



## D6.3 New Models for Shared Delivery of Common Services Roadmap

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## List of Acronyms

Abbreviation / acronym	Description
AR	Annual Roadmap
ARF	Architecture Reference Framework (EUDI)
CA	Capability Areas
CA1-5	Capability Areas
CAAR	Control Authority Access Repository
CEF	Connecting Europe Facility
CG	Coordination Group
DBA	Doing Business Abroad
DC	Data Consumer
DE	Data Evaluator
DSSC	Data Space Support Centre
DID	Decentralized Identifiers
DLT	Distributed Ledger Technologies
DO	Data Owners
DP	Data Provider
DSI	Digital Service Infrastructure
DSM	Digital Single Market
EBSI	European Blockchain Service Infrastructure
EC	European Commission
EESSI	Electronic Exchange of Social Security Information
EIB	European Innovation Board
EIF	European Interoperability Framework
EU	European Union
EUDI	European Digital Identity
EIA	European Interoperability Architecture
eIDAS	Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC
ESSIF	European Self-Sovereign Identity Framework
G2G	Government To Government
IAL	Issuing Authority Locator
IDK	Information Desk
IEC	Interoperable Europe Community
IEM	Information Exchange Model
IM	Intermediation Pattern
IA	Implementing Act
IR	Implementing Regulation
IT	Information Technology

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Abbreviation / acronym	Description
LKP	Lookup Pattern
LSP	Large-Scale Pilot
MA	Moving Abroad
MOR	Multilingual Ontology Repository
MS	Member State
OOP	Once Only Principle
OOTS	Once Only Technical System
OT	Operational Team
PA	Public Administration
PKI	Public Key Infrastructure
ROI	Return Of Investment
S&N	Subscription & Notification
SDGR	Single Digital Gateway (Regulation)
SME	Small and Medium Enterprises
SP	Service Provider
SSI	Self-Sovereign Identity
SA	Studying Abroad
SUMA	Supported User-Managed Access
t1-t5	Time-period Defined as t3 (2023-2025), t4 (2025-2030 and t5 (2030+).
TAO	Trusted Accreditation Organisation
UC	Use-Case
USI	User Supported Intermediation
VC	Verifiable Credential
WG	Working Group
WP	Work Package
WPL	Work Package Leader

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## Executive Summary

This deliverable outlines the key aspects for sustainability and governance of the DE4A results. Sustainability is referring to all actions needed in order to assure the long-term success of the project outputs.

DE4A has explored and piloted how to create an effective and efficient implementation of the once-only principle (OOP) at European level for a useful digital Government transformation in order to boost the Digital Single Market. To this aim, existing and upcoming policies have been taken into consideration, as well as new policies for innovative approaches to enable an optimal implementation. The DE4A results have contributed to different Regulations, such as the **Interoperable Europe Act, the Data Governance Act, the Implementing Regulation (IR) of the SDG Once Only Technical System (OOTS) and the upcoming Data Act and the toolbox of the EUDI Wallet provided in the revision of the eIDAS Regulation**, including the OOTS-EUDIW Synergies Contact Group through MS participation in the respective policy-making instances. The DE4A results are also likely to be reused in future Implementing Acts (IA) for the SDGR and even other domains.

DE4A has delivered the following main outputs:

- ▶ **DE4A Multipattern architecture for the cross-border exchange of evidences** that comprises six interaction patterns: Intermediation, User Supported Intermediation, Lookup Verifiable Credentials, Subscription & Notification and special case of ‘Push’-like pattern linking domicile registration and deregistration procedures. The sustainability of this multipattern approach is based on the fact that the evidence exchange pattern adopted by the Implementing Regulation on technical specifications for SDG OOTS very clearly matches the DE4A USI pattern. In addition, this flexible architecture can be applied to a much broader range of public sector services, going beyond the principal focus of the SDGR and may be established as a horizontal infrastructure to be used for a multitude of sectoral requirements.
- ▶ **DE4A connector** that is the component that establishes the cross-border communication between the Member States (Data Evaluators and Data Owners) for the exchange of evidences over an eDelivery network. The connector improves interoperability by supporting multiple patterns in a single application and making easy scalability to connect large numbers of Data Evaluators (DE) and Data Owners (DO). The DE4A connector is not deemed to be able to be used as-is, but rather harmonization need to happen, according to the needs of the Member States to implement the SDG Once Only Technical System. Nevertheless, the architectural design principles of the connector can be reused and in fact, are being reused by several Member States for the implementation of the SDG OOTS. There are also aspects that have been implemented in the DE4A connector (e.g dynamic discovery) that may be needed in future versions of SDG OOTS as part of its evolution.
- ▶ **DE4A Self-Sovereign Identity Framework** with two main components (SSI Authority Agent and the Mobile End User Agent) that supports the implementation of Verifiable Credentials a user-centric evidence exchange pattern, following specific project requirements such as re-use of existing legal and technical frameworks and using eID and eIDAS to facilitate the authentication process of the users, as well as using the SSI approach to facilitate the user-centric, evidence management and exchange, aligning with EBSI/ESSIF specifications and integrating with such EU-wide framework and infrastructure through EBSI’s Early Adopters Programme. This framework is relevant for the upcoming EU Digital Identity Wallets ecosystem (revision of eIDAS regulation) as an alternative way to realize Once-Only. The wallet prototype in DE4A can be seen as “a European Passepartout supporting pseudonymous identification and allowing the user to manage the different personas of their human Digital Twin in a privacy-enhancing way”. With relatively low effort, additional “contexts” can be defined in order to support management of different types of credentials in a single wallet.

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- ▶ **DE4A semantic components** required for a common understanding to facilitate the cross-border exchange of information between public authorities. DE4A solves the problem of “evidence mapping” by implementing two concepts, the Canonical evidence and the Information Desk under the principles of proportionality, subsidiarity and efficiency and according to the European Interoperability Framework. The concept of canonical evidence is the keystone of these principles, as it provides the grounds for semantic interoperability of cross-border and cross-sector evidence. The Information Desk can be taken as a reference for further developments of the SDGR OOTS as they provide a simpler approach while offering more functionality. In addition, the DE4A semantic results can be useful for the implementation of OOP through the EU Identity Wallet provided by the upcoming revision of the eIDAS Regulation, for the implementation of OOP at national level or at international level beyond the European Union, and for the implementation of the exchange of information in any domain, not only in the public sector.
- ▶ **Legal findings** like the need of a more comprehensive EU level legal framework that supports not only governance and interoperability discussions but allows new eGovernment services and new interaction patterns to be created and sustained from an operational perspective.
- ▶ **Hands-on experience and knowledge for DE4A Member States:** The project has generated for 8 participating Member States (also Germany who joined as Observer for an additional pilot with The Netherlands) and other stakeholders the necessary experience to address short, medium and longer term challenges in the contexts of Once-Only, Single Digital Gateway and effective and integrated cross-border public service delivery to citizens and businesses in the context of public services modernisation across the EU

The DE4A common components are available for the SDG and Once Only Principle communities in the public GitHub repository (“**DE4A EU project**”) [19] and documented in the DE4A Wiki [16] and DE4A deliverables [17]. Although setting up new organigrams and organisations to handle project outcomes has been often deemed a suitable option in earlier large-scale pilots (LSP), the project will not follow this approach. DE4A outputs will go directly to the SDGR-working Groups (SDGR-WG) and EBSI through the Member States participating in the project and the software components will be also promoted to be part of future releases of the OOTS Hub [15], the catalogue of reusable services already available for implementing the Once-Only Technical System where at least some of them (e.g MOR) could fit.

With regards to the business value, the project has not focused on the realization of the Value of the Generic Business Models (Ecosystem Models being the latest) for each of the identified Time horizons (t2 end 2023, t3 2025, t4 2030). The project has rather only road-mapped some of the needs and needed activities. In 2023, the focus for the MS and Commission needs to be the consolidation of the outputs of the different SDGR and EBSI projects for citizens and agencies. For 2025, there need to be clear recommendations also for private service providers in need of the canonical evidence, which indicates that a stable plan should be ready in 2024 also for new actors.

The Digital Single Market (DSM) ecosystem and the data driven economy that it supports should not require sustained budgetary funding. The infrastructure and public data services of the ecosystem should be allowed to capture part of the value that they create from the businesses participating in the DSM. This will not happen automatically. To the contrary, the value created through the existence of the ecosystem could easily dissipate to commercial participants that are able to monetize it through their services, while the ecosystem requires increasing public funding. This is being looked at by many EU projects today and is likely a moving target beyond 2030 [32].

Despite the proposed soft handover, the deliverable describes the project views on the practical running of services similar to the DE4A pilots. The suggested governance is based on the methodology and findings summarised in this deliverable (inc. the Success stories) and proposed in relation to the sustainability needs of the Member States and suggested components.

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# 1 Introduction

## 1.1 Purpose of the document

The main purposes of this document are three-fold:

- ▶ To present the DE4A outputs that contribute to the implementation of the SDG OOTS;
- ▶ To provide an overview of the key factors which positively influence the viability of the project in the future. These factors have been clustered in four main aspects of sustainability: political, legal, business and technical dimensions;
- ▶ To offers insights of the governance principles related to the project result sustainability;

The outcomes of this deliverable are of interest:

- ▶ Internally, to DE4A partners that have been involved in the project activities;
- ▶ Externally, to the community engaged in the Single Digital Gateway implementation and longer-term horizons for European public services interoperability solutions.

## 1.2 Structure of the document

This document is divided into four main sections:

- ▶ Chapter 1 Introduction
- ▶ Chapter 2 DE4A Outputs: It describes the main outputs of the project.
- ▶ Chapter 3 DE4A Sustainability: It provides an overview of the key factors which positively influence the viability of the project in the future. These factors have been clustered in four main aspects of sustainability: political, legal, business and technical dimensions.
- ▶ Chapter 4 DE4A Governance: It offers insights of the governance principles related to the project result sustainability.
- ▶ Chapter 5 Pilots extended functionalities: It summarizes the needs for future functionality of the pilots to make the services even more useful in the context of SDG life events based on the ideas provided by DE4A Member States in a workshop.
- ▶ Chapter 6 Success Stories: It contains a set of success stories of the project.
- ▶ Chapter 7 Conclusions

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## 2 DE4A Outputs

The main outputs of the project are briefly described in this section. For a detailed description please refer to the DE4A Toolbox [16] and previous project deliverables [17].

### 2.1 DE4A Multi-pattern architecture

DE4A provides a multi-pattern architecture for the cross-border exchange of evidences. This approach comprises six interaction patterns [4]:

1. **Intermediation (IM) Pattern:** A user-triggered and user-controlled, direct exchange between competent authorities whereby the user only interacts with the eProcedure Portal of the Data Consumer (DC).
2. **User-supported Intermediation (USI) Pattern:** A variant of the IM pattern that includes a direct interaction between the user and the Evidence Portal of the Data Provider (DP), wherein the user supports the DP in establishing a unique identification, previews the evidence and approves the exchange; akin to the pattern defined in the Once Only Technical System (OOTS) implementing regulation.
3. **Lookup (LKP) Pattern:** A direct request-response exchange of evidence between Data Consumer (DC) and Data Provider (DP) without any user involvement.
4. **Subscription & Notification (S&N) Pattern:** A pattern that allows the DC to subscribe to and get notified about relevant business events (or life events) of a company (or citizen).
5. **Push Pattern:** In this target time horizon a pattern that allows to push an event signal along a pre-established communication relationship without a prior subscription; with the potential to extend to more general event signalling in the future.
6. **Supported User-Managed Access (SUMA) Pattern (also called Verifiable Credentials – VC) :** A user-centric interaction pattern, making use of the EUDI-Wallet, including a support for the user in identifying and contacting the adequate Data Provider (Electronic Attestation of Attributes provider, in EUDI-terms) directly from the wallet.

### 2.2 DE4A Common Technical Components

The following figure shows the DE4A architecture with the common components released by the project. The design of these components follows the multi-pattern approach and is available in D5.6 Final release of the DE4A common components document [20] and DE4A Wiki [21].

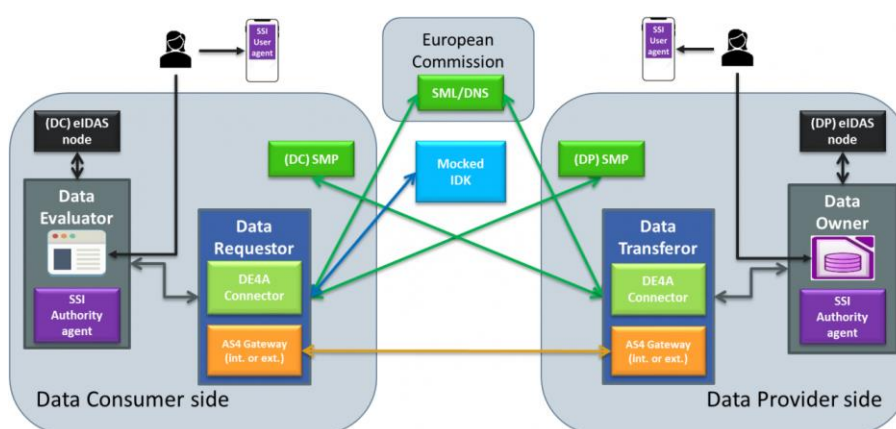


Figure 1: DE4A Architecture

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The DE4A common components are available for the SDG and Once Only community in the public GitHub repository (“**DE4A EU project**”) [19].

### 2.2.1 DE4A Connector

The DE4A connector is the software component that establishes the cross-border communication between the Member States (Data Evaluators and Data Owners) for the exchange of evidences over an eDelivery network. The connector improves interoperability by supporting multiple patterns in a single application and making easy scalability to connect large numbers of Data Evaluators (DE) and Data Owners (DO). The connector is based on open standards and European best practices like eDelivery and uses phase4 as the built-in AS4 gateway (AS4 based on CEF eDelivery). More details on provided functionalities can be found in “D5.6 Final release of DE4A Components” [20] and DE4A Wiki [28].

The DE4A connector has been released with Apache license (see [22]).

### 2.2.2 DE4A Self-Sovereign Identity (SSI) Framework

DE4A implements a Self-Sovereign Identity framework with two main components (SSI Authority Agent and the Mobile End User Agent) that support implementation of Verifiable Credentials user-centric evidence exchange pattern, following specific project requirements such as re-use of existing legal and technical frameworks and using eID and eIDAS to facilitate the authentication process of students, as well as using the SSI approach to facilitate the user-centric, evidence management and exchange, aligning with EBSI/ESSIF specifications and integrating with such EU-wide framework and infrastructure through EBSI’s Early Adopters Programme.

#### 2.2.2.1 DE4A SSI Authority Agent

The Authority agent is responsible for managing the connections between User and authorities (i.e. DP, DC) and activities related to Verifiable Credentials/Presentations (i.e. proof requests, validation, issuing). It is an enterprise-level solution developed to support the interaction between the student (diploma Holder) and the diploma Issuer or Verifier, managing the overall communication flow in the VC pattern for such endpoints. It enables students to follow the VC pattern flow and obtain or submit their diplomas as Verifiable Credentials through the interaction with HyperLedger Aries agent deployed on the Issuer/Verifier side and the Mobile User Agent running in the student’s mobile wallet. The Authority Agent is implemented as a high-level API, which provides a set of methods, which are to be called by the underlying Evidence (Data Provider) and eProcedure (Data Consumer) Portals. More details on provided functionalities can be found in “D5.8 Final Release of DE4A Self-Sovereign Identity Supporting Framework” [23] and DE4A Wiki [24].

The DE4A SSI Authority Agent has been released under Apache 2.0 license (see [25]).

#### 2.2.2.2 DE4A SSI Edge or Mobile End User Agent

The Mobile User Agent (Mobile User Agent) works as standalone mobile device application that runs different components to implement SSI approach. The main goal of this mobile edge agent is to enable users (students) to manage their digital credentials (diplomas on the pilot scope) and to interact with the Issuer's/Verifier's portals, creating cryptographically secure communications for information exchange with these endpoints based on W3C DID and VC standards and protocols like DIDComm. The application is built with Android Studio using Kotlin language. More details on provided functionalities can be found in “D5.8 Final Release of DE4A Self-Sovereign Identity Supporting Framework” [23] and DE4A Wiki [24].

The DE4A SSI Mobile User Agent has been released under Mobile User Agent License (Proprietary), see [27].

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## 2.3 DE4A Semantic Components

The project has implemented the DE4A semantic framework (see Figure 2)– a general framework for the semantically interoperable, cross-border, once only principle implementation that capitalizes on available semantic standards. At the centre of this framework lies the “Information Desk”, which constitute concepts and information that is required for a common understanding for facilitating the exchange of information between crossborder public authorities.

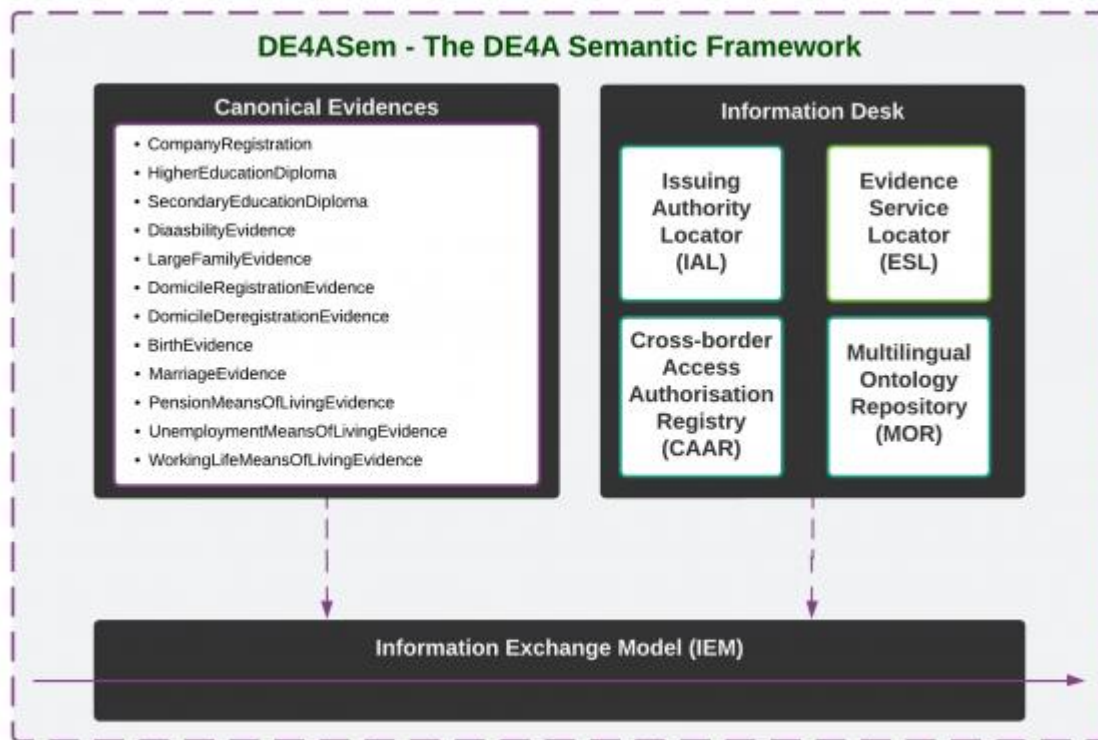


Figure 2: DE4A Semantic Framework

The semantic components that constitute the framework are described below and more information on them can be found in “D3.4 Semantic Framework – Final Version” [30] and the DE4A wiki [29]. All the semantic components are available in the DE4A Github [19]

### 2.3.1 Canonical Evidences

The borderless exchange of evidence required by public services faces the challenge of a lack of harmonization thus heterogeneity. This challenge requires interoperability agreements for the classification, granularity and standardisation of relevant evidence to be actionable in any cross-border use case. These agreements have been made by the competent authorities involved in the DE4A pilots with the help of semantic experts who have reused existing vocabularies and ontologies.

First, domestic evidence relevant for the DE4A uses cases has been classified into 12 canonical types for proof of company registration, completion of higher education, completion of secondary education, disability, large family, domicile registration, domicile deregistration, birth, marriage, pension means of living and working life as a pension. Second, for each canonical evidence type has been defined a canonical form according to a common data model and format, which enables a common understanding and an automatic processing of cross-border evidence.

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Competent authorities are responsible to match their domestic evidence with the corresponding canonical types and to guarantee the accuracy and equivalence of the information provided by the domestic evidence and the corresponding canonical evidence. Both domestic and canonical evidence should be exchanged when canonical evidences are not lawfully issued, so the domestic evidence would be the basis for regular or on-demand legal audits. This approach follows the logic behind the multilingual standard forms set by the [Regulation 2016/1191](#) on Public documents.

The canonical evidences for the three pilots have been released under the CC-BY license.

### 2.3.2 Issuing Authority Locator (IAL)

The Issuing Authority Locator (IAL) component helps Data Consumers (DC) to find out the issuing authority within a particular country either to obtain a canonical-evidence-type or to subscribe to a canonical-event-catalogue and know the characteristics of the evidence provision or the subscription provision, respectively.

The IAL has been released under Apache 2.0 licence.

### 2.3.3 Information Exchange Model (IEM)

The DE4A Information Exchange Model (IEM) is the payload specification of the messages to be exchanged between competent authorities. IEM is agnostic to any technical implementation and according to the DE4A project specific pilot needs thus supporting the DE4A multi-pattern exchange approach and the canonical evidence approach mentioned above.

DE4A IEM allows communications between data owners and evaluators according to DE4A interaction patterns through Modeling messages to exchange between data transferors and requestors by reusing existing European and international vocabularies and standards.

General information to include in messages concerns details about the transmission, data subject, data evaluator, data owner and exchange. DE4A IEM models all the information required to properly process requests and responses, as well as to log and audit the transmissions from the public administrations' point of view. DE4A IEM also allows multi-evidence exchange when the same subject and competent authority are involved, thus contributing to the efficiency of the user and systems interactions.

The IEM XML-Schemas has been released under CC-BY licence.

### 2.3.4 Multilingual Ontology Repository (MOR)

We are in a digitally connected multilingual world, where understanding, mapping and relating to different languages is a mandatory part in integrative and borderless citizen-centric e-services. Starting with Google translations, many solutions for language translations are available up to date. However, the automatic translation of documents may pose a challenge for information exchange in public services since automatically translated documents do not have a legal value, and hence cannot be treated as lawfully issued evidence. In addition, the more context a text has, the more accurate its automatic translation can be, but neither evidence as human-readable documents nor evidence as structured data have enough context to guarantee a good automatic translation.

In a cross-border public service provision process there are two occasions where the language matters for the user, 1) to understand evidence, 2) to interact with the system for guiding the evidence exchange (namely the portal pages for the user to explicit request the evidence and to preview it and approve the exchange). In cross-border information exchange, typical process involves language translation to and from the lingua franca namely (Canadian, British or American) English. DE4A has solved the multilingualism problem by introducing the Multilingual ontology repository (MOR), following the i18n recommendation. First, the MOR database stores, maintains and semi-automatically translate in all EU languages the canonical form of the evidence types and, secondly, the MOR technical

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components use this database to implement the graphical user interfaces in the selected language for the user to guide the evidence exchange.

The problem of accuracy and legality of evidence translations is tackled by a two-step process, with non-verified (machine translated) and verified (verified by a domain expert and approved) labels and descriptions that are visible in the evidence exchanged. The MOR technical components are web client-side thus independent of the MS portal technology and provides two usage modalities: customizable and integrable common web components for full dialog functionalities and MOR multilingual functionality integrable in existing web pages.

The MOR has been released under Apache 2.0.

## 2.4 Legal Findings

The main legal finding of the project, from the DE4A project perspective, is that cross border Digital Government is currently being addressed in a fragmented way at the EU level, and that coherence and consistency would be hard to achieve without a more comprehensive EU level legal framework that supports not only governance and interoperability discussions, but actually allows new Digital Government services and new interaction patterns to be created and sustained from an operational perspective.

The piloting in real life procedures with real data and real users in DE4A has created legal compliance concerns, which were hard and sometimes impossible to mitigate for some use cases. As the SDGR has not yet entered into complete application, this raises doubts on the extent to which exchanges can already take place in real life procedures. This is however an inevitable part of piloting prior to the entry into application of the legal framework.

Also, given that DE4A ambition was to explore and pilot optimal approaches to create effective once-only information exchanges, and to generally improve the efficiency and user friendliness of eGovernment in Europe, without necessarily focusing exclusively on the SDGR, the project has delivered a number of useful innovations in the project, such as the multi-pattern evidence exchanges, the use of mobile wallets and verifiable credentials, and fine-grained powers validation that do not have comprehensive and mature legal frameworks at the EU level at the present time. These innovations were mapped against the sustainability mechanisms created by existing and emerging legal frameworks as reported in “D7.4 Report on legal sustainability” [3].

## 2.5 Generating value for the implementation of the SDG OOTS by Member States

DE4A has made important contributions towards the implementation of the SDG OOTS by Member States:

- ▶ By generating value for the SDG activities in particular regarding preparation for the SDG OOTS implementation. DE4A Member States have now a deep understanding of the requirements and the needed technical options and contributions for the development of the SDG OOTS. These Member States have delivered valuable input to several instances of the SDG process (SDG Coordination Group, Committee, specialized sub-groups...) with clear and positive results, which can be seen to be reflected in particular in the specifications for the SDG OOTS of the recent Implementing Act [1] where a solution for evidence exchange fundamentally analogous to the USI pattern is defined. In addition, the project contributed to a wide range of topics to OOTS architecture and semantic working groups.
- ▶ On a sectorial level, generating value and tangible impact by making fundamental contributions to aspects: for the experience with Verifiable Credentials can be highlighted (EBSI registries, agents for competent authorities and wallets for students) aligned with Europass-EDCI data models for

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student-centric evidence provision (Studying Abroad Pilot); the cross-border authentication and powers validation infrastructure usable for legal persons representation that effectively lowers barriers for companies to start or do business in a different Member States, as well as mechanisms to be informed of company events and/or keep company data automatically updated through subscription to notifications about changes in business registers (Doing Business Abroad Pilot); the proactive citizen services with automated back office deregistration procedure linked to a previously confirmed address change (Moving Abroad Pilot).

In conclusion, the project has provided value for stakeholders through advanced technical functionality like exchange of multiple evidences at once, streamlined user experience in USI with multilingual support and simplified steps in VC pattern and, more importantly, with the consolidation of lessons learnt and advice provided for the most significant types of challenges to achieve cross-border interoperability that MS will need to face in similar projects like the SDG OOTS implementation.

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## 3 DE4A Sustainability

The project common ambition has been that the knowledge and hands-on experience, delivered through different channels (project deliverables, public Wiki, dissemination events, papers, etc.), serve the community of Once-Only practitioners at European Commission and Member States levels in the context of the Single Digital Gateway and its OOTS. This experience and knowledge are also relevant for longer-term initiatives in the context of inclusive, trustworthy, value-based digital transformation in the public sector, strengthening Europe's digital sovereignty and interoperability.

The project has have provided practical solutions to address interoperability challenges at all levels (technical, semantic, organisational and legal): from elicitation approach for (complex) canonical evidence definition, to cross-border authentication (even for non-notified eIDs in pilots) and authorisation also based on (full and fine-grained) powers validation achieved extending eIDAS infrastructure with pilot-specific nodes in Doing Business Abroad, effective record matching at DOs, improved and secure eDelivery framework with dynamic discovery and with open source Connector to save cost and effort in Member States and also improving interoperability by supporting multiple patterns in a single application and making easy scalability to connect large numbers of DEs and DOs), or establishment of a self-sovereign identity supporting framework successfully integrated with cutting-edge blockchain EU infrastructure (EBSI Early Adopters programme) and innovative technologies (mobile wallets and agents), anticipating for MS fully user-centric evidence exchange and foreseen synergies between the SDG and upcoming eIDAS EUDI Wallets ecosystem, to name a few.

This sustainability deliverable has listed and discussed the key factors which positively influence the viability of the project in the future. These factors have been clustered in four main aspects of sustainability: political, legal, business and technical dimensions.

### 3.1 Political sustainability

DE4A has explored and piloted how to create an effective and efficient implementation of the once-only principle (OOP) at European level for a friendly eGovernment in order to boost the Digital Single Market. To this aim, existing and upcoming policies has been taken into consideration, as well as new policies for innovative approaches to enable an optimal implementation. The DE4A results have contributed to different Regulations, such as the **Interoperable Europe Act, the Data Governance Act, the Implementing Regulation (IR) of the SDG Once Only Technical System and the upcoming Data Act and the toolbox of the EUDI Wallet provided in the revision of the eIDAS Regulation**, including the OOTS-EUDIW Synergies Contact Group through MS participation in the respective policy making instances. The DE4A results are also likely to be reused in future Implementing Acts (IA) for the SDGR and even other domains.

#### 3.1.1 Sustainability with respect to the Implementing Regulation of the SDG Once Only Technical System

The objective of the SDGR is to create a clear legal basis for the once-only principle at the cross-border level in the EU, and to support the establishment of a technical system for the automated exchange of evidence between competent authorities in different Member States. More specifically, article 14 of the SDGR requires that this system will support the exchange of evidence necessary for the completion of the procedures exhaustively listed in annex II of the SDGR, as well as procedures governed by the Directive on the recognition of professional qualifications [5], the Directive on services in the internal market [6], the Directive on public procurement [7], and the Directive on procurement by entities operating in the water, energy, transport and postal services sectors [8][8].

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### 3.1.1.1 Relevance of DE4A for the Implementing Regulation

To a large extent, DE4A pilots a potential blueprint for the SDGR's technical system. As is explained in much more detail in "D2.7 Interoperability Architecture for Cross-border Procedures and Evidence Exchange in light of the Single Digital Gateway Regulation" [4], the DE4A architecture description builds on the first version of the OOTS under the SDGR. In addition, the OOTS [1] adopts in its first version an exchange pattern similar to the DE4A User-supported Intermediation (USI) pattern (authentication and preview on the Data Provider-side).

On the other hand, some common misconceptions raised during the discussions for the OOTS implementation, regarding procedure harmonisation and adaptation of base registries, which have been further clarified by DE4A. The idea that MSs are required to harmonise their procedures for a common set of procedural requirements or required evidence, is not true: each MS can maintain their procedures as they are with their own procedural requirements and required evidence. The notion that MSs are required to adapt their base registries according to specific data models is not true either. Procedure and evidence providers can work with PDF documents, although this often leads to suboptimal results. Instead, as the vast majority of automatic evidence issuing is implemented from structured data bases, it is useful to strive for maximising semantic interoperability at the lowest possible level, through common data models that allow automated processing and avoid legal translation requirements. Providing evidence as both a PDF -often the lawfully issued domestic evidence- and as a structured document -the corresponding canonical evidence according to a common data model- is complementary and covers all needs. This approach has been successfully implemented for public documents through the multilingual standard forms provided in Regulation 2016/1191. As for the Regulation on Public Documents, the mapping between the domestic evidence and the canonical evidence -the standard form- is the responsibility of the issuing competent authority. Since these semantic agreements for relevant information are usually part of European implementing regulations on systems for the automatic exchange of such information, there is a great opportunity to adopt this approach as mandatory in further revisions of the OOTS implementing act thus solving the legal translation issues and enabling the automatic processing of evidence.

DE4A really made it a top priority to ensure and make clear that the cross-border evidence exchange will not rely on a central database of citizen/business data. Citizen data will be exchanged directly between MS competent authorities at the request of the applicant based on different patterns and most often only after a preview of the citizen. At the same time, this implementation of the OOP at European level means applicants no longer need to do the work to figure out what the matching evidence is in another Member State and which authentic data source can provide it and to play the go-between. Public Administrations can trust evidence delivered through this system as it is provided directly from the authentic source via a trusted protocol eDelivery (or involving trustworthy Distributed Ledger Technologies (DLT) infrastructure, e.g. EBSI). The eDelivery technology provides a G2G network for the exchange of evidence between competent authorities with the same level of trust and security, regardless of the format and content of the evidence or the participants in the exchange. Besides, as the evidence comes directly from the authentic source, public administrations will always receive the latest available version of the lawfully issued evidence at the time of requesting. However, in the absence of a proper legal basis and a fully automated discovery of the required cross-border evidence, this exchange should be driven by the applicants, who should be properly informed about the functioning of the exchange in order to explicitly consent to use the network [38]. This user-driven mechanism puts applicants in control of the exchange, thus facilitating the data protection of the exchange, as the evidence subject -the applicant- previews the evidence and subsequently cancel or confirm to the issuing authority the sending of the evidence to the requesting authority. On the other hand, only harmonisation rules can provide the necessary legal basis and fully automated discovery mechanism to save the user interaction with the system.

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### 3.1.2 Sustainability with respect to the eIDAS Regulation

The eIDAS Regulation [9] (including the ongoing revision via the eIDAS 2 amendment proposal -[10] provides the main rules in relation to electronic identification and certain trust services, including electronic signatures and registered electronic delivery services. The eIDAS 2 amendment would add specific rules in relation to European Digital Identity Wallets, electronic ledgers, and electronic attestation of attributes. Both the basic Regulation and its amendment contain specific governance and sustainability rules for these components and services.

#### 3.1.2.1 Relevance of DE4A for the eIDAS Regulation

DE4A has explored and piloted trustworthy and secure evidence exchange using Distributed Ledger Technologies (DLT), which is always user-driven through digital wallets under the control of the applicants, provides a divide-and-conquer approach to the problem of the cross-border evidence discovery and ensures privacy regarding how applicants use their evidence. DE4A has based the DLT implementation of the evidence exchange on the European Blockchain Infrastructure Services (EBSI), the eIDAS network for notified electronic identification means and W3C specifications for decentralised identifiers and verifiable credentials. While evidence validity / revocation mechanisms are not supported yet at EBSI-level and thus not piloted, this verifiable credential specification provides several means to guarantee that the evidence provided is valid and is the latest available version of the lawfully issued evidence at the time of requesting, which could be included in the implementation of the evidence exchange. DE4A has proven that technically, apart from eDelivery, Distributed Ledger Technology can be used for the SDGR implementation and recommends that action be taken to include this basis, legally and technically, into the SDGR OOTS functioning.

Current European policies - SDGR, eIDAS and EBSI- show how a common European infrastructure is established by European cooperation for core services. Different technologies like Multi-Blockchain-Networks and Hashgraphs may be in play for the future of the SDGR services.

### 3.1.3 Sustainability with respect to the Interoperable Europe Act

The proposal for an Interoperable Europe Act [10] was published in November 2022, and aims to strengthen cross-border interoperability and cooperation in the public sector at the EU level, specifically by defining shared governance mechanisms such as the creation of an Interoperable Europe Board to develop a common strategic agenda for cross-border interoperability, the support in operational implementing interoperability solutions, and progress monitoring; mandatory interoperability assessments to evaluate the impact of changes in IT systems related to cross-border interoperability in the EU; and the creation of an Interoperable Europe Portal to identify reusable and interoperable solutions and building blocks.

#### 3.1.3.1 Relevance of DE4A for the Interoperable Europe Act

The DE4A Multi-pattern approach shows a path towards efficiency and cost reductions, thus improving economic growth and ROI, compared to a unique-pattern world. While many requirements have been met by the pilots, much more remains from the upcoming data spaces to show real impact on the Digital Single Market, mobility, life-long learning and exports. DE4A has proven that in the absence of a proper legal basis and a fully automated discovery of the required cross-border evidence, the User-Supported Intermediation pattern is required; otherwise, the direct Intermediation pattern is enough. Besides, DE4A has also proven an efficient collaborative delivery of public services in the business domain requires the Subscription and Notification pattern combined with the Look-up pattern. The implementation of cross-border proactive public services, such as the domicile registration/deregistration mechanism, requires the push pattern. These different patterns can be promoted as Interoperable Europe solutions once the Interoperable Europe Regulation comes into force, so further implementation regulations will not need to discuss on the architectural pattern for

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their respective information exchange but select one of the available patterns that better suits their needs. In the same way, the organisational, business, application, technical and information components used by the several patterns might be promoted as Interoperable Europe solutions to contribute to the speed and quality of further implementing acts.

Finally, while our pilots have not been able to show direct monetary impacts other than significant time-savings, we are confident to say that the DE4A pilots have had a positive impact on the understanding of current and upcoming legislation, policies and services towards the bigger goals of the EU initiatives aimed to an effective and efficient Digital Single Market.

### 3.1.4 Sustainability with respect to the Data Governance Act

The emerging Data Spaces policy field, as proposed by the European Data Strategy [12] and partially implemented via the Data Governance Act [13], to be further expanded and developed by the proposed Data Act [14] and a range of other initiatives. The central vision is to establish and support a range of sector specific “Common European data spaces”, which bring together relevant data infrastructures and governance frameworks in order to facilitate data pooling and sharing. At least ten such Data Spaces are contemplated under the European Data Strategy, including a Common European data space for public administration

#### 3.1.4.1 Relevance of DE4A for the Data Governance Act

The Data Spaces framework is still at a relatively early stage of development. The European Data Innovation Board has a mandate that could be useful to support the emergence of a data space for public administration [3]. Considering that the DE4A multipattern architecture facilitates the exchange of data, the integration of DE4A results into such a data space could be a possibility. However, as no data space for public administration has been created yet, the framework is usable to further develop the DE4A outputs and to support awareness and even support among other Member States.

## 3.2 Technical sustainability

This section summarizes the sustainability of the architectural and software results of the project. It is worth mentioning that considering that By December 2023, the Once-Only Technical System, must be rolled out in every Member State, the European Commission and Member States are developing services and solutions to implement the Once-Only Technical System. To avoid reinventing the wheel and to instead rely on cost-efficient solutions, a catalogue of reusable services for implementing the Once-Only Technical System has been developed [15]. This catalogue captures a list of services and solutions made available by the European Commission and Member States to support the deployment of the OOTS. As the current list is not exhaustive and will undergo multiple iterations to ensure the best and most up-to-date support for the national implementers and developers, DE4A components like the MOR can be offered to be added to this list.

### 3.2.1 DE4A Multi-pattern architecture

DE4A has created a flexible architecture that can be applied to a much broader range of public sector services, going beyond the principal focus of the SDGR. The project defined the concept of a multi-pattern architecture for three pilots, covering five of the life/business-events mandated by the SDGR as the requirements of different sectors, participants and procedures were too heterogenous to be resolved by a single exchange pattern. Instead of developing different systems for different needs, the DE4A multi-pattern architecture proposes a consistent set of components that are jointly able to support different patterns.

These interaction patterns that the project implemented and tested have proven to work in the pilots so they are clearly to be taken into consideration by SDG. Although the SDG OOTS is currently only

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considering the USI pattern there are other ways to extend it in the future and DE4A has piloted them well and have proved to work.

In fact, based on the project findings, the need for such a multi-pattern exchange architecture, that is established as a horizontal infrastructure to be used for a multitude of sectoral requirements and solutions, is a reality. And the infrastructure of OOTS, designed for one specific interaction pattern can in be easily leveraged to support the multi-pattern architecture, including the EUDIW, in the mid-term future, for cross-border eGovernment interoperability. This would support such disparate requirements as self-determination of the user and, where applicable, pro-active eGovernment procedures.

### 3.2.2 DE4A Connector

The DE4A connector is not deemed to be able to be used as-is, but rather harmonization need to happen, according to the needs of the Member States for the implementation of the SDG OOTS. Nevertheless, the architectural design principles of the connector can definitely be reused. In fact, several Member States are currently working on the SDG connector based on these principles.

The rest of DE4A software components (e.g IAL, SMP,..) need to be adapted for reuse as different design decisions were taken as DE4A needed to make decisions before the SDG Implementing Act was ready. At this respect, the SDG has specific requirements like a different trust model or there is no dynamic discovery in the current version of the specifications of the SDG OOTS. However, some of these aspects that have been implemented by DE4A may be needed in future versions of SDG OOTS as part of its evolution.

### 3.2.3 DE4A Self Sovereign Framework

Leveraging the DE4A Self-sovereign Identity supporting framework implementing the Verifiable Credential exchange pattern (see D5.8 [23]), enabled students to directly obtain and manage in their mobile wallets their diplomas in the form of Verifiable Credentials (attestations) from trusted data sources (universities where they previously studied or Ministries of Education) and were also able to present them as Verifiable Presentations directly to a competent authority in another MS to request their recognition. On the other hand, DE4A MS participating in the Diplomas Recognition use case deployed and configured the Authority Agent enabling a secure interaction with student users (through their mobile wallets) and allowing to securely issue signed verifiable credentials to them (Higher Education Diplomas) or to verify them when presented by students (in terms of format, identity contained in them and issuing authority registered in EBSI).

All this is relevant for the upcoming EU Digital Identity Wallets ecosystem (revision of eIDAS regulation), as some DE4A MS have gained anticipated and hands-on experience about highly innovative technologies that will be relevant in that context, also considering the multiple synergies currently being analysed in detail between the EC and MS in the “OOTS and EUDI Wallet Synergies and Interoperability Contact Group”. In this context it is expected to provide an ecosystem where citizens are able to look-up and get evidence through the OOTS and download it to their wallet.

An alternative way to realize Once-Only has been piloted by DE4A, with reduced verification costs, high user control of exchange process, fostering reinforced transparency and (decentralised) trust in public institutions. This can contribute to longer term horizons of open collaboration and innovation platforms supported by ICT (“government as a platform”) which ensure modular services quality (“government as a service”) as envisioned by DE4A (see One Network for Europe Digital Single Market Ecosystem in D2.8 [32] ) for better, interoperable, digital public services with potential to regroup resources under common infrastructures at European level (e.g. combining OOTS and EUDI wallets EUDI Wallet users could benefit from all components of the OOTS and duplication of investment could be avoided). In this regard, the wallet prototype in DE4A can be seen as “a European Passepartout

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supporting pseudonymous identification and allowing the user to manage the different personas of their human Digital Twin in a privacy-enhancing way” as mentioned in D2.8 [32]. With relatively low effort, additional “contexts” can be defined in order to support management of different types of credentials in a single wallet. MS and agencies participating in the pilot have gained technical awareness and anticipated technical insights relevant for the future, when they may play the roles of relying parties consuming information presented to them from EUDI Wallets (Verifiers) or as (Qualified) Electronic Attribute Attestation providers (Issuers). Work in this area will continue with EBSI Wave 3 of Early Adopters [33] and with the Large Scale Pilots funded under Digital Europe Programme in the Call to “Support the implementation of the European Digital Identity Framework and the implementation of the Once Only System under the Single Digital Gateway Regulation”.

### 3.2.4 Semantic components

The Once-Only principle (OOP) at European level for the cross-border use of relevant evidence to prove the applicant’s compliance with the procedural requirements of public services is necessarily implemented through the automatic exchange of actionable and understandable information, regardless of the use case and the Member State. This cross-border interoperability requirement inevitable needs cross-border and cross-sectoral semantic agreements.

The so-called “evidence mapping” is the process to solve the categorisation, granularity and standardisation problems regarding relevant cross-border evidence, in order words, the semantic agreements for a common understanding of the available evidence types in the European public sector, their issuing details and the definition of a common data model for each of these types. DE4A pilots have solved these problems by implementing two concepts, the Canonical evidence and the Information Desk (IDK), under the principles of proportionality, subsidiarity and efficiency and according to the European Interoperability Framework. The concept of canonical evidence is the keystone of these principles, as it provides the grounds for semantic interoperability of cross-border and cross-sector evidence.

DE4A has found that there is generally a lack of European harmonisation of procedural requirements and evidence types, so experts in national domains need to acquire knowledge of how other national domains work in order to create European semantic agreements, thus creating new knowledge. Due to this situation, the SDGR is facing the difficulty of eliciting the required information for the evidence mapping. DE4A semantic experts have looked into this elicitation problem from their experience in DE4A pilots and from the academic literature and, as result, they have proposed a methodology to address this elicitation problem from a socio-technical perspective, as well as a semantic framework to model canonical evidence, both of which have been presented as research papers. These learnings and concepts that ease the evidence mapping can be adopted by the next steps of the SDGR OOTS.

Once the canonical evidence types have been identified, the IDK offers information (metadata) to the participants in the cross-border exchange of evidences to enable this exchange by means of four catalogues: information on the issuing authorities or each canonical evidence type according to the competence territorial organisation in each Member State (IAL – Issuing Authority Locator), the details for using the evidence exchange service for each canonical evidence type and issuing authority (ESL – Evidence Service Locator), the semantic description of the common data models in a reusable and multi-lingual manner (MOR - Multilingual Ontology Repository) and an access authorisation mechanism based on the attributes of the evidence request (CAAR - Cross-Border Access Authorisation Registry). Although DE4A has only designed the CAAR and the MOR has been implemented in one of the exchanges as a proof of concept, the IDK can be taken as a reference for further developments of the SDGR OOTS as they provide a simpler approach while offering more functionality.

In addition, the DE4A semantic results can be useful for the implementation of OOP through the EU Identity Wallet provided by the upcoming revision of the eIDAS Regulation, for the implementation of

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OOP at national level or at international level beyond the European Union, and for the implementation of the exchange of information in any domain, not only in the public sector.

### 3.3 Legal sustainability

DE4A has successfully created and piloted several components and exchange patterns that can be used in the implementation of the SDGR. More importantly however, *the results of DE4A go beyond the SDGR* – as was intended from the onset – *and show a number of architectural and functional possibilities* that seem highly desirable from a policy perspective, and the general objective of providing effective, efficient, reliable and proactive digital government services to EU citizens. These do not always have a clear legal framework, in relation to multi-pattern exchanges, interrupted procedures, revocation of evidences, the role of verifiable credentials and SSI (Self Sovereign identification), and the need for clearer and unambiguous rules on representation rights and competencies (rights & responsibilities).

The horizontal observation from the project members is that it would be useful to establish a broader horizontal Digital Government framework at the EU level that more easily allows cross border Digital Government procedures to be established, that allows any EU level infrastructure to be set up and maintained permanently and provides a clear legal value to these procedures and the exchanged information, beyond the current focus on governance and interoperability.

In effect, within DE4A, there is an interest to approach Digital Government by creating a legal “meta-framework” for cross-border Digital Government services in the EU that goes beyond mere interoperability, and beyond current notions of once-only services as currently focused in the SDGR. The goal should be to establish a long-term legal framework that can flexibly address all Digital Government needs (including new procedures and new patterns), integrating existing building blocks, but without the need for ad hoc new legislative interventions in each instance.

For some of the legal sustainability challenges, partial quick wins are available:

- ▶ Within the Gateway coordination group under the SDGR, the existing governance mechanisms can be used to discuss to what extent multi-pattern approaches can be supported under the current SDGR, and how interrupted procedures could be addressed.
- ▶ Similarly, the Gateway coordination group could consider under which circumstances evidences could be issued as Verifiable Credentials, building on the framework for (qualified) electronic attestations of attributes under the eIDAS 2 proposal.
- ▶ Within the eIDAS revision, further focus would be needed to:
  - Improve identity matching
  - Integrate and formalise the fine-grained powers validation of company representatives
  - Deregistration and “Consent freshness” – Special care should be taken for the consent freshness (invented due to lack of a better word/definition, but basically defines a period of time since consent).

The legal perspective is discussed in more detail in “D7.4 Report on legal sustainability” [3].

### 3.4 Business Sustainability

The potential value of the DE4A solution became evident in terms of effectiveness, efficiency and the enabling of service transformation. The value impact of the three categories differs depending on the pilot and the use cases, but is significant in any of them.

Below we address business value in the context of the pilots, based on findings reported by each DE4A pilot in their Final Running Phase reports D4.4 [35], D4.8 [36] and D4.12 [37]).

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### 3.4.1 Studying Abroad - Specific Value Overview

While many requirements have been met by the pilot in terms of demonstrating the value of DE4A to create value in terms of effectiveness, efficiency and enabling of service transformation, much more remains to improve on the expected functionality in different steps of our educational journey, including life-long learning. Pilot partners feel strongly that it was the right choice to include a use case leveraging DE4A's Self-Sovereign Identity Supporting Framework and the piloting with blockchain decentralized technologies (EBSI) and it is important that the findings get taken up by EBSI community and by initiatives for global standardisation so that Europe advances its position as a knowledge economy.

The value of the Studying Abroad (SA) pilot for public administration users focuses on specific benefits (i.e. administrative burden reduction achieved by automated exchange of data across-borders following Once-Only principle) realised and verified with real students and members of students offices during cross-border piloting and comes from the fact that cross-border services are deployed with trusted evidence and verified cross-border interoperability. Staff of universities and Ministries of Education, as well as European students moving either physically or virtually to another university or using educational services such as applying for study grants, are the main actors involved in determining the benefits and value generated.

Specifically the problem of understanding if a diploma is authentic is a serious one and that the current process to do this validation is complex and time-consuming (sometimes, it can take a week before information is received about the authenticity and validity of the diploma). The automatic validation provided by UC1 Application to Higher Education Area (evidence downloaded using the connector) and UC3 Diploma recognition (verifiable credentials validated using data stored in EBSI) makes this process efficient and consumes no time at all, which is a great evolution concerning the current process. In the case of well-known universities, it can take a few minutes for a student office at some pilot Data Evaluators to validate paper-based evidence of foreign students. If that is not the case and there is suspicion about evidence, the process can take an hour or even more. On average, the time reduction with the DE4A procedure is around 20-30 minutes per foreign student. The DE4A procedure also ensures that the information about the validity of the diploma is always available from a trusted source.

Some of the data issues mentioned by Data Evaluators are the lack of officially translated content. The benefits of the new procedure for applying to Higher Education piloted in DE4A are higher compared to the traditional situation, but officially translated and normalised content would be crucial to increase the benefits of the system. English translation provides no benefit other than better comprehension for staff, but official translation is still needed so that titles can be verified for the applied programme. In any case, regardless of being tabulated data, visual examination is required, as there is no way to automatically match a programme to a degree (in the sense that the knowledge acquired in that degree is valid for application to the programme).

Concerning the canonical evidence structure and domestic evidence, some Data Evaluators would welcome the whole diploma supplement and would also need information on whether the foreign higher education institution is an accredited institution.

It should be emphasised that the effort reduction in processing the evidence is not fully achieved if not all data required by the specific enrolment procedure is included in the evidence, since the administrative personnel must request the scanned copy of the certificates/diplomas containing the missing information to complete and validate the data in the old way. If all required data is provided, the validation procedure can save significant time, as, for example, currently the validation procedure can take days because of the volume of e-mails and phone calls exchanged with some applicants.

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For Data Owners, the benefits depend on the existing procedures for issuing diplomas at each participating institution but they estimated (as Data Evaluators did) that benefits considerably exceed the cost and effort of customization and integration.

Record matching remains an important issue; in one MS, for example, a university receives for national services user's national ID in the service request and can search and return the data associated with the said national ID. No interaction with the user is required: either the data is found or not. Problems occur when degrees are awarded to foreign students. In this case, they are associated with their passport numbers possibly and usually with the foreigner's ID number that Spain requires any foreigner studying or working in Spain to get issued. If users use eIDs from their country of origin, the search will fail (given the sensitivity of the operation and the lack of a trusted date of birth, the matching by attributes is not allowed). The only way around this would be to authenticate the user at the university, which cannot be done due to the back-channel nature of the university service in relation to the central intermediary system for data provision.

The availability of multi-evidence support has it made possible for users to request data from different service providers in a single operation. Since different sources implied different messaging structures, standardization became a must to mitigate complexity.

To summarise business value validated by SA Pilot, DE4A allows time to be saved both to the student (less input, fewer errors, no need to scan and upload diploma and grades in PDF) and to the university officials (no email/phone checks), as it provides a high degree of trust on the received data, which is also tabulated and can be used for the ranking out of the box. Also, eIDAS provides a high trust in the personal data of the student, and it enables the creation of a full account, instead of a temporary one.]

The user-centric handling of this kind of evidences provides clear value to students, empowering them to be in control of how they exchange academic data like diplomas not only in context of higher education, but in hiring and work-life. The risk of an AI doing the sorting of applicants based mainly on achieved certificates and may miss more Human-centric attributes that want/need for our civil societies. User-centricity enabled by decentralised technologies enable students to be more organised while saving a lot of time since they do not need to repeat evidence acquisition process for multiple official procedures.

The educational systems of Europe are highly diverse it cannot be envisaged that a quick transformation can take place in the short term. In order to support the trend of aligning and harmonizing education across Europe it is important to facilitate mobility across universities and countries for all students. In this regard, the UC of applying for study grants across borders may be particularly important to level the playing field for different social groups and achieving societal cohesion. The possibilities of this service should be analysed to be maximized considering policy alignment and assessing potential sources of funding in the EU and also within Member states. Stakeholders in the domain of the pilot should reach out to foundations and other services that fund Research and Development to see how the DE4A resulting specifications and components can be reused.

### 3.4.2 Doing Business Abroad - Specific Value Overview

Business value in terms of efficiency, effectiveness and service transformation is confirmed by companies, which particularly appreciate the short duration and simplicity of the entire online eProcedure, which usually the piloted eProcedure has been completed within 2 minutes given the fact that, a. According to Data Evaluators, the currently used procedures without OOTS could take days or weeks to complete. The fact that immediate results are also provided for powers validation, instead of having to collect and upload documents about mandates, adds to the positive experience.

The part of arranging proper configuration of the mandates within the home Member State (which is not part of the piloted process) however, decreases the perceived value of the solution. From a DE4A

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pilot-perspective however, this process was eventually deemed out of scope and something that cannot be changed by the DE4A project, nor can it be influenced in favour of the pilot. In some Member States, the functionality concerning mandate management and validation is often developed and maintained by private parties, which are not DE4A partners. Therefore, it needs policy level discussion and agreement before further meaningful harmonization can happen.

The value of finer grained powers validation still seems not to exist for SMEs, as distributed mandates are less common. During interviews with representatives of SMEs, some respondents of mid-size enterprises would choose to perform important activities (like registering a new business activity across border) themselves rather than delegating the task to an employee. Respondents expect Fine Grained Powers Validation to be of value for large companies.

For companies, the value of the eIDAS/Powers Validation and the OOP TS solution is considered to be major. The feedback in the interviews and questionnaires was all very positive.

Data Evaluators (including the German DE) look forward to the benefits from having validated data available in a harmonized, structured and easy to process format. It saves time and produces less errors when processing in the portal and other systems. This benefit is expected to lead up to hundreds to thousands of hours saved per year on processing and correcting, assuming that the solution is used for all DE processes (not just the process that was piloted). On several occasions the implementation led to immediate process improvements on the DE-side, or to food for thought on process improvements. There is also a downside: if implemented for just one procedure, the solution would probably not be cost-effective. Furthermore, some Data Evaluators expect the majority of benefits to be present after a learning curve (that has already started with the DEs while piloting).

The Data Owners, usually already providing standard data services, did not notice much of the piloted DBA “Stating a business in another MS”-UC1 solution. The main added value would be that data in the Business Registers is used more often and for the right purposes, which means an increased ‘right-to-exist’ for Business Registers (although the volume in piloting is probably too low to really make an impact). Another value could be that there will be less manual work for processing requests, and handling errors.

Still, Data Owners generally believe the added value is greater for Data Evaluators. They would provide services connected to the S&N pattern to help Data Evaluators out, increase support for national companies to do business across border and of course if legislation dictates so. Created added value is then not financial and internal, but for other parties and about user friendliness.

### 3.4.3 Moving Abroad - Specific Value Overview

Business Value was confirmed on the one hand by citizen end-users, appreciating overall experience with the procedures in terms of clarity, simplicity, reduced effort to complete all steps and overall duration which was generally between 2-5 minutes.

Data Evaluators confirmed benefits of having access to validated and high-quality evidence data available from authoritative and trustworthy data sources in electronic and harmonized / structured and easy to process format as this saves them time while minimizing evidence processing errors. Canonical evidence models were confirmed to be fit for the direct evidence requirements in procedures, although it was a complex exercise to find the balance between mandatory and optional attributes in semantically complex certificates like birth and marriage (similarly for pensions, labour and unemployment information). This will be a much larger challenge when addressed across all EU MS considering many different electronic procedures and data services. In this regard, work done for defining Multilingual Forms in the context of the Public Documents Regulation EC 2016/1191 and further work done by semantic working group in SDG OOTS context represents a good basis towards harmonization over canonical models.

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Retrieval of multiple evidence in a single request can add some time to overall duration but still saves much time when compared to having to request evidences one by one running separate requests. DEs confirmed that integrating the Explicit Request based on a generic design caused no problems and the functionality is very limited, simple and low-cost to implement.

Aspects involving delegation (e.g. scenarios between natural persons for procedures involving evidence of multiple family members or legal custodians of minors, elderly or people with disabilities) are inherently complex and deserve further research given the relevance in the context of procedures for citizens moving abroad.

Reliable and fast authentication using eIDAS and evidence exchange using OOTS was also confirmed by DEs and DOs and also they estimated benefits to (considerably) exceed involved costs to use DE4A solutions. Regarding record matching specific requirements for registration of users and authentication of recurrent users apply for each DE and reliance on eIDAS personal identity attributes formally attested by EU MS authorities in (notified) eIDs is definitely helpful for DEs and DOs.

Both DEs and DOs confirmed benefits of f Multilingual Ontology Repository developed to simplify and accelerate the Explicit Request functionality (including its dialogues with users and with the central components of the system) and enabling language selection for the Preview functionality supporting multilingual labels for evidence attributes.

Data Owners further confirmed that implementing the Preview based generic wireframes were provided in collaboration with Common Component Design & Development WP was achieved without problems.

Although the canonical evidences in the Moving Abroad (MA) Pilot are among the most stable (e.g. birth and death certificates), they can still change (e.g. marriage certificates, domicile evidence). Thus, it is essential to have registers up to date at all times and a possibility for other services to always check against updated online service. Establishing which competent organisation is in charge of each piece of evidence is a matter of territorial administrative organisation on the national side and it needs to be made easy for citizens to locate the appropriate data source to benefit from the Once Only Principle (e.g. YourEurope portal of the SDG). .

Evidence types or attributes are also potentially useful in services with countries outside of the EU (e.g. Visas). There is also a need to be able to change them over time (e.g. Divorce, Sex-change/Administrative gender updates, etc.). These evidences and the mandates they can help create, will need to work in hundreds of procedures under Moving Life Events.

With a longer time perspective (t5), the piloted services are also extremely important beyond SDGR services and support EU policies and programmes for Digital Transformation (e.g. [Europe's Digital Decade](#)) and highly integrated EU public administration.

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## 4 DE4A Governance

The Once-Only Technical System (OOTS), sometimes also called Once-Only Principle (OOP) technical system, is a technical framework for data sharing with much larger scope than DE4A and has been topic of projects such as The Once-Only Principle Project (TOOP) that started already in January 2017 and ended on 31 March 2021. This section should be read in relation to the D7.4 that goes into depths in the regulated governance mechanisms but excludes eg. Infrastructures like EBSI.

One of the main objectives of DE4A was development of common services and components fully aligned with the SDG roadmap, in particular to assist Member States to realize OOP Technical System. While OOTS decentralised architecture connects public authorities, to exchange evidence at the citizen's or business' request, it has also been acknowledged to be more than just a system. In fact, it is often addressed as technical "ecosystem" since it includes distributed collection of systems that are independently established and maintained by different EU Member States, therefore involving different organisations with their own procedures, resources, and staff. This is also why governance must be based on experiences from technical coordination that coordinated the technical work, monitored the developments and evolution of the architecture, as well as its compliance to OOTS, integration and interconnection and the use of common and reusable "Building Blocks".

In previous deliverables D6.1 [34] and D6.2 [18] presented landscape of relevant governance models and made assessment of different alternatives for DE4A. Three streams: conceptual, empirical and consultation, all had to rely on assumptions about governance that are difficult to simulate or validate, since the project results were not ready and available. DE4A pilots offered more insights into the joint public administration (PA) governance principles or high-level decision making, and it was decided to focus on operational governance related to the project result sustainability. Besides terminology and the main issues related to service co-delivery business models and governance (such as roles and responsibility of Public Administration or impact assessment for different stakeholders), also presented the best practices, lessons learned and all other previous experiences in the area, including ongoing activities in SDG coordination group. Conclusion was to focus on three governance pillars addressed through questions who what and how. After the last workshop in October 2022 and considering overlaps that exist with SDG Coordination Group, it has been decided to narrow down focus to DE4A results, such as connector or semantic results and re-orient scope of these questions:

- ▶ Who: list of relevant stakeholders – this remains relevant, but with a focus on operational governance issues e.g., who should decide about the evolution of DE4A connector
- ▶ What: the current scope is of DE4A results, their maintenance, evolution, reuse, and adoption
- ▶ How: here focus on processes, rules, norms, and actions with a different degree of formality, related to the sustainability of results of DE4A, for example change request or versioning of a specific software component

*One should also note that the main parameters in the choice of governance model, according to the Member States are: simplicity, similarity to SDG and OOTS governance model and inclusion of a group that will be dedicated to evolution and emerging technologies.*

### 4.1 Internal DE4A governance

Internal governance and decision on who, what and how is structured around DE4A results and their ownership, in further text called DE4A outputs. Each output has a clearly assigned IP. The main governance body of DE4A would be the DE4A-Coordination Group (DE4A-CG), elected by subgroups (or working groups). This CG would be the interface with the European Commission, member states and other initiatives, while subgroups would report to it on a regular basis.

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In order to simplify structure and provide basis for the later synchronization with OOTS-WG and other external initiatives, Internal DE4A governance model for subgroups will mimic OOTS-WG structure with four roles defined:

- ▶ Coordinator (usually the main owner of result),
- ▶ Editor,
- ▶ Contributors.
- ▶ Rapporteur

It does not mean that four different persons are needed. Editor and Rapporteur, for example, could be one of the Contributors or Coordinator of a group for DE4A outputs.

During the workshop in February 2023, three alternatives for subgroup orientation and segmentation have been presented, based on:

- a) Type of results (technical, semantic, patterns and legal)
- b) Five-layer-model (Specifications, Components, Building Blocks , Core Platforms and General (Horizontal) Services)
- c) Hybrid

Finally option a) has been selected, with the inclusion of another WG for the Emerging Technologies, that would be in charge to monitor technology trends and their application to DE4A evolution. This subgroup would make DE4A “future proof” and would be filtering significant events towards DE4A-CG.

In a similar way to OOTS-WG reporting to SDG-GC, DE4A-WGs would report to DE4A-CG that would also be responsible for the interactions with the EC, EBSI and others. DIGIT has published a list of experts appointed by MS to contribute to the OOTS-Operational-Governance-subgroup. In accordance with the SDG-OOTS-IR, the sub-group will focus on operational arrangements and service level agreements (SLA). DE4A Member States needs to be involved in these discussions. They would participate in discussions on who are the relevant entities that need to agree on operational arrangements, as well as the types of operational arrangements (Scope, Type etc). Finally, in the scope of OOTS Components they would represent the interest of DE4A component owners, in case these components are to be reused or adapted.

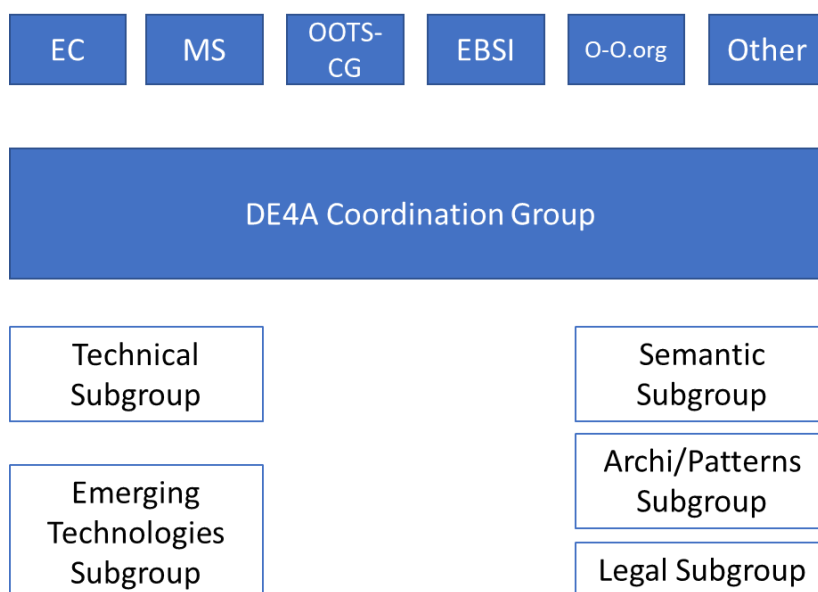


Figure 3: DE4A Governance

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Frequency of DE4A WG meetings and internal functioning can be decided later, but in the beginning, it could be useful to have monthly synchronization calls. When it comes to the links towards the external bodies, it has been suggested to also add link towards Once-Only.org, which is the follow up from TOOP project<sup>1</sup>.

Technical WG would submit an Annual Roadmap and CG would be in charge of approving this roadmap. It will of course depend on funding, as well as the status of the other SDG implementations and components.

Main actions where DE4A needs to be “synchronized” with OOTS and other stakeholders are;

#### 1) Map of patterns to use cases (Continuous activity on demand triggered by Architectural-WG)

There are multiple possible configurations and multiple needs that are reflected in multi-pattern architecture. DE4A has model with VC and EBSI infrastructure, for example, and another with BRIS infrastructure covering needs of subscription, notification and lookup.

There are different patterns for different needs, and this is a guiding principle for DE4A relationship with DG-DIGIT and SDG-GC. One of the actions will be to deliver the map of patterns, which is the starting point for later processes and rules related to the joint work.

#### 2) Adaptability of components

Connectors are not deemed to be able to be used as-is, but rather harmonization need to happen, according to the needs of the SDG-WG and the MS. In this sense decisions need to be taken, and proper processes (e.g., Change Management) need to be developed at DE4A-CG level, which will be transferred to subgroups. Related detailed decisions are decisions on eg. versioning.

#### 3) Monitoring Outputs and Outcomes

In EC infrastructures everything needs to be monitored. There should be Annual Reporting to CG about these procedures and Data Sources (DS) and Data Using Services (DUS), outputs of monitoring can be used by any stakeholder. Discussion on what to log, why and how to log should be done at CG-level, while implementation should be done in technical-WG, with support from Semantic-WG.

Technical-Connectors includes logging which permits to extract statistics. DE4A-CG will decide who is using it and how this statistic is used. Balancing the need for societal and service progress and human-centric needs for privacy.

With regards to the Policy level also initiatives need a (one) monitoring mechanism as automated as possible for Quarterly and Annual reporting needs according to Yearly Plans as planned per WG and per MS.

Also covering and informing defined external stakeholders.

#### 4) Interoperability

Cover all issues, including semantics, where different Interoperability Specifications need to be discussed. Regulation now also includes concept of Connectathon and Conformity testing and pilot-space/playground/Sandbox/Projectathons for interoperability. This would be in the scope of this set of actions. Actions would also include discussions about process for Schema updates and Interoperability tests of Interoperability Specifications (IS) including rules & norms and configurations for approval, repository management etc. All this led by each WG in a flow from Requirement (inc. laws and regulations) to constrained standard/IS. Three corners can be seen to rule the power balance in any testing event;

1. Testing tool/Reference Implementation eg. 1the IHE-Gazelle+playground (“reference implementation”)

<sup>1</sup> <https://once-only.org/>

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2. Interoperability Specification
3. The MS Implementation/Testbed

How to tackle the legal interoperability issues workflow from MS or projects to finalization is partially tackled in D2.8 and is beyond the WP6 scope.

Interoperability Specifications should also be addressed by Legal WG (supported by “quick MS decisions”) as well as Semantic-WG, for their respective areas of interest (Legal and Semantic IOP). CG should take decisions and propose mitigation measures in case of a conflict. Two types of requests can happen: Top-down-request for Bottom-up-request, when interoperability issues have been detected by an Operational Team (OT).

Commission also recently published its proposal for an Interoperable Europe Act that builds on prior experiences with European Interoperability Framework (EIF). Two governance bodies are envisaged: Interoperable Europe Board (IEB), composed of representatives from the EU Member States, and Interoperable Europe Community (IEC) which will enable the involvement of a broader set of stakeholders (including from the private sector). *While it is not clear when these will be operational, DE4A WG should get involved in the community build-up already.*

*In relation to this initiative, a new legal framework for multi-country projects, the European Digital Infrastructure Consortium, might be considered.* It is a new instrument to help Member States speed up and simplify the setup and implementation of multi-country projects and is described under the Digital Decade policy programme.

#### 5) Data-governance process of legal/“canonical” terms/models

It includes Processes, Rules, Norms, and Actions related to Access control, Policy (e.g. Event Subscription) and what forms of datasets etc. as described in earlier chapters and WP3 deliverables in relation to Evidence Exchange Components when comparing traditional and emerging patterns: challenges and technical/security anchors e.g. comparison between trust models (PKI and DLT) and the CAAR (Control Authority Access Repository).

Data-governance should also always be reviewed by Legal-WG. In a matter of fact, the D7.4 deliverable of DE4A (Report on legal sustainability) already made an initial analysis of a future legal framework for data space. The concept of Data Spaces was first elaborated in the Data Strategy for Europe, that also mentions Data Spaces for Public Administration. In terms of legal frameworks and governance, the Data Governance Act sets a few common governance principles, notably creating the European Data Innovation Board, as a kind of expert group consisting of a broad range of representatives. *DE4A should be involved in the work of this board*, especially for sector-specific frameworks and practices to share or jointly process data, as well as future set up and operation of EU Data Space for public administration.

In the meantime, DE4A WG will collaborate with the Data Spaces Support Centre<sup>2</sup> to explore the needs of public administration data space initiative, define common requirements and discuss best practices.

#### 6) Reuse and adoption

DE4A Outputs will mainly be used by those national OOPs that do not have one platform, but EU sponsorship might be needed for new adoptions and developments. The Interoperability regulation will publish a portal with services similar to the OOTS-HUB expect and this is likely to be a future third communication/interoperability channel for the GitHub content. There may be a need for a hierarchy recommendation to be made by the MS;

1. SDGR-CG (Legal and org/governance supported)

<sup>2</sup> <https://dssc.eu/>

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2. Interoperability portals (consider timing, JoinUp, OOTS-HUB and EIA-consolidation)
3. Playground support from Luxembourg, Portugal and Spain, until end of 2023)
4. GitHub (Free to reuse)

Member States and RegTech/GovTech vendors can reuse components from GitHub. Some components are free to use without notification, while others are not. Control and ownership are separated and transferred for future interoperability needs and solutions (eg. Portals / catalogues).

Two scenarios are envisaged:

- ▶ New interoperability regulations and specifications are published: in this case CG would propose a solution to EU-Interoperability-Board (EIB)
- ▶ Legal-WG produces procedures and License that enable others to adopt and reuse components

#### 7) Onboarding procedure to hypothetical association

Actions in this group would start with creation of a checklist for onboarding procedure, such as filling in onboarding template. It will also address customization and adaptation of systems and technical validation actions. This will be decided on SDG-CG level and a draft example is available from the onboarding of Germany to the DBA-pilot in a Getting Started<sup>3</sup>.

This section has been cut short as do not see the hypothetical association as a viable option in the end.

#### 8) Process for support, emergency and audit processes

This set of actions would publish rules and responsibilities for support. Example of a process that could be triggered by DE4A Legal-WG: In relation to Subscription and Notification pattern there is an issue in supporting exchanges without individual prior requests and previews. Interpretation of the current legislation, clarification on what constitutes an 'evidence', or what exceptions are 'provided under Union or national law'. This might lead to the need to technical adaptation or change in legislation (e.g. update of SDGR-IA). DE4A see SDG as a permanent (non-permanent in legal terms, so yet temporary) landing place for the DE4A Outcomes and outputs the handover to the EC needs to happen via the formal MS mechanisms. When DE4A state this it is in comparison to both EESSI (I and II) and creations like the eHealth network (art14-network) and EBSI.

## 4.2 Links to external bodies and initiatives

In DE4A had three pilots with services that were validating DE4A specifications and results. In general, not all cross-border services will need to connect to the OOTS and competent authorities should determine which procedures require the exchange of evidence across borders. This is a part of governance outside of the scope of DE4A, where competent authorities will need to connect to provide evidence, for some of the 21 procedures covered by the SDG Regulation in the scope of OOTS.

Once again, will describe experiences from DE4A about decision making and other processes, rules, norms, and actions related to governance of cross-border services and procedures with relevant stakeholders such as service providers and end users.

<sup>3</sup> [https://wiki.de4a.eu/index.php/Getting\\_started\\_guide](https://wiki.de4a.eu/index.php/Getting_started_guide)

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Figure 4: DE4A governance overlaps with Digital Service Infrastructure (DSI)

Operations are largely dispersed, with the lead policy DGs (in their role as DSI owners) as the main Actor and Owner. DE4A need to assess which activities may be concentrated with a common set of procedures, and which should merely follow guidance, for example in cases when DSI opts for Complete Autonomy.

DE4A-CG is in charge to communicate with MS about cross-border services, but it will involve subgroups (WG) as needed.

Your-Europe-portal serves as a front door to implemented functionalities requested by the SDGR, while OOTS HUB [15] is a catalogue of reusable services.

Once again, there are processes, rules, norms, and actions, such as those related to assistance and problem-solving services on how to carry out certain administrative procedures, that need to be synchronized with DE4A stakeholders whenever in case that DE4A results are reused.

There are also Operational Teams working for different administrations throughout the EU and offering other types of “Once-Only” components and supporting services, as well as technical design documents and operational specifications. DE4A results have clearly assigned owners and technical decisions or support is associated to these owners.

Open-source components are made available for OOP and SDG communities in DE4A GitHub [19]. Another option is to use catalogue of reusable services (OOTS Hub) already available for implementing the Once-Only Technical System. Further iterations for this catalogue are expected, as well as the optimal support for the national implementers and developers. Catalogue already contains eDelivery phase4 that was used in DE4A (besides others such as Harmony or X-Road), eIDAS components, Evidence Broker and Semantic Repository, Preview Space (where DE4A MOR component could fit), testbeds etc.

Synergies through relationship with other groups such as EBSI will be described in a DE4A coordination group mandate and if needed, new subgroups could be created to serve as a direct interface.

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## 5 DE4A Pilots – Extended functionalities post-pilots

DE4A Member States and pilot leaders were invited in a workshop to think freely on the needs for future functionality to make the services even more useful in the context of SDG life events. This chapter documents those needs together with issues reported in the pilot reports and makes a brief analysis considering the Capability Areas defined in “D6.2 Business Models for Sustainability” [18] and the time horizons taken as reference for the DE4A architecture definition.

The Capability Areas (CA) defined in D6.2 Business Models for Sustainability are:

1. Digital Base Registries and Documents (CA1)
2. Access to Transactions (APIs) (CA2)
3. Reporting & Analytics (CA3)
4. Compliance (CA4)
5. Security (CA5)
6. Governance (CA6)

The DE4A Architecture Framework [2] defined five distinct time horizons as reference for the architecture definition:

- ▶ T=0: The baseline or starting point before the implementation of the Single Digital Gateway (SDG) corresponding approximately to 2019.
- ▶ T=1: The situation at the launch of the SDG, in 2020, as information platform that provides access to information on public services across Europe, spanning from a European portal, containing European-level information on rights and obligations of European residents and companies operating in the European single market, to National Portals and Websites of single public service providers, containing information of on specific public services and links to eProcedure portals.
- ▶ T=2: The target time horizon for the fully operational SDG in 2023, including cross-border eProcedures and, most relevant for the scope of this deliverable, the first version of the Once Only Technical System (OOTS), that allows the direct, cross-border exchange of evidence between competent authorities in context of these eProcedures. The DE4A pilots focused on this and partly the next time horizon.
- ▶ T=3: The mid-term future time horizon where the OOTS is fully adopted and use of the infrastructure extended not only to cover additional procedures, but also to accommodate additional interoperability requirements of public administrations, one could say a “OOTS version 2”. We envision the creation of a true multi-pattern architecture that also incorporates fully user-centric interaction patterns supported by the emerging European Digital Identity (EUDI) Wallet at approximately 2-3 years after the first version of the OOTS. The high-level target architecture description in this document focuses on this time horizon.
- ▶ T=4: The long-term future time horizon, beyond a full system lifecycle from today where we would expect the emergence of a consistent European Digital Single Market Ecosystem that does cover both public and private sector services and blurs the boundaries of national systems. It is difficult to put a date on this time horizon, but we hope that it can be reached in the next decade, maybe earlier. This time horizon is the focus of another, forthcoming DE4A deliverable.

### 5.1 Studying Abroad

Life-long learning is a key enabler for a functioning Internal Market. The need for a balanced approach between meritocracy and the individuals needs and wants demand a level playing field. It is therefore important to ensure clear ownership of duties and responsibilities when it comes to educational evidences. The citizens and students need to be in charge of the sharing of their data.

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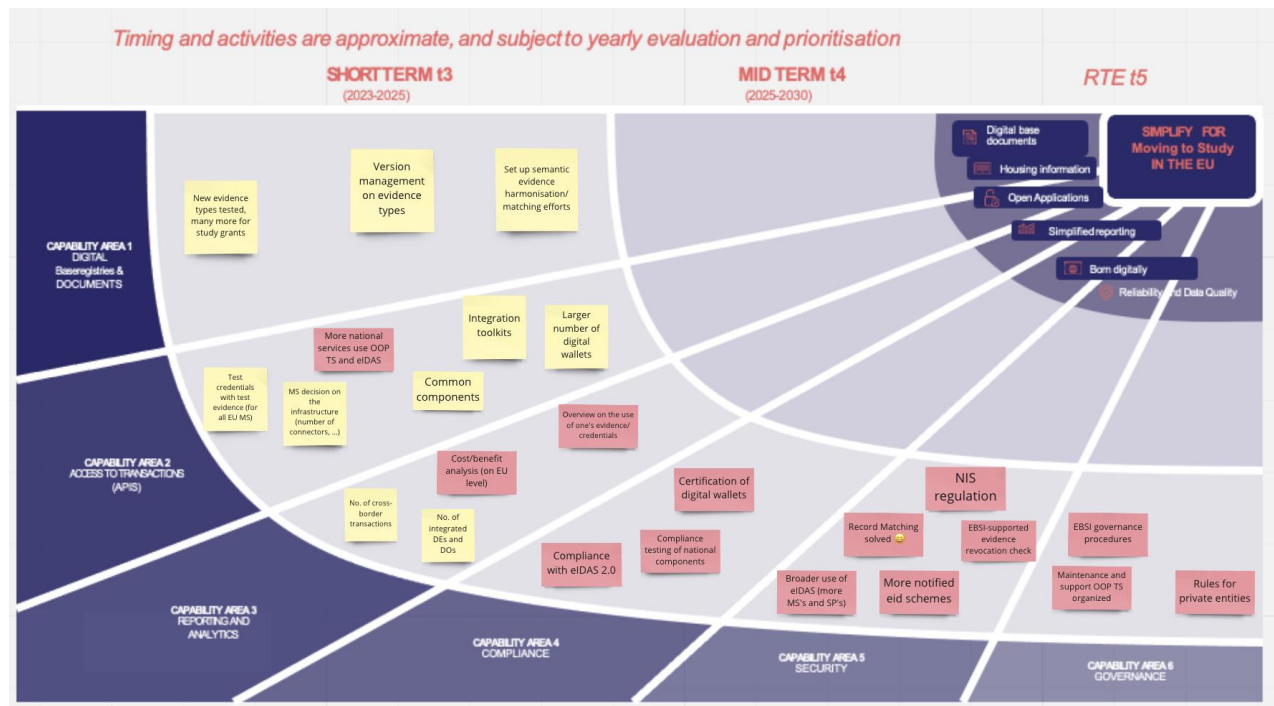


Figure 5: Studying Abroad Life Event Ecosystem

While many requirements have been met by the Studying Abroad (SA) pilot much more remains to further increase the functionality and impacts.

**Functionalities for CA1**

- ▶ in t3: New evidence types tested, and many more for study grants. Version management on evidence types. Set up semantic evidence harmonisation/matching efforts.

**Functionality for CA2**

- ▶ in t3: Test credentials with test evidence (for all EU MS). MS decision on the infrastructure (number of connectors, etc.). More national services use OOP Technical System and eIDAS. Common components. Integration toolkits. Larger number of digital wallets.

**Functionality for CA3**

- ▶ in t3: No. of cross-border transactions. No. of integrated Data Evaluators and Data Owners. Cost/benefit analysis (on EU level). Overview on the use of one's evidence/ credentials.

**Functionality for CA4**

- ▶ in t3: Compliance with eIDAS 2.0. Compliance testing of national components. Certification of digital wallets.

**Functionality for CA5**

- ▶ in t3: Broader use of eIDAS (more Member States and Service Providers). More notified eID schemes. Record Matching solved. NIS regulation. EBSI-supported evidence revocation check.

**Functionality for CA6**

- ▶ in t3: EBSI governance procedures. Maintenance and support OOP TS organized. Rules for private entities.

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## 5.2 Doing Business Abroad

Correct and up-to-date information is a key enabler for the Real-time Economy, an area that is governed very strictly by the law and in regulations (e.g. down to the timing of information release) as well as in policies from enterprises themselves. All of this can and is being put into systems that are getting more and more automated and also affected by Artificial Intelligence.

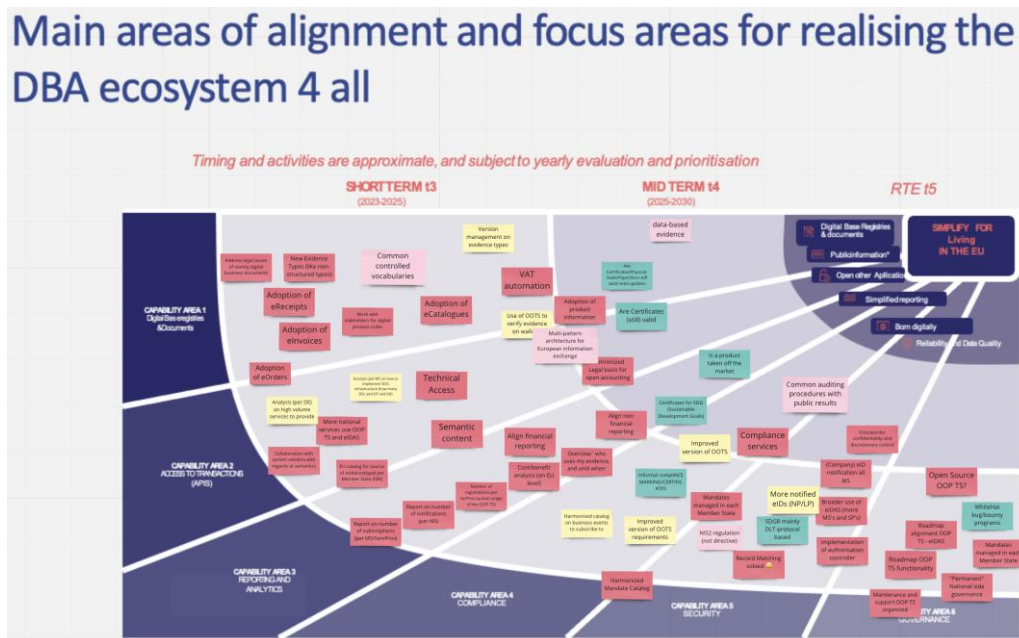


Figure 6: DBA Life Events Ecosystem

While many requirements have been met by the Doing Business Abroad (DBA), much more remains to further increase the functionality and impacts as visualized in the Figure above. They are transcribed below based on Compliance Area (CA) and timing. In conclusion one can say that the DE4A services and attributes for DBA should be reused/connected in many other services.

### Functionalities for CA1

- ▶ **in t3:** Address legal issues of storing digital business documents. New Evidence Types (like non-structured types). Adoption of eInvoices. Adoption of eOrders. Work with stakeholders for digital product codes. Common controlled vocabularies. Adoption of eCatalogues. Version management on evidence types. VAT-automation. Use of OOTS to verify evidence in wallets
- ▶ **in t4:** Adoption of product information. Are Certificates/Physical-Seals/PaperDocs still valid or need updates. Data-based evidence.

### Functionalities for CA2

- ▶ **in t3:** Analysis (per DE) on high volume services to provide. Collaboration with system vendors with regards to semantics. More national services use OOP TS and eIDAS. Decision per MS on how to implement SDG infrastructure (how many Data EU Evaluators and Data Transferors and Data Requestors). EU catalogue for source of evidence(type) per Member State (IDK). Semantic content. Technical Access. Multi-pattern architecture for European information exchange.
- ▶ **in t4:** Harmonized Legal basis for open accounting. Are Certificates (still) valid.

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### Functionalities for CA3

- ▶ **in t3:** Report on number of subscriptions (per MS/Service Provider (SP)). Report on number of notifications (per MS). Number of registrations per SP (actual usage of the OOP TS). Align financial reporting. Cost/benefit analysis (on EU level). Overview ' who uses my evidence, and until when'. Align non-financial reporting.
- ▶ **in t4:** Certificates for SDG (Sustainable Development Goals). Handle Multiple Board-members. Is a product taken off the market

### Functionalities for CA4

- ▶ **in t3:** Harmonised catalogue on business events to subscribe to. Improved version of OOTS requirements. Informal compliance marking/certificates. Improved version of OOTS..
- ▶ **in t4:** Compliance services. Common auditing procedures with public results.

### Functionalities for CA5

- ▶ **in t3:** Mandates managed in each Member States. Harmonized Mandate Catalogue. NIS2 regulation (not directive). Record Matching solved. SDGR mainly DLT-protocol based. implementation of authorisation controller. Broader use of eIDAS (more MS's and SP's). More notified eIDs. (Company) eID notification all MS.
- ▶ **in t4:** Crossborder confidentiality and discretionary control.

### Functionalities for CA6

- ▶ **in t3:** Maintenance and support OOP TS organized. "Permanent" National side governance. Roadmap OOP TS functionality. Mandates managed in each Member State. Roadmap alignment OOP TS – eIDAS. Whitehat bug/bounty programs. Open-Source OOP TS.

## 5.3 Moving Abroad

Easing the trouble of moving to a new MS is a daunting task. DE4A has touched some administrative procedures for this life event. However, much more remains to further increase the functionality and impacts of the Moving Abroad pilot.

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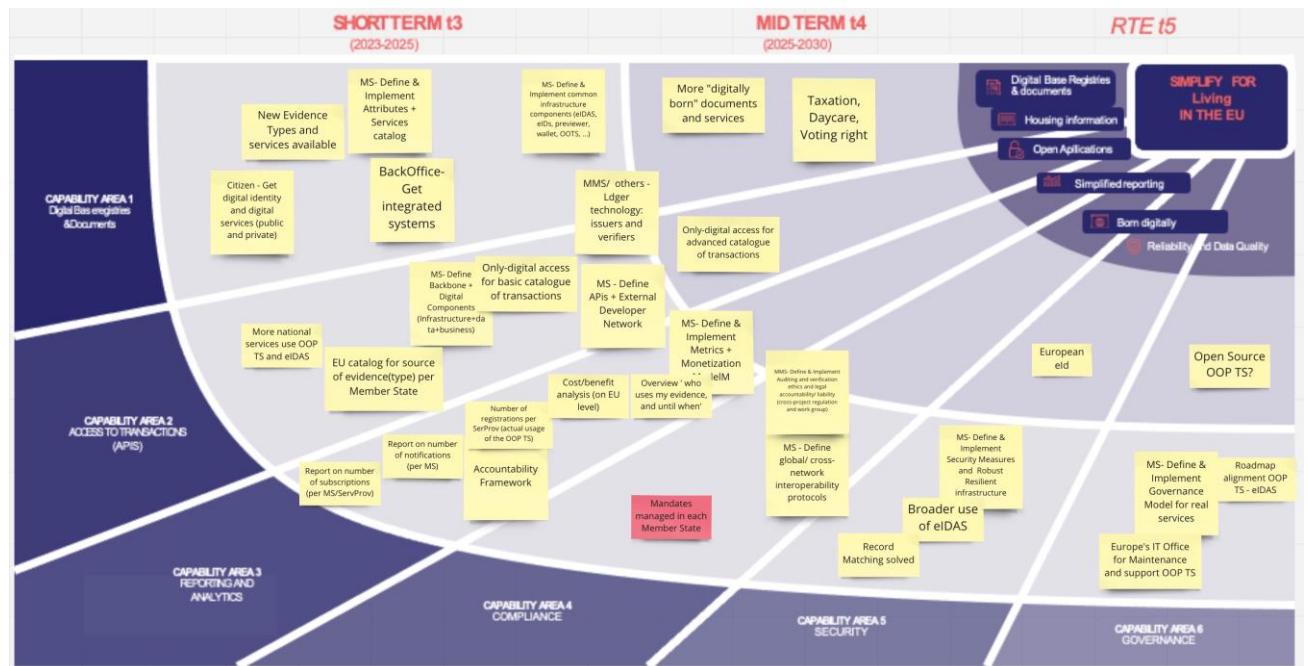


Figure 7: DBA LE Ecosystem Roadmap

**Functionalities for CA1**

- ▶ **in t3:** Citizen - Get digital identity and digital services (public and private). BackOffice- Get integrated systems. MS- Define & Implement Attributes + Services catalogue. MS- Define & Implement common infrastructure components (eIDAS, eIDs, previewer, wallet, OOTS). New Evidence Types and services available.
- ▶ **in t4:** Finding Day-care for your kids. Taxation. Voting rights. More "digitally born" documents and services.

**Functionalities for CA2**

- ▶ **in t3:** MS- Define Backbone + Digital Components (Infrastructure+data+business). MS/others - Ledger technology: issuers and verifiers. MS - Define API:s + External Developer Network. More national services use OOP TS and eIDAS. EU catalogue for source of evidence(type) per Member State. Only-digital access for basic catalogue of transactions.
- ▶ **in t4:** Only-digital access for advanced catalogue of transactions.

**Functionalities for CA3**

- ▶ **in t3:** Accountability Framework. MS- Define & Implement Metrics + Monetization Model. Report on number of subscriptions (per MS/SP). Report on number of notifications (per MS). Number of registrations per SP (actual usage of the OOP TS). Cost/benefit analysis (on EU level). Overview 'who uses my evidence, and until when'.

**Functionalities for CA4**

- ▶ **in t3:** MMS- Define & Implement Auditing and verification ethics and legal accountability/ liability (cross-project regulation and WG). Mandates managed in each Member State.

**Functionalities for CA5**

- ▶ **in t3:** MS - Define global/ cross-network interoperability protocols. MS- Define & Implement Security Measures and Robust Resilient infrastructure. Record Matching solved. Broader use of eIDAS.
- ▶ **in t4:** European eID.

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**Functionalities for CA6**

- ▶ **in t3:** MS- Define & Implement Governance Model for real services. Europe's IT Office for Maintenance and support OOP TS. Roadmap alignment OOP TS – eIDAS. Open-Source OOP TS.

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## 6 Success stories

DE4A has made significant legal, technical and semantic achievements in the once-only area through advanced technical functionality (like exchange of multiple evidences at once, streamlined user experience in USI with multilingual support and simplified steps in VC pattern) piloted with real users in real-life conditions. Also, and more importantly, with the consolidation of lessons learnt and advice provided for the most significant types of challenges to achieve cross-border interoperability that Member States will need to face in similar projects like the SDG OOTS implementation

In this sense, the value of the project for stakeholders have been confirmed through multiple “success stories” that are described in this section and are also available in the pilots deliverables (D4.4 [35], D4.8 [36] and D4.12 [37]).

### 6.1 DE4A as a key step for a successful implementation of SDGR Article 14

DE4A is mainly a true success story because it was and is an essential preparation and pilot implementation of many core elements and solutions that Member States must put in place anyway until December 2023 for the SDG OOTS defined in Article 14 of the SDGR.

DE4A made it possible to have a better and deep understanding of the requirements and the technical options also needed in the context of the SDG OOTS. The piloting and the many discussions and preparatory work done in this context allowed us and the other participants to gain hugely in maturity and in understanding of the issues involved.

This allowed Member States participating in DE4A to provide essential and valuable input also in the context of the SDG OOTS discussions and meetings that took place at EU Level: SDG coordination group, SDG Committee and dozens and dozens more technical and specialised meetings.

The main input of DE4A to the SDG OOTS is probably in this context that SDG OOTS finally also uses, after many and sometimes controversial discussions on the topic, essentially the USI pattern, the most appropriate pattern in our opinion to fit the requirements and needs defined in Article 14 of the SDGR. It is the most appropriate because it allows, to the highest extent, for the reuse as is of the national solutions used for authentication (e.g. eIDAS nodes) and the other national solutions (e.g. preview space), achieves hence the highest level of interoperability and efficiency and makes identity matching as easy as possible.

Finally DE4A also made it possible, on a more national level, to put in place many national solutions and building blocks that Member States will be able to reuse in the context of SDG OOTS.

### 6.2 Completing DE4A OOTS integration in a short period of time

#### Record speed implementation

The German state of Nord Rhine Westphalia managed to implement the entire DE4A OOTS and eIDAS infrastructure needed for piloting in the doing business abroad pilot, and the integration to the portal (Wirtschaftsportal) of both solutions within an extremely short timeframe. The total duration was less than six months. Worth mentioning is that the implementation was even done partly during the summer holiday period, which is known as a period where resource availability is low. The German project was very well organized and benefited from the available documentation and experience with the DE4A infrastructural components. Having hands-on experience, Germany can now proceed with implementation across the Member State.

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### 6.3 Deregistration process– Proactive government

DE4A Moving Abroad pilot provides a strong basis for what has to be done in SDG anyway and made it possible to design an optimal online procedure for cross-border change of main residence, achieving a maximum level of user centricity by including the deregistration of the user in the country he lives directly in the registration process in the new country and making it hence, unnecessary for the user to start a second, specific online procedure just to deregister. This is true Once Only implemented in the best interest of the user.

Currently, the change of domicile address may imply going to consulates/embassies in the scenario where the respective electronic authentication mechanisms are not configured in the entities responsible for this data processing. For instance, in the case of Portugal, a citizen needs to access the portal <https://eportugal.gov.pt/en-GB/servicos/alterar-a-morada-do-cartao-de-cidadao> and makes the change request. Subsequently, the citizen will receive a letter at the new address to confirm the change of address associated with their Citizen Card on the portal <https://eportugal.gov.pt/en-GB/servicos/confirmar-a-alteracao-de-morada-do-cartao-de-cidadao>.

With the development of the deregistration use case in the DE4A project, the citizen only needs to access the Portal register the new address and request/approve its change in the Country of Origin. In this way, the Country of Destination will send an address change request to the Country of Origin, without the need for citizen intervention.

As a final step in the process, the citizen will only have to confirm the change of address with the code received at the new address in the Country of Destination on the portal <https://eportugal.gov.pt/en-GB/servicos/confirmar-a-alteracao-de-morada-do-cartao-de-cidadao>.

Advantages for the citizen:

- ▶ Simpler: a single change of address on the Country Portal where the citizen is and/or will reside, through authentication via the eIDAS node.
- ▶ More secure: Includes two security mechanisms - a password and a temporary code generated by the authentication.gov app (higher security level).
- ▶ More convenient: avoids going to face-to-face services and waiting times.

In the context of the SDG/OOTS project, the presented use case piloted between Luxembourg and Portugal can be useful to leverage the legal changes to allow an easy cross-border address change, being recognized by both the Origin Country and the Destination Country. The technological components developed within the scope of this use case can be reused in the context of the SDG, at least on the Portuguese side, considering that the Portuguese ePortals will not have changes/adaptations for the SDG.

### 6.4 Helping companies to make cross-border businesses easier

DE4A helps companies to reduce the administrative burden of starting and doing business in another EU Member States. Examples of this can be seen in the following success stories:

*“That’s it?”*

A Romanian entrepreneur selling trainings to companies in other Member States is very familiar with traditional procedures for registering business activities and other procedures with foreign public authorities. During the pilot, the entrepreneur completed the online procedure within minutes (including authentication, checking the mandates and filling in the forms). The entrepreneur could not believe the simplicity and short duration of the entire procedure and expressed his hope that this solution would soon be available across Europe.

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### ***“Best compliment SDG could ever have”***

A Dutch entrepreneur registering a new business activity in Germany was surprised after having completed the online procedure. “What can you possibly learn in this pilot, from something so simple and quick?” she wondered. This is perhaps the best confirmation a DE4A use case and the SDGR could ever have, as it proves clearly that the ambition to ‘lower barriers’ had been achieved. The simplicity, immediateness and short duration are perfect examples of ‘lowering barriers’ to be established by the Single Digital Gateway regulation, enabling a free market across Europe.

### ***“High quality of services”***

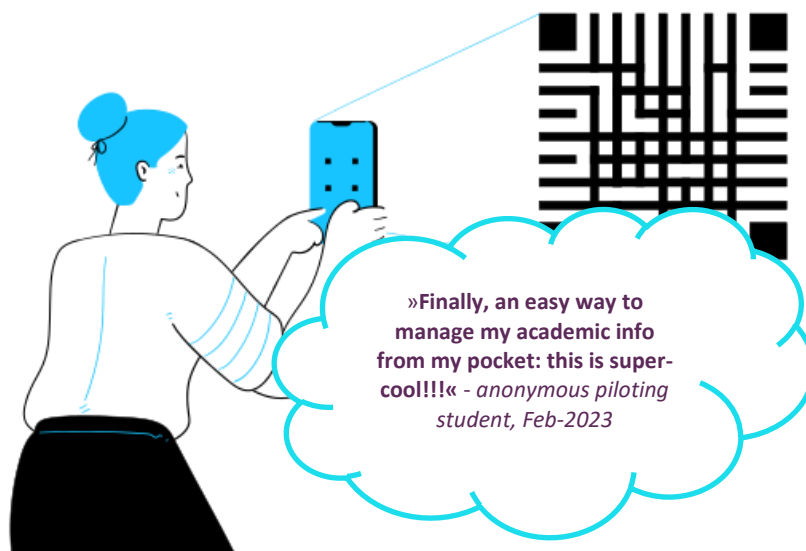
The possibility to stay informed about relevant events happening to a company that receives a service of public authorities involved in the pilot, is considered valuable. Public authorities are able to timely evaluate their service delivery and can adjust when needed, in order to keep a high standard of service. For some public authorities, the piloted Subscription and Notification mechanism is more advanced than existing similar mechanisms on a national level and the concepts used for piloting provide inspiration for examining upgrades to existing national systems. Public authorities see the piloted mechanism as a step towards providing fully online services that make it more attractive for foreign companies to do business in their country.

## **6.5 Benefits for students using verifiable credentials and wallets**

*“With a user-centric evidence exchange students are in control on how they exchange data, while saving time and becoming more (digitally) organized”*

From the perspective of the students, the piloted DE4A approach with the Verifiable Credential pattern, brings multiple advantages to them. This pattern was piloted only in one use case in the study abroad pilot, i.e., diploma recognition, which is however connected to the application for studies use case.

To understand the benefits for the students, it should be noted that the new digitalized process for the students involves the usage of their smartphones for gathering and presenting their diploma evidence in a digital form.



The digitalized process brings the following benefits to the students, which were verified by piloting students from 3 different EU countries and their respective institutions, i.e., University of Maribor, University Jaume I and IST Lisbon (INESC-ID):

Once the student acquires their diploma on the smartphone, they will have this digitized form of their diploma 24/7 and for as long as they wish. They can use it for the diploma recognition

process but also for any other official process later on, where the diploma would be needed, as well as for their own unofficial activities (e.g., showcasing to family and friends).

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The students can be assured of the trustworthiness and integrity of the evidence collected, as they can see and verify that documents are digitally signed and related to correct issuing authorities and will therefore be accepted as authentic by providers of different electronic services.

By using this approach, the student can also be more organized, while collecting their various possible evidence in a digital format and using them later on when needed. By using this approach, the student also saves a lot of time, since the moment the student has acquired the evidence (e.g., diploma) once, they do not have to repeat the acquisition process again when having to use other official processes.

Due to the usage of the smartphone, the student has the confidence and recognizes that they have the full control of their data (i.e., diploma), since it is they who present the evidence (i.e., personal data) directly to the evaluators and not exchanged mysteriously by evaluators and processors (e.g., ministries). This is even more an issue when the data is being exchanged cross-border.

Since the technology being used in the VC pattern (i.e., SSI, VC, DID, ZKP) enables also selective disclosure it gives the student even more options and confidence to share their, once acquired personal data, not only to anyone they care to but also in the scope, they are willing to do so. Since students are always early-adopters of technology, they are already naturally connected to smartphones, thus for them using our VC pattern's mobile-first approach is naturally more user-friendly and gives them satisfaction and confidence to use the digitalized processes.

## 6.6 DE4A and eIDAS, providing students with high-level of trust

When evaluating master's degree enrolment applications, the officials from the University Jaume I have to undergo a lengthy process of manual evidence validation, which includes the validation of the diploma that proves that the applicant has passed the undergraduate programme that is a requirement to access this master's degree programme.

An uploaded PDF copy of the diploma and grades certificate (with the average grade) is visually validated first, then compared to the data input by the user on the application (the input data is tabulated and used to rank the applications, so it must match the real diploma data), and finally, the university of origin has to be contacted (by phone or email) to validate that the diploma is not counterfeited. Also, personal data of the student is open to input errors or impersonation attempts: user creates a temporary account, with self-stated personal data, and an uploaded copy of the ID document (passport, national ID card) which later requires an in-person validation by the officials, who will compare the physical document with the uploaded one.

DE4A allows time to be saved both to the student (less input, less errors, no need to scan and upload diploma and grades in PDF) and to the university officials (no email/phone checks), as it provides a high degree of trust on the received data, which is also tabulated and can be used for the ranking out of the box. Also, eIDAS provides a high trust on the personal data of the student, and it enables the creation of a full account, instead of a temporary one.

## 6.7 DE4A Multilingual Ontology Repository (MOR), helping to address the semantic interoperability challenge

Implementing the Once-Only Principle (OOP) for public services at European level faces a great challenge: semantic interoperability. In DE4A, cross-border semantic interoperability has been addressed primarily by the DE4A semantic framework for the semantically interoperable, cross-border, once-only principle implementation that capitalizes on available semantic standards.

One of the components that is part of this framework is the DE4A Multilingual Ontology Repository that offers a complete set of resources for understanding canonical evidence types and for providing a dialogue with users for the explicit request and preview of evidences.

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A light multilingual ontology repository has been created with the terms of the Domicile Registration canonical evidence type, the terms used but this evidence type from common vocabularies, and the terms used by the user dialogue interfaces. Labels and descriptions of each term were defined in English, automatically translated into Romanian, Spanish, French and Portuguese, and then revised by domain experts speaking these languages. In the Use Case "Request Address Change" of the moving abroad pilot, the MOR client-side component for the explicit request dialogue has been used by Romania and the MOR web semantic functionality has been used by the Spanish preview page. The implementation of the explicit request functionality in the Romanian eProcedure portal required only the adaptation of the CSS classes of the MOR client-side component to the graphical style of the portal and the implementation of Javascript variables as interfaces with the MOR component, thus simplifying and accelerating the implementation of the explicit request functionality, including its dialogues with users and with the central components of the system. The integration of the multilingual functionality in the Spanish preview page required only the inclusion of the MOR language selector and the corresponding Javascript module, as well as the use of the MOR custom attribute in HTML elements that contains labels to be provided in different languages, making it easy to incorporate the multilingual functionality into an existing page.

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## 7 Conclusions

DE4A has substantially advanced the possibilities for the implementation of the Once Only Principle in Europe. In parallel to the project, the Implementing Act of the SDG Regulation has been developed and put into force. On one hand, this approach enabled the project to provide its learnings and recommendations into the law-making process. On the other hand, the uncertainty led to a change of focus in the sustainability work during the project duration.

DE4A developed a multi-pattern architecture for eGovernment interoperability with a focus on digital-by-default procedures for citizens and businesses and the full implementation of the Once-Only Principle. With the approach the project has been able to show that for the upcoming period of time (t4) there is need for a multipattern approach. The connector, SSI framework and semantic components can be taken for the current and future implementation of the SDGR OOTS as they provide additional functionalities to the SDG requirements. In addition, some of the DE4A outputs can be useful for the implementation of OOP through the EU Identity Wallet provided by the upcoming revision of the eIDAS Regulation, for the implementation of OOP at national level or at international level beyond the European Union, and for the implementation of the exchange of information in any domain, not only in the public sector.

Overall, it can be concluded that the DE4A project has reached its goal to ensure the future existence of the key functionalities of the developed solution.

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