs, and usefulness considerations. This finding was directly implemented in the online survey. For example, the personal assessment of the envisioned IMPULSE solution is collected based on a short movie explaining IMPULSE and how it will be used. However, these quantitative data may not be sufficient, which is why WP4.1 also collects and triangulates qualitative data such as the results of the pilot case studies that were part of WP2.

e) The literature analysis also revealed four adoption barriers. These include: 1) negative experiences of citizens with eID solutions or negative reports on such solutions; 2) insufficient trust in the actors developing and implementing new eID solution; 3) an insufficient interoperability of a new eID solution with other e-services; 4) a small number of additional use cases. However, it is still largely unclear how these adoption barriers can be reduced and to what extent these barriers actually apply in the partner countries. That is why the focus groups with experts for each country are intended to discuss which political, organizational or infrastructural measures might promote the adoption of IMPULSE.

References

Axelsson, Karin; Melin, Ulf; Lindgren, Ida (2013): Public e-services for agency efficiency and citizen benefit — Findings from a stakeholder centered analysis. In: Government Information Quarterly 30 (1), 10–22.

Davis, Fred D.; Bagozzi, Richard P.; Warshaw, Paul R. (1989): User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. In: Management Science 35 (8), 982–1003.

Domeyer, Axel; McCarthy, Mike; Pfeiffer, Simon; Scherf, Gundbert (2020): How governments can deliver on the promise of digital ID. Ed. McKingsey & Company.

Eaton, Ben; Hedman, Jonas; Medaglia, Rony (2018): Three Different Ways to Skin a Cat: Financialization in the Emergence of National e-ID Solutions. In: Journal of Information Technology 33 (1), 70–83.

Echikson, William (2020): Europe's Digital Identification Opportunity. Hg. v. The Centre for European Policy Studies (CEPS).

Ehrlich, Tobias; Richter, Daniel; Meisel, Michael; Anke, Jürgen (2021): Self-Sovereign Identity als Grundlage für universell einsetzbare digitale Identitäten. In: HMD Praxis der Wirtschaftsinformatik 58 (2), 247–270.

European Commission (2020a): EBSI Economic Assessment Report. Potential economic effects of the introduction of a digital service that would allow organisations, to request digital certificates from a natural person.

European Commission (2020b): EBSI Social Assessment Report: Study of the self-sovereign identity management in the context of blockchain implementations in public administrations, while representing the three different use cases of the EBSI 1 project and focussing on their potential social impact. Ed. Ghent University. European Commission.

Felden, Frank; Zelt, Thilo; Bauer, Patrick; Siegert, Sabine; Einaste, Taavi; Müller, Mario et al. (2020): Zehn Jahre elektronischer Personalausweis: Wie Deutschland ein erfolgreiches eID-Ökosystem aufbauen kann. Hg. v. Boston Consulting Group and Nortal.

fortiss & Initiative D21 (2018): eGovernment MONITOR 2018. Nutzung und Akzeptanz digitaler Verwaltungsangebote – Deutschland, Österreich und Schweiz im Vergleich.

fortiss & Initiative D21 (2019): eGovernment Monitor 2019. Nutzung und Akzeptanz digitaler Verwaltungsangebote – Deutschland, Österreich und Schweiz im Vergleich, zuletzt geprüft am 23.01.2022.

Gustafsson, Mariana; Elin, Wihlborg (2013): Safe Online e-Services Building Legitimacy for E-government. A Case Study of Public E-services in Education in Sweden. In: eJournal of eDemocracy and Open Government 5 (2), 155–173.

*Hedström, Karin; Karlsson, Fredrik; Söderström, Fredrik (2016): Challenges of introducing a professional eID card within health care. In: Transforming Government: People, Process and Policy 10 (1), S. 26–*46.

Heichlinger, Alexander; Gallego, Patricia (2010): A new e-ID card and online authentication in Spain. In: Identity in the Information Society 3 (1), 43–64.

Houtan, Bahar; Hafid, Abdelhakim Senhaji; Makrakis, Dimitrios (2020): A Survey on Blockchain-Based Self-Sovereign Patient Identity in Healthcare. In: IEEE Access 8, 90478–90494.

Janssen, Marijn; Weerakkody, Vishanth; Ismagilova, Elvira; Sivarajah, Uthayasankar; Irani, Zahir (2020): A framework for analysing blockchain technology adoption: Integrating institutional, market and technical factors. In: International Journal of Information Management 50, 302–309.

Im, Il; Kim, Yongbeom; Han, Hyo-Joo (2008): The effects of perceived risk and technology type on users' acceptance of technologies. In: Information & Management 45 (1), 1–9.

Kim, Sanghyun; Garrison, Gary (2009): Investigating mobile wireless technology adoption: An extension of the technology acceptance model. In: Information Systems Frontiers 11 (3), 323–333.

Kostka, Genia; Steinacker, Léa; Meckel, Miriam (2021): Between security and convenience: Facial recognition technology in the eyes of citizens in China, Germany, the United Kingdom, and the United States. In: Public understanding of science (Bristol, England) 30 (6), 671–690.

Krol, Kat; Parkin, Simon; Sasse, M. Angela (2016): "I don't like putting my face on the Internet!": An acceptance study of face biometrics as a CAPTCHA replacement. In: 2016 IEEE International Conference on Identity, Security and Behavior Analysis (ISBA). 2016 IEEE International Conference on Identity, Security and Behavior Analysis (ISBA). Sendai, Japan, 29.02.2016 - 02.03.2016: IEEE, 1–7.

Kubach, Michael; Sellung, Rachelle (2021): On the Market for Self-Sovereign Identity: Structure and Stakeholders. In: Heiko Roßnagel, Christian H. Schunck und Sebastian Mödersheim (Hg.): Open Identity Summit 2021. 01.-02.06.2021 Copenhagen, Denmark. Bonn: Gesellschaft für Informatik (Lecture notes in Informatics (LNI) Proceedings, volume P-312), 143–154.

Lai, Yin Ling; Lee, Joseph (2020): Integration of Technology Readiness Index (TRI) Into the Technology Acceptance Model (TAM) for Explaining Behavior in Adoption of BIM. In: Asian Education Studies 5 (2), S. 10.

Liebig, Brigitte; Nentwig-Gesemann, Iris (2009): Gruppendiskussion. In: Stefan Kühl, Petra Strodtholz und Andreas Taffertshofer (Hg.): Handbuch Methoden der Organisationsforschung. Wiesbaden: VS Verlag für Sozialwissenschaften, 102–123.

Mahula, Stanislav; Tan, Evrim; Crompvoets, Joep (2021): With blockchain or not? Opportunities and challenges of self-sovereign identity implementation in public administration. Lessons from the Belgian case. In: Proceedings of the 22nd Annual International Conference on Digital Government Research, 495–504.

Ølnes, Svein; Jansen, Arild (2018): Blockchain technology as infrastructure in public sector. In: Marijn Janssen, Soon Ae Chun, Vishanth Weerakkody, Anneke Zuiderwijk und Charles C. Hinnant (Ed.): Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age. dg.o '18: 19th Annual International Conference on Digital Government Research. Delft The Netherlands, 30 05 2018 01 06 2018. New York, NY, USA: ACM, 1–10.

Pöhn, Daniela; Grabatin, Michael; Hommel, Wolfgang (2021): eID and Self-Sovereign Identity Usage: An Overview. In: Electronics 10 (22), 2811.

Ritchie, Kay L.; Cartledge, Charlotte; Growns, Bethany; an Yan; Wang, Yuqing; Guo, Kun et al. (2021): Public attitudes towards the use of automatic facial recognition technology in criminal justice systems around the world. In: PloS one 16 (10), e0258241.

Rogers, Everett M. (2003): Diffusion of innovations. 5. edition, Free Press trade paperback edition. New York, NY: Free Press.

TUM & Initiative D21 (2018): eGovernment Monitor 2018. Nutzung und Akzeptanz digitaler Verwaltungsangebote – Deutschland, Österreich und Schweiz im Vergleich. Ed. KANTAR.

TUM & Initiative D21 (2020): eGovernment Monitor 2020. Staatliche Digitalangebote – Nutzung und Akzeptanz in Deutschland, Österreich und der Schweiz. Ed. KANTAR.

TUM & Initiative D21 (2021): eGovernment Monitor 2021. Staatliche Digitalangebote - Nutzung und Akzeptanz in Deutschland, Österreich und der Schweiz. Ed. KANTAR.

Venkatesh, Viswanath; Morris, Michael G.; Davis, Gordon B.; Davis, Fred D. (2003): User Acceptance of Information Technology: Toward a Unified View. In: MIS Quarterly 27 (3), 425.

Vassil, Kristjan (2016): Estonian e-Government Ecosystem. Foundation, applications, outcomes. Background paper digital dividends. Tartu.

Wang, Fennie; Filippi, Primavera de (2020): Self-Sovereign Identity in a Globalized World: Credentials-Based Identity Systems as a Driver for Economic Inclusion. In: Front. Blockchain 2, Artikel 28.

Watson, Hayley; Finn, Rachel L.; Barnard-Wills, David (2017): A gap in the market: the conceptualisation of surveillance, security, privacy and trust in public opinion surveys. In: Surveillance & Society 15 (2), 269–285.

World Bank Group (2018a): Public Sector Savings and Revenue from Identification Systems: Opportunities and Constraints. Washington, DC, last checked: Jan 30, 2023.

World Bank Group (2019): Global ID Coverage, Barriers, and Use by the Numbers: World Bank, Washington, DC, last checked: Feb 29, 2021.

Yin, R. K. (2009). Case Study Research: Design and Methods. Thousand Oaks, CA: SAGE.

Zhong, Yongping; Oh, Segu; Moon, Hee Cheol (2021): Service transformation under industry 4.0: Investigating acceptance of facial recognition payment through an extended technology acceptance model. In: Technology in Society 64, 101515.

Annex A Questionnaire

1) Introduction

Thank you for your help!

This survey is conducted by a group of researchers at institutes and universities in Finland, Germany and Austria. Our survey is for a scientific project funded by the European Union. We want to understand what people think about online public services, computers and smartphones, and how they use them. This will help us develop new technology and improve public services online.

By taking the survey, you provide really important input for our research! This takes about 15 minutes.

The survey is completely anonymous. No information you share can be traced to you, nor can you be traced by any information you provide. You can also withdraw from the survey at any point.

For each completed survey, we will donate 2 € to one of several charities (you can pick!), up to a total of €500 Euros.

Let me thank you again for support

Nicholas Martin, Fraunhofer ISI, Deutschland

Jiri Musto, LUT University, Finland

If you have any questions, please feel free to contact me at nicholas.martin@isi.fraunhofer.de

To learn more about our research project, visit https://www.impulse-h2020.eu/

Information on data protection

Participation in this survey is voluntary.

You can interrupt the survey at any time and continue or cancel it at a later time.

The survey serves only the following purposes:

- Performing the research planned in the IMPULSE research project on the use of online services and technologies, in particular digital identity and log-in technologies, and ways to improve these;
- Performing other research on digitalisation and technology use by Fraunhofer ISI.
- Analysis of the data is performed by Fraunhofer ISI and only by persons who are bound to data secrecy according to § 53 BDSG (23.06.2021) or to confidentiality when handling personal data and to compliance with the EU Data Protection Regulation (DSGVO) and other relevant regulations and guidelines.
- Analysis of the data – including textual responses – is performed in such a way that it is not possible to draw any conclusions about individual persons from the results.
- Only anonymous data are collected in the survey. In particular, no names, IP addresses, residential addresses or other personal data are collected.

The technical and organisational requirements according to Art. 25 and 32 DSGVO for the protection of personal data are complied with.

The data will be deleted no later than five years after the end of the project, in January 2029.

If you have any questions about the survey and data protection, please contact:

Processing owner: Nicholas Martin, nicholas.martin@isi.fraunhofer.de

Fraunhofer data protection officer: Ralph Harter, ralph.harter@zv.fraunhofer.de

2) Demographic Data

To understand survey results better, we would first like to collect some background information.

Q1. How old are you?

- Free text box

Q2. What is your gender

- Female
- Male
- Diverse

Q3. What is your highest level of education?

- Completed primary school
- Completed secondary school
- Completed post-secondary school vocational training
- Completed university
- Currently at university
- Currently in post-secondary school vocational training

Q4: What is your annual household income, after tax?

(country-specific quintiles)

- Less than X
- X+1 to XX

- XX+1 to XXX
- XXX+1 to XXXX
- More than XXXX+1
- Prefer not to answer

Q5. What is your citizenship?

- Citizen of [*survey country*]
- Permanent resident of [*survey country*]
- Migrant / non-permanent residency
- Prefer not to answer

Q6. Due to discrimination and for other reasons, minority groups often have distinct views about technology. To help us develop genuinely inclusive technology, we would therefore like to ask you your ethnicity.

- White
- Minority
- Prefer not to answer

Q7. Do you live in a…

- Rural area or village
- Small or middle-sized town
- Major city [country-specific number: ~top 6 cities]

3) Technology & data protection

Q8. I enjoy trying out new technologies.

Strongly Disagree		…		Strongly Agree.
1	2	3	4	5

Q9. People have different views on privacy. In general, how concerned are you about your privacy when you access services on the internet?

Very Concerned		…		Not Concerned at All
1	2	3	4	5

4) Introducing the IMPULSE solution

Video: We are developing a new Log-In system for online services. We would like to get your feedback on it. Please watch the video, which shows the basic elements of our system.

Q10. Would you use IMPULSE instead of the digital identity (log-in) systems you currently use (like username/password, smartcard, PIN, etc.), if IMPULSE were available?

Certainly not		…		Certainly yes
1	2	3	4	5

Q11. Why would you not use IMPULSE instead of the digital identity (log-in) systems you currently use?

- I do not want to depend on my Smartphone
- I do not have a Smartphone
- I am worried about what happens if I lose my Smartphone or it is stolen
- I am worried about facial recognition technology
- IMPULSE is too complicated
- I use too few online services to make IMPULSE worthwhile
- I am worried about hackers and identity theft

5) Using the IMPULSE solution

Q12. For which online services do you think it would be most sensible to use IMPULSE? Please indicate the three most important in your opinion.

- Online banking
- eHealth (e.g. electronic communication with a doctor to get a prescription instead of going in person)
- Digital vaccination certificate for Covid or other diseases
- Social media
- E-commerce (e.g. Amazon, Airbnb)
- Completing tax returns online

- Registering for social services online
- Email
- Other (free text box)
- None

Q13. Please choose of the following words and phrases that you feel describe IMPULSE.

convenient; easy to use; saves time; makes signing up for services easier; makes logging in easier; exciting; safe; privacy-friendly; interesting; unnecessary; weird; complicated; creepy; IMPULSE gives me control over my data; dangerous; surveillance; not useful; with IMPULSE, I can decide who gets my data; other (free text box)

Q14. Today, many people have multiple digital identities (log-ins), with different usernames/passwords. Please tell us which statements you agree with.

Strongly Disagree		…		Strongly Agree
1	2	3	4	5

- Using multiple digital identities is a hassle, but sensible
- I would prefer to have a single digital ID for all online services and accounts
- I sometimes forget my username/password, or forget which identity to use for a service or account
- I sometimes don't use a service because the sign-up process (when you enter information like your name and address and create a username/password or similar) is too much hassle
- Managing multiple digital identities and ways of identifying myself overtaxes me
- If signing up for services were easier and faster, I would use more services
- If I had only one single, secure digital ID, that I could use for all online services, I would use more services

6) Control of personal data

Q15. With IMPULSE, you create a new digital identity for each online service, and store these identities on your phone, in the IMPULSE App. As we saw in the video, you create these digital identities with photos of your state identity card, but then the photos are deleted. No record of your identity card is kept.

Some European governments have proposed an alternative system: a digital version of your state identity card, that you store on your phone and can use as a single, universal digital identity for all online services – instead of having multiple digital identities like with IMPULSE.

Which system would you prefer to use?

- IMPULSE: multiple digital identities stored on your phone but no record of your ID card kept on your phone
- Alternative: digital version of your identity card stored on your phone that serves as a single, universal digital identity

Q16. For many people, it is very important to have "control over their data". Having "control over your data" has many dimensions. Below is a list of some dimensions. Please indicate the three most important in your opinion.

- Online service providers cannot demand more data from me than necessary to make the service work
- Online service providers cannot refuse me their service unless I allow them to use my data for advertising
- Online service providers cannot use website lay-out and other tricks that manipulate me to give them extra data or data-use permissions
- Online service providers have to ask for my consent before collecting or using my data
- Online service providers must provide a short, easy-to-understand privacy policy explaining how they use my data
- Online service providers must delete my data if I ask them to

7) Experiences with eID solutions and digital skills

Q17. Some people are very skilled with computers and smartphones; others are just getting to know them. Please tell us about your skills. I know how to…

Strongly Disagree		…		Strongly Agree
1	2	3	4	5

I know how to…

- …use Google or other internet search engines
- …find relevant information on websites of state agencies or the municipal government
- …use email or social media
- …save or store files (documents, music etc.) on my device and retrieve them when I want them
- …use Cloud Applications like Dropbox, iCloud, Google Drive, or SharePoint to store and share documents
- …use online services like online banking, e-government or e-health
- …use Word or PowerPoint or similar applications
- …read a simple computer code and make basic changes to it
- …re-install or update computer programs

Q18. There are many different technologies to give users a digital identity to log in to an online service, computer or smartphone, like username and password, PIN/TAN, Smartcard etc. Please tell us which ones you have used or heard about.

	I have used this technology	I have heard about this technology	I have not heared about this technology
User Name + Password			
SmartCard + PIN-Number			
PIN / TAN			
Fingerprint recognition			
Face recognition			
Voice recognition			
Eye [iris] recognition			
Other [please specify]			

8) Preferred technical solution

Q19. Please indicate below which three digital identity (log-in) technologies you prefer to use for your log-ins.

- User Name + Password
- SmartCard + PIN-Number
- PIN / TAN
- Fingerprint recognition
- Face recognition
- Voice recognition
- Eye [iris] recognition
- Other [please specify]

Q20a. Many online services require you to use a digital identity (log-in), like a username/password, PIN/TAN, Smartcard/PIN or biometric recognition. Please estimate how many private online services you regularly use that require a digital identity (log-in). Such services are e.g. online banking, social networks, insurance, Amazon/online shopping, Airbnb, Booking.com... Just give us your best estimate.

Freetext box

Q20b. Please estimate how many online government services you use that require a digital identity (log in). Such services include filing tax returns online, re-registering a car or residence online, participating in a public digital discussion forum, registering with a government agency online... Just give us your best guess.

Freetext box

9) e-Government services

Q21. eGovernment means digitising public services, so citizens can do them online: for example complete tax returns, pay municipal bills, register a car or residence, or apply for social benefits. Have you used eGovernment services (online public services)?

- Yes
- No

Q22a. Please tell us about why you have not used eGovernment services, and your views about eGovernment in general. Please tick all that apply.

- I am not aware of any eGovernment services
- The eGovernment services that exist are not relevant to me
- Going to the public administration in person is faster than using eGoverment
- Doing things in person at the public administration is easier than using eGoverment
- eGovernment feels cold and nonpersonal. I prefer having personal interaction with the civil servants
- I am worried about the security of my data if I use eGovernment
- I would be worried to make a mistake if I use eGovernment
- I would use eGovernment if it was fast, simple and I could be sure my data are safe
- Other Free Textbox

Q22b. Thinking about your experience with eGovernment, what aspects should be improved the most? Please indicate what you consider to be the three most important improvements.

- Make signing up for eGovernment (creating a digital identity to use for eGovernment) easier and faster
- Make logging-in to eGovernment services easier and faster
- Make more public services available online
- Make finding information about eGovernment services easier
- Improve the layout of eGovernment websites
- Offer more assistance for using eGovernment (e.g. helplines, chatbots)

- Ensure all eGovernment services can be completed fully online (i.e. no need for any offline steps, like providing physical signatures

10) Charity organizations

Q23. Thank you very much for your answers! Finally, we would like to ask you to choose a charity to which we may donate - as a thank you for your participation - 2 euros. Please click ">>>" afterwards to complete the survey.

The following organizations are available for selection:

- WWF - Nature and Biodiversity Conservation Organization,
- World Food Program - World Food Program of the United Nations,
- Rewilding Europe - Making Europe a better Place,

Save the Children.