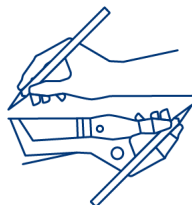




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 EUROPEAN RESEARCH EXECUTIVE AGENCY (REA)

REA.C – Future Society

C.1 – Inclusive Society



ITHACA
 AI To Enhance Civic Participation

ITHACA
artificial Intelligence To enHance Civic pArticipation

Deliverable D1.2: Overview of Personal Information Management Systems

Work Package: WP1 – State of the art and conceptualization

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Executive Summary

This deliverable provides an overview of Personal Information Management Systems (PIMS). This type of system aims to allow individuals to manage their personal data in secure storage systems and share them when and with whom they choose. Storage and sharing needs to adhere to legal and ethical standards, such as the General Data Protection Regulation (GDPR) and all applicable privacy and transparency principles. According to the description of Task 1.6, this overview includes (a) existing initiatives and projects claiming PIMS features, (b) elements of architecture, records, and checklists required for the implementation, (c) safeguards for compliance with the GDPR, and (d) user interfaces of such systems. This elaboration and overview should serve as a guideline for the design and implementation of the ITHACA platform. Task 3.10 will take up these considerations along with user requirements elaborated in Work package 2, in order to design and develop a PIMS for ITHACA.

Following the task description, this document presents an overview to PIMS, lists several current systems and projects, and outlines requirements of the PIMS design in ITHACA. First, a general introduction to PIMS and requirements is given that includes a definition of PIMS, a schematic architecture, and basic requirements. Then, existing systems, projects, and initiatives are presented that implement PIMS features. This list consists of NextCloud, Solid, MyDex, Mydata, PIMCity, CONSUL DEMOCRACY, and the Better Reykjavik platform. Based on these systems and the general requirements, key PIMS concepts are extracted and technical and human-centred requirements for the design of the PIMS component in ITHACA are presented, such as data security, interoperability, transparency, consent management, and accessibility. Furthermore, an overview of personal information is given that might be relevant in the context of ITHACA, and a co-creation concept is advocated on how to integrate user requirements in future work. Finally, conclusions for the design of the ITHACA platform are derived from these considerations.

The report was updated in September 2024 by integrating an analysis of EU Digital Identity Wallets and related frameworks and pilot implementations (added Section 4). The features and requirements of EU Digital Identity Wallets strongly overlap with the characteristics of PIMS presented in the report. In particular, interoperability and interfaces, user centric design and usability, security and privacy are shared among PIMS and EUDI wallets. In contrast to other PIMS, the EU Digital Identity includes a mechanism to authenticate and validate the real person of a user (added requirements on identity authentication in Section 5.1). This might have the advantages in the citizen participation process as fake accounts and false identities can be avoided. However, the authentication process might be difficult for people of vulnerable groups, who often do not have enough digital skills to manage the complex process of a EUDI registration and account management. Furthermore, general recommendations for the project design have been added to the document (Section 5.5).

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List of Abbreviations

Abbreviation / Acronym	Description
AI	Artificial Intelligence
API	Application Programming Interface
ARF	Architecture and Reference Framework
EEA	European Economic Area
EUDI	European Union Digital Identity
GDPR	General Data Protection Regulation
ITHACA	artificial Intelligence To enHAnce Civic pArticipation
PDK	PIMS Development Kit
PIMS	Personal Information Management Systems
PSK	PIMCity Stakeholders
SaaS	Software as a Service
Solid	Social Linked Data

1. Introduction

1.1 Purpose and scope

This deliverable provides an overview of Personal Information Management Systems (PIMS). This type of system aims to allow individuals to manage their personal data in secure storage systems and share them when and with whom they choose. According to the description of Task 1.6, this overview includes (a) existing initiatives and projects claiming PIMS features, (b) elements of architecture, records, and checklists required for the implementation, (c) safeguards for compliance with the General Data Protection Regulation (GDPR), and (d) user interfaces of such systems. This elaboration and overview should serve as a guideline for the design and implementation of the ITHACA platform.

The main purpose of this deliverable is to provide information of existing PIMS for the development of PIMS in Work package 3. According to the task description Task 3.10 will make use of best practices of PIMS identified in T6.1 as well as user requirements gathered in WP2. The development of a PIMS in T3.10 (a) will support data protection principles, (b) will enable users to define how their personal information should be used and for what purpose, and (c) will enable users to keep track of the way this information is used so as to be sure that it is not processed in a way not permitted by them. This will ensure comprehensive consent management functionality enabling users to also withdraw their consent when desired and a user-friendly control dashboard to be provided for this purpose.

Following these task descriptions, this deliverable will provide a general introduction to PIMS including their system architecture concepts and key features related to personal data and data protection. Furthermore, existing PIMS are listed and shortly described, in order to provide a reference for the development. Finally, considerations for the PIMS development in the context of ITHACA are given at the end of the deliverable taking into account the requirements for ITHACA and existing PIMS.

1.2. Intended audience

The main goal of this deliverable is to guide the design and development of the ITHACA platform and specifically the PIMS development conducted in T3.10. Thus, the primary audience consists of the researchers, designers and developers of the ITHACA platform. They are provided with general information of PIMS, a list and short description of existing tools, building blocks of the software architecture, key concepts and features related to legal and ethical aspects, and examples of user interfaces.

The second type of audience are the end users with a focus on vulnerable groups and their needs. This indirect audience will benefit from the elaboration of this deliverable, as it provides information on how to secure personal data, make personal data transparent, and provide support for informed decisions, all in alignment with the 'Privacy by Design' and 'Privacy by Default' principles outlined in Article 25 of the GDPR.

1.3 Structure of the document

The document is structured in the following way. First, a general overview of PIMS is given in the next section, which includes a definition, the general approach, and basic requirements of general PIMS. Section 3 provides a list of existing systems, projects, and initiatives that deal with PIMS. Conclusions and requirements derived from existing systems and PIMS concepts that are relevant for the development of the ITHACA platform are presented in Section 4. Finally, a summary and future work is given in the last section.

2. PIMS definition and concept

This section gives a general overview of PIM systems, which consists of recent definitions of PIMS, a description of the overall concept, and requirements derived from the definitions and concepts.

2.1 Introduction

Traditionally, two decades ago PIMS research addressed the efficiency and productivity of the workflow in private and professional context. Concepts, approaches, and software tools have been created that aimed to support individuals to manage their data. Approaches have been elaborated that help people to find previously stored information again, recall it when needed, and use it effectively in the next interaction with the item (e.g. Bergman, Beyth-Marom, & Nachmias, 2003).

More recently, PIMS research deals with storing and sharing of personal data and focuses on legal and ethical aspects, such as privacy and transparency (e.g. Jansen & Singh, 2022). A key question is how to assure the control and sovereignty of the users concerning their personal data. The work and PIMS overview provided in this deliverable refer to the concepts and approaches of the recent PIMS research, and do not take into account workflow efficiency that has been the research topic in older PIMS research.

2.2 Definition

The European Data Protection Supervisor appointed by the European Parliament and the Council provides a definition that focuses on the secure management and sharing of personal data (European Data Protection Supervisor, 2023a):

"Personal Information Management Systems (or PIMS) are systems that help give individuals more control over their personal data. PIMS allow individuals to manage their personal data in secure, local or online storage systems and share them when and with whom they choose. Providers of online services and advertisers will need to interact with the PIMS if they plan to process individuals' data. This can enable a human centric approach to personal information and new business models."

Another event short definition is given by Jansen & Singh (2022):

"Personal Information Management Systems (PIMS) seek to empower users by equipping them with mechanisms for mediating, monitoring and controlling how their data is accessed, used, or shared."

These definitions address the management of personal information of individuals and includes the following characteristics:

- the data can be stored in data storages in a secure way
- the data can be shared with other applications and provide interoperability for these applications
- the management of the data follows a human-centric approach

2.3 Overall concept

A TechDispatch report of the European Data Protection Supervisor (2020) provides further information on the overall concept of PIMS. It highlights that the PIMS concept offers a new approach in which individuals are the owners and managers of their personal information. The end users should be enabled to manage their personal data in a secure way in local or online storage systems and share them when and with whom they choose. Individuals would be able to decide what services can use their data, and which third parties can use them. This allows for a human centric approach to personal data and to new business models, protecting against unlawful tracking and profiling techniques that aim at circumventing key data protection principles.

Thus, this concept consists of two parts, a technical concept and a human-centric concept. The technical concept describes how the data is managed technically, including the storage of the data, the interoperability features to share data with third party applications, and the implementation of user-centric concepts. An overview of the technical concept is depicted in Figure 1. This diagram gives an example where photo, contacts, and calendar data in the same storage are used by different applications. Moreover, the storage (a PIMS) enables security features, consent management, access control, and data minimisation principle.

The human-centric part of the concept refers to how the user perceives key features of PIMS, such as security and access control. Access to own data must be provided in an understandable way, so that the user can understand with reasonable cognitive effort what the data are about, how they are used, by whom they are used, and how they can control the third party usage of their data.

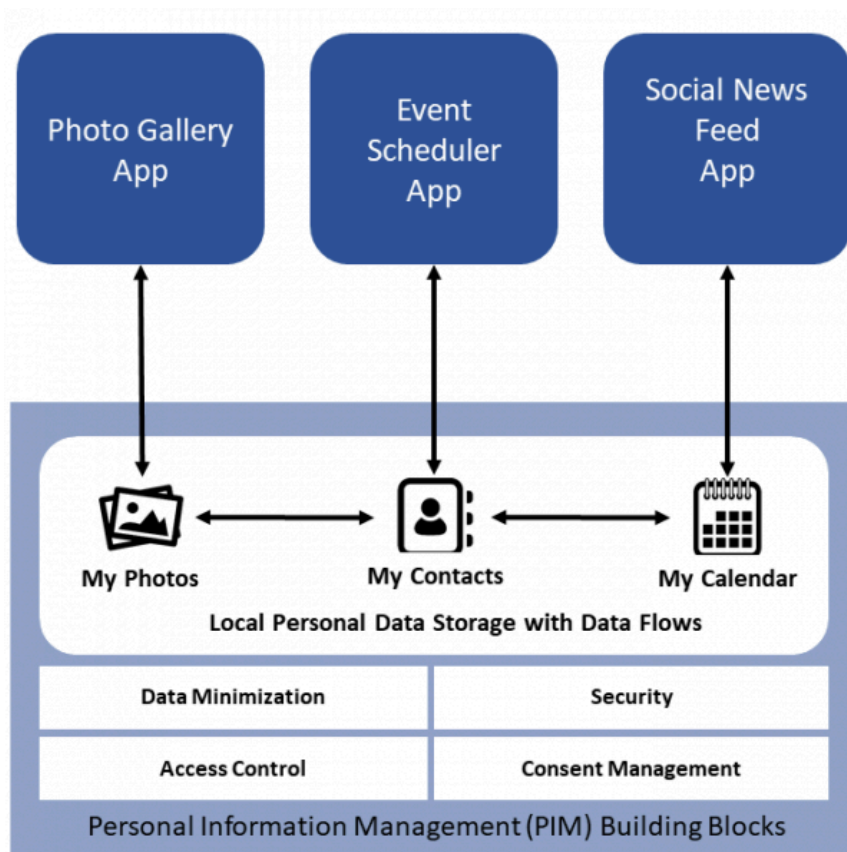


Figure 1: A simple schema for a Personal Information Management System with personal data storage. Image taken from European Data Protection Supervisor (2020).

2.4 General requirements

The main objective of PIMS is to put users in control of their personal information. In addition to serving as an effective and user-friendly mechanism to provide or withdraw consent, well-designed PIMS would also facilitate the users' rights of access to their data and their right to keep it up-to-date and accurate, thus enhancing the quality of data. From a legal point of view, this also refers to the General Data Protection Regulation (GDPR) of the European Commission (Regulation, 2016), as it enhances compliance with the requirements of informed consent (art. 7 of GDPR).

Following these considerations the following requirements of PIMS can be derived (European Data Protection Supervisor, 2020). Most of these concepts have both technical and human-centric aspects. Technical aspects relate to the implementation of the respective concept. Human-centric aspects relate to ethical, legal, and societal aspects.

2.4.1 Consent management

In the context of PIMS is consent and consent management a key concept as it involves users in the collection, storage, and processing of their personal data. Users become aware of which data is processed and for which purpose this is done, and they are empowered to understand and revoke the storage of their data. Bernemann, J., & Kneuper, R (2023) describe an approach of how the issue of granting relevant consent to the storage and use

of cookies is solved with the use of PIMS. They propose to store the consent in the storage of a PIMS, where users can manage their consent. This includes, the ex-ante settings of consents, the editing and revoking of consents, the automatic creation of a report in which consent has been given.

Furthermore, Bernemann, J., & Kneuper, R (2023) also list general requirements on consents. Providing consent must be voluntary, users must be informed about the purpose of the consent, the consent must be for a specific case, and the consent must be provided explicitly and without ambiguity. Moreover, the PIMS must record all details about the consent, the duration of the consent must be provided, and the user must have the possibility to revoke the consent.

More importantly, consent management ensures compliance with GDPR by specifically addressing the following critical elements:

- **Demonstration of Consent:** The controller (the controlling person or organisation) is required to substantiate that the data subject has willingly consented to the processing of their personal data.
- **Written Declaration:** When consent is embedded within a broader written agreement, the clause seeking consent must stand out clearly from other sections. The language should be straightforward, unambiguous, and easily comprehensible. Any part of the declaration conflicting with GDPR standards will be deemed invalid.
- **Right to Withdraw Consent:** Individuals have the prerogative to rescind their consent at any moment. Revoking consent does not retroactively affect the legality of data processing activities conducted before the withdrawal. Individuals must be made aware of this right before offering their consent, and the withdrawal process should be as uncomplicated as the initial consent procedure.
- **Assessment of Freely Given Consent:** In determining the legitimacy of consent, particular attention must be paid to whether the fulfilment of a contract or the delivery of a service hinges on consent for processing non-essential personal data.

2.4.2 Transparency and traceability

Commercial online platforms often collect personal information of users as part of their business model. In their general *terms of usage* statements they require the consent of the users. Though they are subject to the GDPR and have to provide information about which data is stored, they mostly do not provide this information in a user-friendly way.

PIMS, however, should provide information about stored personal data in an understandable and comprehensive way. Comprehensiveness refers to the fact that all data should be visible to the user, including the purpose why they are stored, which function or tool makes use of them and what is the flow of processing. Understandability refers to the method of how the information is presented. Instead of texts or lists, a graphical dashboard could be provided that can help individuals to follow their data and their processing.

Adhering to these guidelines is not merely a matter of enhancing user experience but is crucial for compliance with the transparency and liability principles outlined in GDPR. Specifically, this aligns with Article 5(1)(a) which mandates lawful, fair, and transparent processing, and Article 24 which requires controllers to implement appropriate measures to ensure compliance. Providing clear, comprehensive, and easily accessible information about

personal data storage and processing is essential for meeting GDPR's stringent requirements for transparency and accountability as stipulated in Articles 12, 13, and 14 concerning the provision of information to data subjects.

2.4.3 Data portability and interoperability

It is a common feature of PIMS that they provide access to personal data of individuals to other applications and tools. This requires standardised or at least well established formats of data representation and application programmable interfaces (API). Furthermore, documentation of the applied formats and standards is necessary to provide interoperability and share data with other applications.

2.4.4 Data security

Data security is a highly important requirement as it concerns personal data of individuals. In PIMS personal data of individuals is accessed by external applications through an API, which exposes the data to the outside. This requires strong security measures, such as encryption and data minimisation. Encryption can be used to verify the authenticity of data and to implement privacy and data protect features, as the access is only granted to authorised agents. Encryption can be applied in both processes, data storage and data transfer. Data minimisation relates to the amount of data that is stored. Only necessary data should be stored and no data should be stored without purpose. So in case of unwanted access, a smaller amount of data can be affected.

Implementing these security measures is not just best practice but is also critical for proving compliance with specific GDPR provisions. Specifically, this aligns with Article 32, which mandates the implementation of appropriate security measures to ensure a level of security appropriate to the risk. By employing encryption and data minimization strategies, organisations can demonstrate their commitment to safeguarding personal data, thereby fulfilling GDPR's stringent requirements for data protection and accountability.

2.4.5 Accountability and liability

When it comes to processing personal data also questions of responsibility, liability, and accountability have to be clarified before setting up such a system. It has to be specified which organisation and persons are in charge of ensuring the privacy and who takes action if a data breach occurs. Furthermore, a process has to be set up on how to deal with data problems and user complaints. This information needs to be accessible and displayed for all users.

3. Existing PIMS solutions and best practices

This section lists and describes a selection of current systems, projects, and initiatives in the context of PIMS. The listed tools serve as best practices of existing PIMS software and should give hints for the development of the ITHACA PIMS solutions.

3.1 Nextcloud

Nextcloud (2023) is an open source Software as a Service (SaaS) solution that offers cloud services for individuals and groups. Users are provided with a safe environment where they can store and share their data of any file type in a hierarchical file system. Furthermore, Nextcloud embraces modules calendar, event schedules, project boards, text processors (Only Office), chat, and video conference tools (Big Blue Button).

Nextcloud is not primarily a PIMS with main focus on sharing data with other applications. However, it shares some relevant features with PIMS. Users can set the appearance by selecting a theme (Figure 2). This dialog also allows users to choose a theme with high contrast, which helps people with visibility problems or impairment. Furthermore, Nextcloud enables users to share their stored files with others by providing a URL to the file. Sharing permissions can be configured, so that the users can control which data is accessible by others. The sharing can be restricted to specific users or allowed to anybody who has the URL. A screenshot of the sharing settings dialog is given in Figure 3. Profile visibility can be configured on a fine granular level (Figure 4). For each profile item (e.g. full name or email addresses) it can be configured if this information is shown to anybody, to users logged in to the system, or to none.

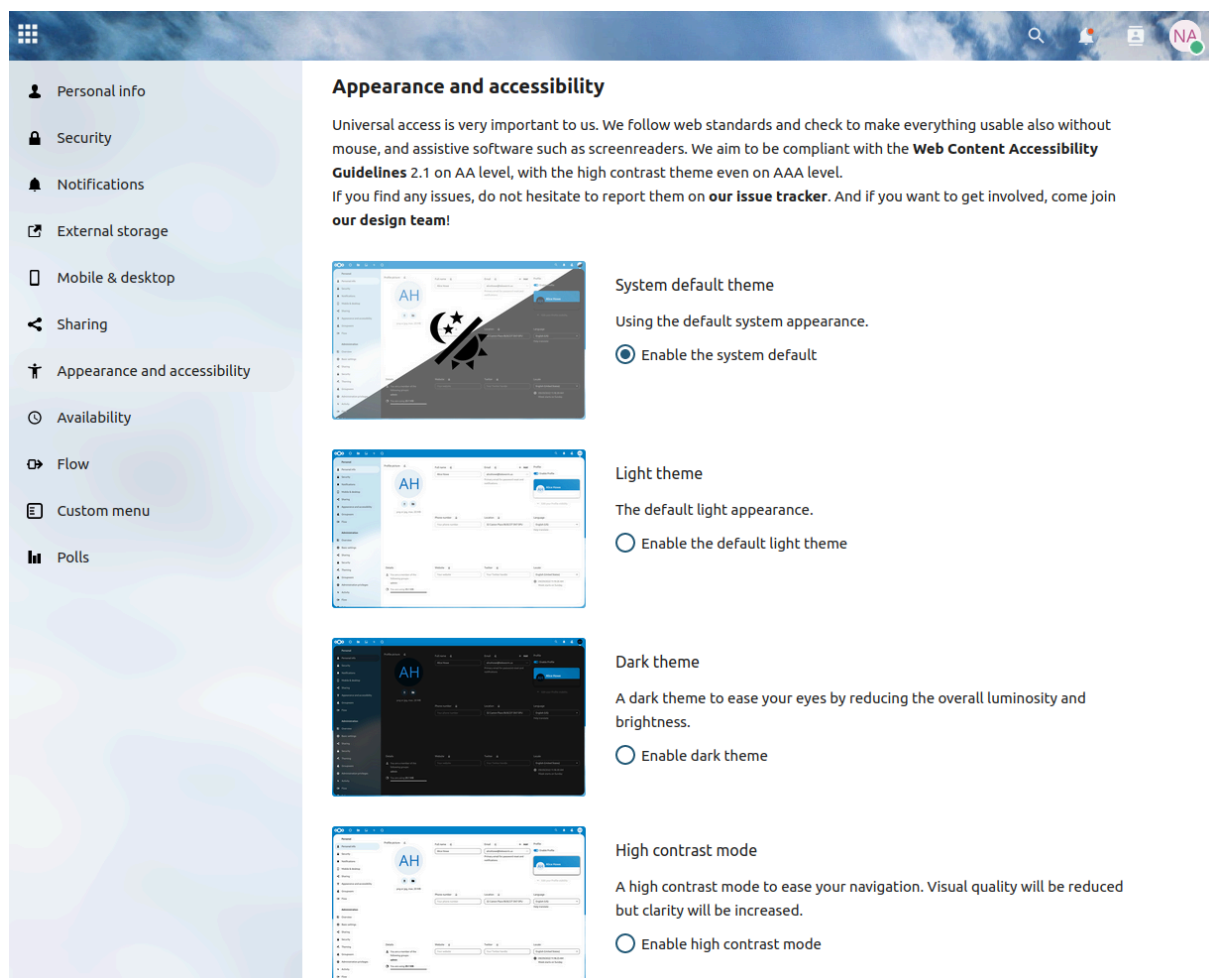


Figure 2: The Nextcloud accessibility settings dialog. Screenshot of the Nextcloud web application.

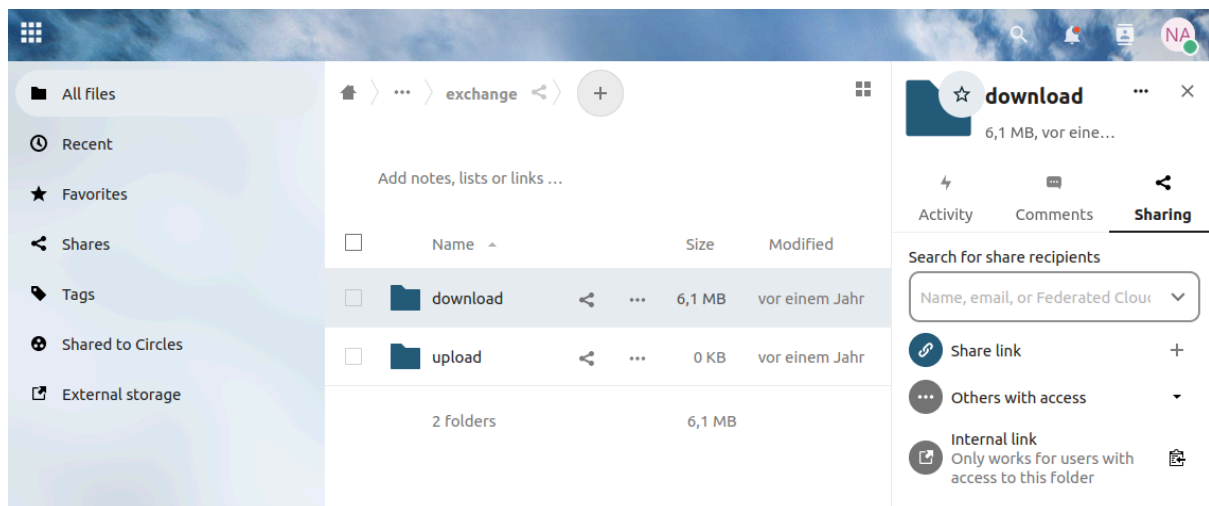


Figure 3: The Nextcloud file sharing settings dialog. Screenshot of the Nextcloud web application.

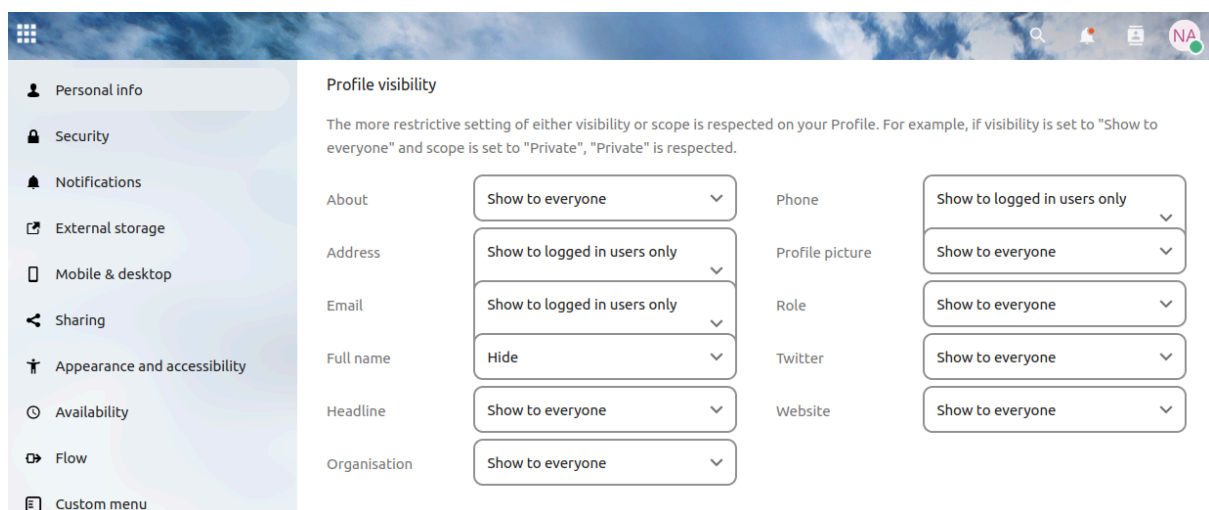


Figure 4: The Nextcloud profile visibility settings dialog. Screenshot of the Nextcloud web application.

3.2 Solid

Solid (2023) is a specification that lets people store their data securely in decentralised data. Solid is an acronym for Social Linked Data and its development is led by Tim Berners Lee. Users can store their data in the so-called Pods that are like secure personal web servers for user data, where any kind of information can be stored. Pods are hosted on Solid servers where users can have multiple Pods.

Users can control access to their data and decide what data to share and with whom (see Figure 5). With Solid's Authentication and Authorization systems, users determine which

people and applications can access their data. They grant or revoke access to any slice of their data as needed.

The same sharing and access control features are available for Solid applications. Within the interoperable Solid ecosystem, different applications can access the same data instead of requiring separate data silos specifically for the applications. For example, instead of inputting email with a bank statement notification service and with the phone's billing service, this information can be stored in a Pod only once and access is granted to read the email information to these disparate applications.



Figure 5: Solid pods of individual users. Image taken from Solid (2023).

3.3 MyDex

MyDex (2023) is a platform that provides any citizen with a Personal Data Store hosted safely and securely in the cloud. The Personal Data Store enables citizens to collect, receive, and store personal data about them and their life. Organisations can deliver personal data into them as part of normal service delivery or collect data from the Personal Data Store with the consent of the citizen (see Figure 6).

Users can access a particular service online through a secure personal store, where all personal 'verified' records are managed. They can be securely accessed by other applications using Application Programming Interfaces (APIs). It provides the ability to grant and revoke access permissions on a general or ad-hoc basis. Thus, It does this by putting citizens in control. They can choose what data is used and how. This way, it's easy for citizens to exercise their rights under GDPR and the Data Protection Act, and for organisations to meet their obligations for transparency, data portability, and informed consent.

MyDex provides a secure identity service supporting registration, authentication, and ongoing management of privacy-protecting digital identity credentials. This puts citizens in

control of their own online identities and enables accessing services where and when they need to, without endlessly creating usernames and passwords.



Figure 6: MyDex model for interchange of data with organisations. Image taken from MyDex (2023).

3.4 MyData

MyData (2023) is an initiative to empower individuals by improving their right to self-determination regarding their personal data. It provides a human-centric approach to personal data management, which combines industry need for data with digital human rights. The core idea is to offer an easier way to see where personal data goes, specify who can use it, and alter these decisions over time. The MyData approach aims to strengthen digital human rights whilst opening new opportunities for businesses to develop innovative, personal data-based services built on mutual trust. The initiative offers a set of principles to combine industry-needs for data access with digital human-rights.

The MyData model seeks to give people access to their information and control over their data (Poikolam et. al, 2020). The General Data Protection Regulation (GDPR) provides a good basis for this, but MyData claims that systems under the GDPR lack easy-to-use tools for people to access and transfer information about themselves from one system to another. Thus MyData proposes a human-centric model that puts the user in control of their data.

The MyData operator reference model (Poikolam et. al, 2020) describes nine core functional elements of operators. These elements affect how easy it is to utilise personal data, how transparent and human-centric the utilisation of personal data is, and how well the infrastructure supports open competition. The nine core functional elements are:

- **Identity management.** Identity management handles authentication and authorisation of individuals and organisations in different, linked identity domains and links identities to permissions.
- **Permission management.** Permission management enables people to manage and have an overview of data transactions and connections and to execute their legal rights.
- **Personal Data Storage.** Personal data storage allows data to be integrated from multiple sources (including data created by a person) in storage under the individual's control.

- **Service management.** Service management uses connection and relationship management tools to link operators, data sources, and data using services
- **Value exchange.** Value exchange facilitates accounting and capturing value (monetary or other forms of credits or reputation) created in the exchange of data.
- **Data model management.** Data model management is about managing the semantics (meaning) of data, including conversion from one data model to another.
- **Personal data transfer.** Personal data transfer implements the interfaces (e.g. APIs) to enable data exchange between the ecosystem participants in a standardised and secure manner.
- **Governance support.** Governance support enables compliance with the underlying governance frameworks to establish trustworthy relationships between individuals and organisations.
- **Accountability and logging.** Logging and accountability entails keeping track of all information exchanges taking place and creating transparency about who accessed what and when.

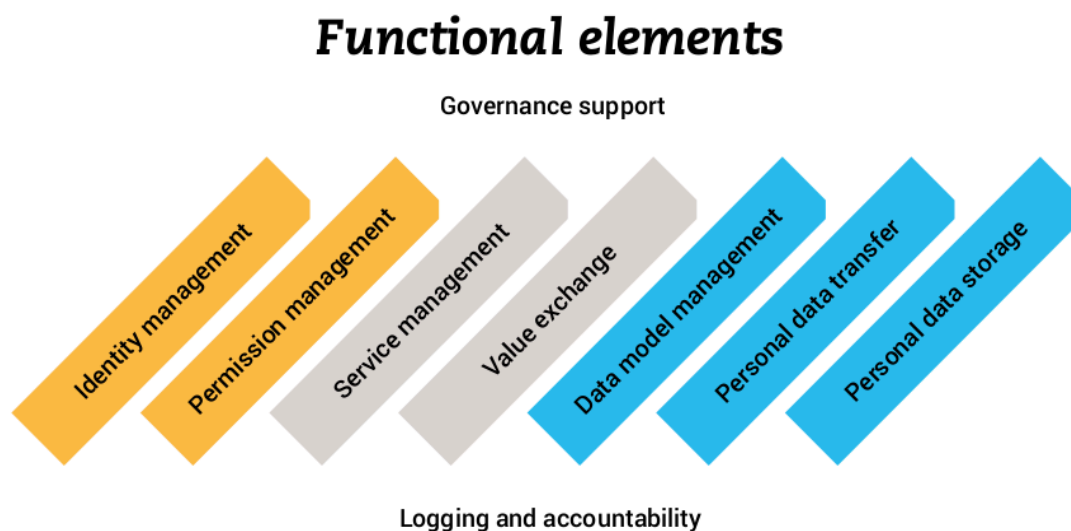


Figure 7: MyData operator reference model. Image taken from Poikolam et. al (2020).

3.5 PIMCity

PIMCity (2023) is a Horizon Europe Project that elaborates a holistic approach to PIMS creation by defining a comprehensive set of required tools and functions. The core part of the project is the development of the PIMS Development Kit (PDK) that aims to reduce the complexity of PIMS and lower the barriers for companies to enter the web data market. Furthermore, PIMCity designs new mechanisms to increase the awareness of users and stakeholders. In order to demonstrate the effectiveness of this concept and the tools of the PDK, EasyPIMS has been developed which is a fully-fledged PIMS. An overview of these components is outlined in Figure 5.

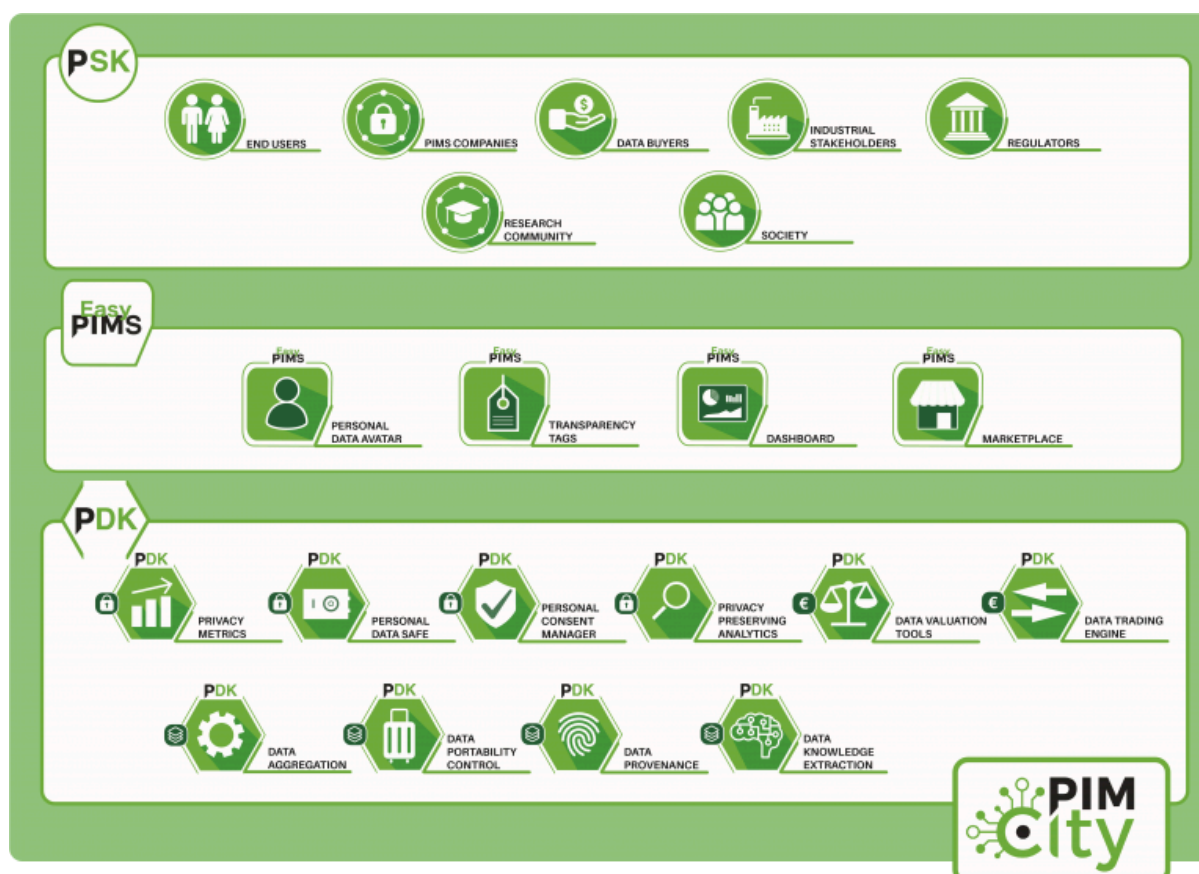


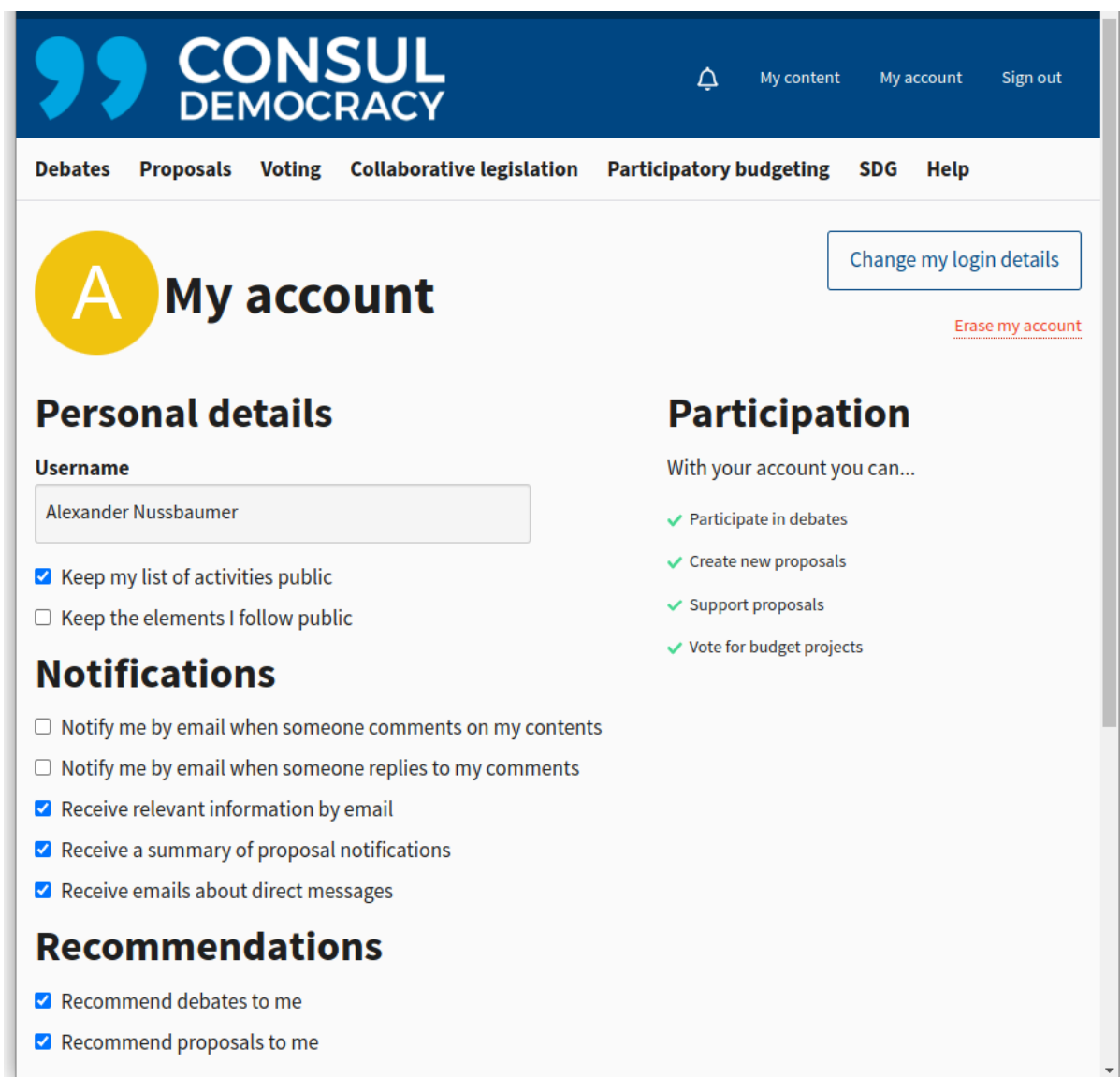
Figure 8: Overall representation of PIMCity's outputs, PDK components and EasyPIMS platform, together with stakeholders which will benefit from them. Image taken from PIMS (2023).

The tools of the PDK include tools to improve users' privacy, tools for new data economy, and tools for novel data management (Jha, 2022). The following list shortly presents the tools for privacy management:

- The Personal Data Safe (P-DS) enables the storage of personal data in a controlled form. It implements a secure repository for the user's personal information like navigation history, contacts, preferences, personal information, etc.
- The Personal Privacy Metrics (P-PM) represent the means to increase the user's awareness. This component collects, computes and shares easy-to-understand metrics to allow users to know how a service stores and manages the data.
- The Personal Privacy Preserving Analytics (P-PPA) allows extracting useful information from data while preserving users' privacy.
- The Personal Consent Manager (P-CM) is the means to define all the user's preferences when dealing with personal data. It defines which data a service is allowed to collect, process, or which can be shared with third parties.

3.6 CONSUL DEMOCRACY

CONSUL DEMOCRACY (2023) is an open source web-based platform that enables citizen participation for an open, transparent and democratic government. CONSUL aims to support decision making processes of citizens with useful features. Briefly, users will register on the platform with an email account and name. They can initiate discussions and surveys on interesting topics. Related surveys or discussions can be structured or unstructured, which also enables group discussions. Furthermore, resources like documents or photos and videos can be integrated into the platform taken from other platforms, such as Facebook. A screenshot of the user settings is shown in Figure 9.



The screenshot shows the user settings page of the CONSUL DEMOCRACY platform. The page has a dark blue header with the CONSUL DEMOCRACY logo on the left and navigation links (My content, My account, Sign out) on the right. Below the header is a navigation bar with links for Debates, Proposals, Voting, Collaborative legislation, Participatory budgeting, SDG, and Help. The main content area is titled "My account" and features a yellow circular profile picture with the letter 'A'. A "Change my login details" button is located in the top right corner, and a red link "Erase my account" is in the bottom right corner. The settings are organized into four sections: "Personal details" (Username: Alexander Nussbaumer, checkboxes for public activities and followed elements), "Participation" (checkboxes for public activities, followed elements, relevant information, proposal summaries, and direct messages), "Notifications" (checkboxes for email notifications on comments, replies, relevant information, proposal summaries, and direct messages), and "Recommendations" (checkboxes for recommending debates and proposals to the user).

Figure 9: User settings page of the CONSUL DEMOCRACY platform. Screenshot of the CONSUL DEMOCRACY web application.

3.7 Better Reykjavik

The second example of a citizen participation project with PIMS features is the Better Reykjavik (2023) project. This project allows citizens of Iceland to participate in the democratic process. Users can add new ideas or topics in relation to certain topics, as well as comment, discuss, and like other ideas. A screenshot with a new idea (a test item) is shown in Figure 10. Other users can debate this idea by adding arguments for or against this idea. Each user can get an overview of their own ideas or discussion items added to this platform (Figure 11). This view provides a graphical overview of the content that users have added. If there is a discussion of others on a user's contributed content, the user will be notified. In a settings dialog the user can configure how (e.g. email or on the website) to be notified on which action (e.g. comment on own idea). This dialog is shown in Figure 12.

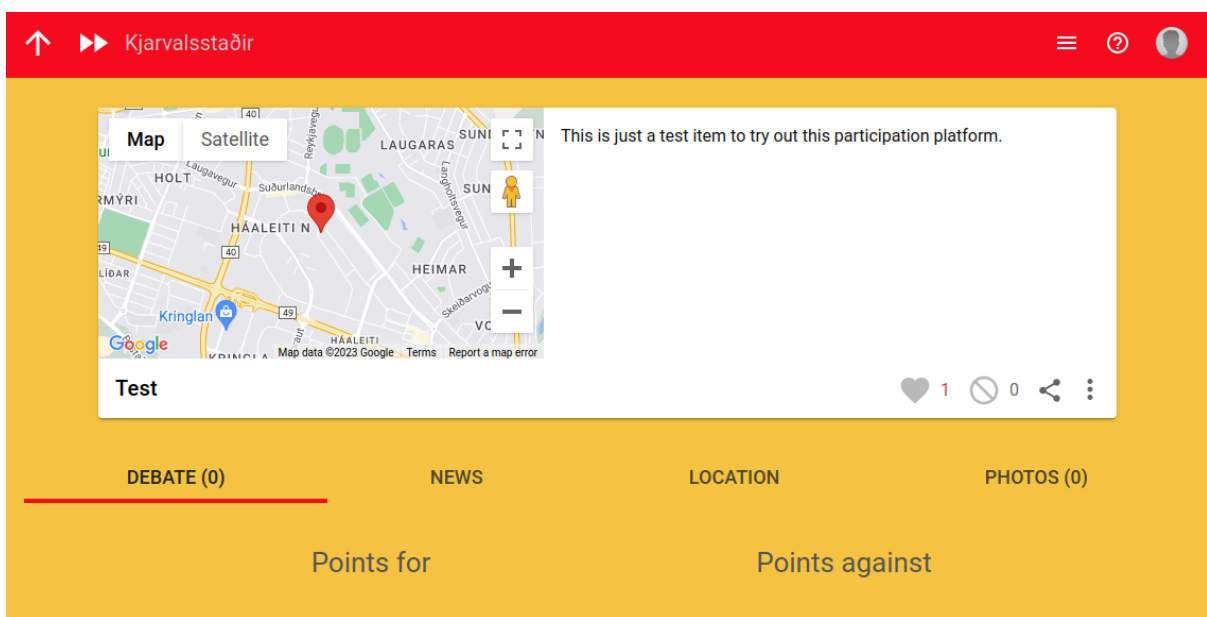


Figure 10: A test item (an idea) added to the Better Reykjavik platform. The item includes an item, a description, and a location shown on the map. Screenshot of the Better Reykjavik web application.

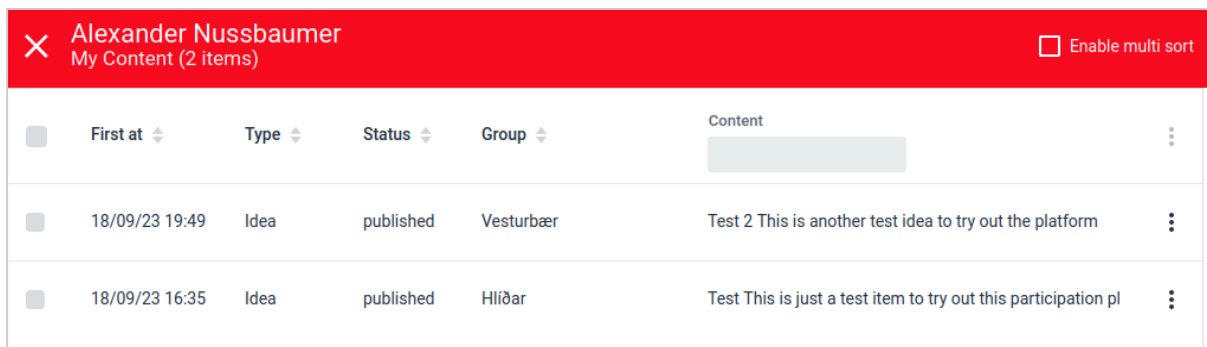



Figure 11: The test item is shown in the content overview page of the Better Reykjavik platform. Screenshot of the Better Reykjavik web application.

Edit user

Name
Alexander Nussbaumer 20/50

Email
xxxxxxxx@gmx.net

 UPLOAD PROFILE IMAGE

Select language
English (GB) ▼

CREATE API KEY

DELETE OR ANONYMIZE ACCOUNT

Notifications

My ideas

Method Frequency

Turn off Browser Email As it happens Hourly Daily

Weekly Monthly

Ideas I like

Method Frequency

Turn off Browser Email As it happens Hourly Daily

Weekly Monthly

CANCEL SAVE

Figure 12: User settings page of the Better Reykjavik platform. Screenshot of the Better Reykjavik web application.

4. EU Digital Identity

This section describes developments and features of the EU Digital Identity Wallet that is closely related to PIMS and share several features.

4.1 European Union Digital Identity Wallet

The European Commission aims to provide an EU Digital Identity (EUDI) that will be available to EU citizens, residents, and businesses who want to identify themselves or provide confirmation of certain personal information¹. Several goals and benefits outline the idea and concept of the EUDI:

- The EUDI should be available for every person eligible for a national ID card
- The EUDI should be recognised anywhere in the EU and be widely usable for public and private digital services across the EU
- The EUDI provides a simple and safe way to control how much personal information and which aspects of their identity is shared with services that require sharing of information
- The individual should be empowered to keep track what has been shared

An EU regulation on the Digital Identity (2024/1183) became effective in May 2024 that requests the establishment of a European Digital Identity Wallet. This regulation amends a previous Regulation (eIDAS, 910/2014). It is designed to address growing demands for interoperability, security, and trust in the digital space, laying the foundation for enhanced electronic identification systems and trust services across the EU (see Deliverable 1.3, Section 3.1.5).

The EUDI can be used for any number of legally relevant cases, for example for opening a bank account, filing tax returns, applying for a university, storing a medical prescription that can be used anywhere in Europe, proving your age, renting a car using a digital driving licence, or checking in to a hotel.

Identity information of persons is stored in a digital wallet that can be on local or remote systems and provide the capabilities to share the information in a secure and privacy-preserving way. In a more detailed analysis the key characteristics, features, and requirements are defined for the EUDI Wallets². The features are structured according to requirements and benefits for four stakeholders:

a) Citizens and businesses:

- User control: Citizens will have the power to choose which aspects of their identity and data they share with third parties, ensuring privacy and control over personal information.
- Widespread usability: The EU Digital Identity Wallets will be available across the EU for accessing public and private digital services, making online interactions more seamless and efficient.

¹ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-digital-identity_en

² <https://digital-strategy.ec.europa.eu/en/policies/eudi-regulation>

- Transparency and security: the EU digital wallets will be open-source licensed, ensuring transparency and security. Users will be reassured that their data is handled securely, with measures in place to prevent misuse or illegal tracking.
- Ease of use: The wallets will offer a user-friendly interface, allowing individuals to easily manage their digital identities and access services. Creating qualified eSignatures for non-professional use will be free, enhancing accessibility.
- Smooth onboarding: Citizens will be able to use national eID schemes to register for the wallets, ensuring a smooth transition to digital identity management.

b) Governments:

- Improved access to digital services: The wallets can streamline the process of identity verification, making it easier for citizens to access government services online and boost uptake.
- Enhance fraud prevention: By providing a secure and verifiable means of identity, it can help reduce identity theft and related fraud as regards government services.
- Improves security: The overall security of citizen data will be enhanced and the risk of breaches reduced.

c) Providers of digital services:

- Improve security and privacy: The wallets can reduce the risk associated with liability for traditional authentication methods.
- Reduce cost of authentication: The wallets can lower the costs associated with identity verification processes by simplifying and automating them.
- Avoid relying on competing big platforms: Service providers will have to rely less on identity services with unclear use of the obtained user data.

d) Society:

- Increased online transactions: With easier and more secure verification, people may be more inclined to engage in online transactions.
- New business opportunities: The adoption of Identity Wallets can spur innovation, leading to new services and products.
- Resource reallocation: Resources previously dedicated to manual verification processes can be redirected to more productive uses.
- Economic growth: Overall, greater adoption of online transactions, new business opportunities and an improved resource allocation can contribute to overall economic stability and growth.

4.2 EU Digital Identity Wallet Toolbox

Currently, the member states and the European Commission work together to set up a European Digital Identity Wallet Toolbox³. This toolbox aims to ensure a uniform implementation of wallets across Europe. In order to achieve this aim, the Commission issued a recommendation⁴ in 2021 that the member states should work together to develop a toolbox that includes (a) a technical Architecture and Reference Framework (ARF), (b) a set of common standards and technical specifications, and (c) a set of common guidelines and best practices.

³ <https://digital-strategy.ec.europa.eu/en/policies/eudi-wallet-toolbox>

⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H0946>

The ARF⁵ outlines the key requirements and features for a future EU Digital Identity Wallet (EUDI), including (a) the objectives of the EU Digital Identity Wallet, (b) the roles of the actors of the ecosystem, (c) the functional and non-functional requirements for the wallet, and (d) potential building blocks.

The non-functional requirements of the ARF are covered by the list of requirements and features for stakeholders in Section 4.1. The most relevant functional requirements are expressed through key design principles of the ARF^{6,7}:

- **User-centricity** is a key principle that places user needs and experience at the center of every design decision. The wallet should be intuitive and easy to use, with seamless integration into existing use cases.
- **Interoperability** is a core design principle, as this ensures that the wallet functions seamlessly across borders within the EU. This includes the need for interfaces, so that the application can connect with other systems and share user data, as well as mutual authentication.
- **Privacy by design** protects user data by e.g. minimising the collection of personal information.
- **Security by design** should be woven into the very fabric of the wallet's design, in order to mitigate potential vulnerabilities. For example cryptographic functions are needed to secure user data in a system.

4.3 EU Digital Identity Wallet Pilot Implementations

Large scale pilot projects are currently being developed that test the technical specifications for the Common Toolbox that will be the base of the EU Digital Identity Wallets. The four large-scale pilot projects are⁸:

- The EU Digital Identity Wallet Consortium (EWC) is a joint effort to leverage the benefits of the proposed EU digital identity in the form of Digital Travel Credentials across the Member States. The EWC intends to build on the reference wallet application to enable uses related to Digital Travel Credentials.
- POTENTIAL is a joint initiative of 19 EU member states that aim to implement the EUDI in six sectors, including banking, telecommunications, mobile driving licences, electronic signatures, and health.
- NOBID is a consortium of 6 European countries implementing the ARF for payment purposes.
- DC4EU is a consortium of 80 relevant institutions from 22 countries including 43 public organisations and 49 private entities. It aims to apply the European Union's eIDAS trust framework focusing on the education and social security fields.

Examples of application areas that are explored by these pilot implementations are:

⁵ <https://digital-strategy.ec.europa.eu/en/library/european-digital-identity-architecture-and-reference-framework-outline>

⁶ <https://eu-digital-identity-wallet.github.io/eudi-doc-architecture-and-reference-framework/latest/arf/>

⁷ <https://digital-strategy.ec.europa.eu/en/library/european-digital-identity-architecture-and-reference-framework-outline>

⁸ <https://digital-strategy.ec.europa.eu/en/policies/eudi-wallet-implementation>

- Accessing government services: Secure access to digital public services, such as applying for a passport or driver's licence, filing taxes, or accessing social security information.
- Opening a bank account: Verification of a user's identity when opening an online bank account, eliminating the need for the user to repeatedly provide their personal information
- SIM Registration: Proof of identity for the purpose of pre- and post-paid SIM card contracts (registration and activation), reducing fraud and costs for mobile network operators.
- Mobile Driving Licence: The storage and presentation of the mobile driving licence in both online and physical interactions such as a driver providing their licence on the side of the road.
- Signing contracts: Creating secure digital signatures for signing contracts online, eliminating the need for paper documents and physical signatures.
- Claiming Prescriptions: Providing details of prescription to pharmacies and initiating the dispensation of medical products.

In addition to the pilot applications, many member states have already implemented solutions for person identification and related services, such as providing digital signatures or governmental services including public opinion polls. The European Union Trusted Lists (EUTL)⁹ is a public list of over 200 active and legacy Trust Service Providers (TSPs) that are specifically accredited to deliver the highest levels of compliance with the EU eIDAS electronic signature regulation. For example, Austria's A-TRUST¹⁰ provides a digital identity service that can be used for many governmental services including requesting postal vote cards or getting access to own health information. The process of registering to A-TRUST includes an appointment at a government office and the installation of an app at the mobile phone used for two-factor authentication.

4.4 Relation to PIMS

Most features and requirements of EU Digital Identity Wallets strongly overlap with the characteristics of PIMS as described in Section 2. In particular, interoperability and interfaces, user centric design and usability, security and privacy are shared among PIMS and EUDI wallets. However in contrast to systems elaborated in Section 3, EUDI wallet designs are more complete instead of focusing on individual features.

In contrast to existing PIMS, EUDI wallets enable the authentication and validation of real persons instead of anonymous users. Depending on the application, this might have several advantages in the citizen participation process, such as the validation of persons in a voting or ensuring the age and place of living in a complaint or request process of a city. However, in the case of ITHACA that focuses on vulnerable groups that often have little digital skills, the authentication process might be difficult. Especially people with little digital skills might have severe difficulties in the registration and authentication process. For example, the two-factor authentication might provide a barrier for ITHACA target users.

⁹ <https://helpx.adobe.com/document-cloud/kb/european-union-trust-lists.html>

¹⁰ <https://www.a-trust.at/en/>

5. Relevance for citizen participation

This section provides guidelines for the development of the ITHACA platform from the PIMS perspective. Since the concrete use cases and functionalities of ITHACA have not been specified yet, this guideline is kept rather general and provides requirements, ideas and safeguards that should be taken into account.

5.1 Requirements for ITHACA

Following the discussion in Sections 2 and 3, there are several requirements that arise from dealing with this personal data in a citizen participation platform. Furthermore, ITHACA has a focus on vulnerable groups which imposes additional requirements. The following list summarises these requirements. This list at the current stage of the project is not a final set of requirements, but a proposal or a frame to define the detailed requirements in the design phase of the ITHACA platform (T3.10). It consists of both technical and human-centric aspects, whereby some requirements are mainly technical, some are mainly human-centric, and some overlap and include both types. Furthermore, most requirements are interrelated, meaning that there are interdependencies and mutual exclusions. Thus, a final detailed requirements set must balance this initial set.

Topic	Description
Personal data storage	A record or storage of personal user data needs to hold all personal user data, such as own contributions in form of various media, reactions on contributions of others, personal settings, as well as permissions and consents.
Data security	The storage and transfer of personal data must adhere to the highest security standards. Specifically, it is imperative to guarantee the implementation of appropriate technical and organisational measures, such as encryption and access management systems. Additionally, the transfer of personal data outside the European Economic Area (EEA) should either be avoided or be conducted in compliance with the guarantees described in Articles 44-50 of the GDPR.
Interoperability	Personal data saved in a data storage needs to be accessible by the various modules of the ITHACA platform, which requires a well defined and documented API, as well as a documented data model with sufficient semantics.
Privacy	It is essential to uphold the principles of 'Privacy by Design' and 'Privacy by Default' in the handling of personal data. This entails implementing robust technical and organisational measures to ensure data security, in alignment with the 'Privacy by Design' principle. Concurrently, 'Privacy by Default' measures must be in place to safeguard user privacy. These measures include collecting only the data that is strictly necessary (data minimization), restricting any further use of the data, and

	employing techniques such as anonymization and pseudonymization to protect the collected data.
Data analytics	Personal data should be anonymously analysed, in order to draw conclusions that can be used by an application to support the user. If data analytics is not performed anonymously, then additional consent is needed.
Data management	Only necessary user data should be stored needed for the system's functions and no data should be stored without purpose (data minimisation). Furthermore, users need to be able to access and delete their own data.,
Data integrity	Personal data must be processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organisational measures (data integrity principle). This can be achieved by appropriate backup mechanisms, which ensures that data remains intact.
Permission management	The users should be enabled to perform fine grained settings about which application or function is allowed to access which data.
Consent management	Consent management is needed that puts people in control of which data are used for which purposes. This includes that users can deny or revoke the use of personal data.
Transparency	It must be shown to the user, which personal data is collected, stored, and how it is processed. This includes a complete list of data and the purposes of use thereof along with, where, and why the data is used. This requirement is strongly related to understandability and explainability of the presented information.
Sharing visibility	It should be shown which data is shown to other users, user groups, or the public.
Traceability	Actions and processes should be recorded and presented in a way that users can understand past activities and the development of a process.
Understandability	All information presented to the end-user (e.g. transparent presentation of stored data, stored permissions and consents, and explanations) should be understandable by end-users. This includes the use of simple language, easy to understand explanations of technical concepts, and understandable presentation of graphical data.
Explainability	The processing and presentation of data, consent, and permissions has to be explained in a way that is understandable by the end users. Within the scope of the ITHACA Project, which incorporates advanced artificial

	intelligence (AI) techniques for data processing, the principle of explainability is of paramount importance. Given that AI methods can often function as black boxes, it becomes crucial to elucidate how data is processed and how specific outcomes are derived. This is not just a matter of ethical transparency but also a legal requirement for compliance with GDPR provisions on automated decision-making, including profiling, as outlined in Article 22. Ensuring explainability in the processing of personal data is therefore essential for both user trust and regulatory compliance
End-user needs	A great part of ITHACA end-users are intended to be vulnerable groups with various special needs that have to be taken into account. The design of data access and interfaces need to be guided by the end-user needs and limitations. This includes accessibility features of the user interface that lowers the barrier to use the ITHACA platform and thus enables the participation of vulnerable groups.
Issue reporting	Users should have the possibility to report and give feedback if there are any issues or problems with the data management
Identity authentication	The identity of a user should be authenticated by the system, so that one user acts under the same account and is known to the system. A full verification process of a person would be preferable, in order to avoid fake accounts and misuses through anonymous accounts. However, the validation process needs to be in line with capabilities of the end users considering the vulnerability restrictions as identified in the requirements analysis of WP2.

Table 1: General and non-functional requirements for the ITHACA platform.

5.2 Concept for data management

Following the requirements listed above, this subsection presents a general concept for data management that takes into account the user data, the tools and functions, and related human aspects. The data presented in this section are examples that are used to outline the concept. The concrete data for the ITHACA platform will be elaborated later in a different work package.

User data that might be collected and used by participation tools are listed in Table 1. This table categorises user information into three types of data. First, personal data is information that describes the user, such as name or age. Second, participation data addresses data that the user or citizen has provided as part of a participation process, such as discussion items, comments, or surveys data. Third, external data relates to data of the user stored and provided by other applications, such as social media platforms.

Category	Data	Description
Personal data	person name	The full name of a person; can be the real name or a nickname or any name the user prefers; visible to others
	username, password	The username and password needed to login; not visible to others; password encrypted
	age	The age or age range of the person
	gender	The gender of the person; careful use of options needed
	email, mobile number	for contacting the person and for securing the account
	place of residence	The place where the person (mainly) lives; this relates to the participation in specific topics (or exclusion from topics)
	language	the language of the user interface and the language(s) the person communicates with others
	accessibility	accessibility relates to special needs regarding the user interface and presentation of information, such as easy language, colour blindness, or visual impairment; this also relates to support tools, such as text-to-speech functions.
	vulnerability characteristics	information about the nature of vulnerability, if applicable, for example if a person is a member of a minority group. This might have an effect on the participation process.
	current location	the current (and past) location of a person; can be derived from GPS data
	role	the type of access and system rights, such as administrator or moderator
	trust level	information if a user is trusted or if there were unwanted behaviour in the past, such as insults
	settings	general technical settings and configurations
activity	usage of the system and functions, log data	
Participation data	discussion items and comments	contributions in a discussion including media data
	feedback and evaluation	feedback and evaluation on community contributions, such as likes or ratings

	survey and voting	data provided in a survey or voting
External data	social media profiles	profile information of social media, such as @username@mastodon.social
	social media data	data provided at social media, such as postings, images, or likes
	social relation	relation data in social media, such as Facebook friends or Mastodon followers

Table 2: Potential user data related to participation platforms and description why they are relevant.

5.3 Bias mitigation

A key focus of the ITHACA project is the mitigation of social biases related to vulnerable people and groups. This goal is also important when it comes to the management of personal information. Different social and vulnerable groups have different needs which have to be taken into account. Thus these needs should be transformed in functional requirements and integrated in the system and tool design.

Examples of requirements for vulnerable groups are understandability and accessibility. Understandability refers to the provision of information in a way that it is understandable for all addressed types of end users and social groups. This might include the use of clear and easy-writing style, choosing the right language, avoiding technical information that is not needed, and meaningful explanation of the provided information and tool functions.

Accessibility refers to the designing the user interface so that it does not provide any barrier for the target group. This mainly refers to disabilities, such as visual disabilities, but also to the digital device that users have available.

Hence, the design of the user interface with the presented information needs a careful analysis of the addressed end user groups, their needs and constraints.

5.4 Co-design approach

The design and development of the PIMS component in ITHACA is dedicated to Task 3.10. According to the task description this task will take into account the architectural elements and best practices elaborated in this deliverable, as well as the user requirements elicited in work package 2. Consequently, end-users should be included in the user requirement and design process. A co-design approach that includes end-users in the conceptual design of the software would balance the requirements formulated in this deliverable and the end-user needs elicited in work package 2. Workshops and focus groups with end-users are a suitable method to design the PIMS concept of ITHACA.

5.5 Recommendation for the project design

Basic recommendations for the project design resulting from the analysis of the PIMS include the consideration of the functional and non functional requirements, the potential data about users, and the technical means of storing and sharing data.

The functional and nonfunctional requirements are presented in Section 5.1. Though all of them should be considered for the project design, it might still be difficult to implement and integrate them as a whole.

The potential data about users are presented in Section 5.2. These data chunks represent information that might be needed for the citizen participation processes.

The architectures of the analysed PIMS and especially the EU Digital Identity Wallet Toolbox provides indication how the ITHACA PIMS could be developed. This includes the following design principles:

- User-centricity. User interface should be designed in a user-friendly way. It should be intuitive and easy to use, with seamless integration into the use cases.
- Interoperability. User data should be made available to the tools of ITHACA and a well documented interface should be in place.
- Privacy by design. Only user data should be collected that are actually needed for the processes, and only user data should be shared with tools that are actually needed by the respective tools.
- Security by design. The user data needs to be protected against security breaches.

Finally, attention should be put on the fact that vulnerable groups have specific needs. The following aspects should be considered:

- Accessibility Issues: Users might have poor digital literacy, or physical limitations (e.g., difficulty using biometric systems like fingerprint scanners).
- Digital Divide and Socio-Economic Factors: Many low-income or rural areas may not have consistent access to digital devices, creating barriers to adopting digital identities and trust services
- Privacy and Surveillance: The use of digital identity systems could lead to increased monitoring by governments or other entities, potentially exposing vulnerable individuals
- Trust in Digital Systems: Ethnic minorities and marginalized groups historically mistrust government and institutional systems; may make groups hesitant to adopt digital identity systems
- Legal and Regulatory Gaps: Vulnerable populations are less likely to be aware of their rights or have access to legal recourse in case of data misuse
- Lack of Control over Personal Data: Vulnerable groups may not fully understand how their digital identity data is collected, used, and stored, raising concerns about consent and long-term privacy implications.
- Bias in Algorithmic Decision-Making: Vulnerable groups, especially people of color or individuals with non-standard features (e.g., facial deformities, rare skin conditions), may be misidentified by facial recognition or other biometric systems due to bias in AI algorithms

6. Conclusion and outlook

This deliverable provides an overview of Personal Information Management Systems (PIMS) and specifies optional requirements of the ITHACA PIMS. According to the task description (T1.6), this overview includes (a) an elaboration of existing initiatives and projects claiming PIMS features (Section 3), (b) elements of architecture, records, and checklists required for the implementation (Section 2.3 and 4.2), (c) safeguards for compliance with the General Data Protection Regulation (GDPR) (Section 4.1), and (d) user interfaces of such systems (Section 4.2). Furthermore, a general introduction to PIMS is given in Section 2.

This elaboration and overview is intended to serve as a guideline for the design and implementation of the ITHACA platform. Future work will include a user-centred design process of the ITHACA platform. Apart from findings and considerations presented in this deliverable, user studies and requirements elicitation with end users are being conducted in WP2. In these studies, system design and functions are discussed with end users (vulnerable groups) and their feedback will be taken into account. The system can be implemented based on the guidelines in this deliverable, the results from the user studies, and the project goals.

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