D4.3 Studying Abroad – Initial running phase

Document Identification			
Status	Final	**Due Date**	28/02/2022
Version	1.2	**Submission Date**	20/09/2022

Related WP	WP4	**Document Reference**	D4.3
Related Deliverable(s)	D4.1, D4.2	**Dissemination Level (*)**	PU
Lead Participant	JSI	**Lead Author**	Tomaž Klobučar (JSI)
Contributors	Francisco Aragó (UJI), Javier Baena (SGAD), Miguel Correia (INESC-ID), Alberto Crespo (Atos), Janja Možina-Brecelj (MIZŠ), Javier Presa (Atos), Martina Šestak (UM), Muhamed Turkanović (UM)	**Reviewers**	Alberto Crespo (Atos) Thashmee Karunaratne (SU) Ioannis Konstantinidis (IHU)

Keywords:
Studying abroad, enrolment to higher education, study grant, diploma recognition, goal, criteria, metrics, data evaluator, data owner, integration, testing, connectathon, user engagement, User-supported intermediation pattern, Verifiable credentials pattern

Document Information

List of Contributors	
Name	Partner
Alberto Crespo	Atos
Francisco José Aragó	UJI
Janja Možina-Brecelj	MIZŠ
Javier Baena	MPTFP-SGAD
Javier Presa	Atos
Martina Šestak	UM
Miguel Correia	INESC-ID
Muhamed Turkanović	UM
Tomaž Klobučar	JSI

Document History			
Version	Date	Change editors	Changes
0.1	27/10/2021	Javier Presa	Table of contents
0.2	13/01/2022	Tomaž Klobučar	Initial draft
0.4	15/02/2022	Francisco Aragó, Javier Baena, Miguel Correia, Tomaž Klobučar, Martina Šestak, Muhamed Turkanović	Sections 2 and 4, Annex I
0.5	23/02/2022	Francisco Aragó, Javier Baena, Janja Možina-Brecelj, Tomaž Klobučar, Martina Šestak, Muhamed Turkanović	Section 3
0.6	25/02/2022	Tomaž Klobučar	Version for internal review
0.7-8	02/03/2022	Tomaž Klobučar	Version with addressed reviewers' comments
0.9	02/03/2022	Julia Wells (Atos)	Quality review for submission
1.0	03/03/2022	Ana Piñuela (Atos)	Final for submission
1.1	19/07/2022	Tomaž Klobučar	Updates after completed pilot run on the number of users, KPIs, use, value, learning, and the type of data. Added sections 3.2.1, 3.2.2, 3.3, 4.2, 4.3, 4.4, 4.5; update of Executive Summary, 3.2.3 (Learning), and conclusions
1.17	12/09/2022	Tomaž Klobučar	Version with addressed comments from the second periodic review
1.18	16/09/2022	Julia Wells (Atos)	Quality review for submission
1.2	20/09/2022	Ana Piñuela (Atos)	Final for submission

Quality Control		
Role	Who (Partner short name)	Approval Date
Deliverable leader	Tomaž Klobučar (JSI)	12/09/2022
Quality manager	Julia Wells (ATOS)	16/09/2022
Project Coordinator	Ana Piñuela Marcos (ATOS)	20/09/2022

Table of Contents

Table of Contents 4
List of Tables 6
List of Figures 7
List of Acronyms 8
Executive Summary 10
1 Introduction 12
1.1 Purpose of the document 12
1.2 Structure of the document 12
2 Pilot Status at the end of the first iteration 14
2.1 Catalogue of services and status 14
2.1.1 Data evaluators 14
2.1.2 Data owners 20
2.2 Strategy followed to mitigate infrastructure delays 25
2.3 Achieved cross-border interoperability status 26
2.3.1 Application to higher education (UC#1) 27
2.3.2 Application for a study grant (UC#2) 28
2.3.3 Diploma recognition (UC#3) 28
2.4 Updates in metrics 29
3 Pilot success criteria related to pilot dimensions 30
3.1 Goals and pilot success criteria 30
3.2 Pilot dimensions 33
3.2.1 Use 33
3.2.2 Value 38
3.2.3 Learning towards Adoption 41
3.2.4 Overview of the success criteria results 49
3.3 Technical common criteria 54
4 Pilot Procedures 57
4.1 Cross-border pilot testing approach 57
4.2 End users' engagement progress and dissemination/impact activities 58
4.2.1 Portugal 59
4.2.2 Slovenia 59
4.2.3 Spain 59
4.3 Pilot governance and internal progress reporting 60
4.4 Knowledge exchange among pilot partners 60
4.5 Stabilisation of pilot experience and user support 61
4.6 Planned improvement following received feedback 61
4.6.1 Canonical scheme of the diploma evidence 61
4.6.2 VC pattern and mobile application 61

4.6.3 Feedback collection 61
4.6.4 Updates to the final iteration plan 61
5 Conclusions and major achievements of the first iteration 64
References 66
Annexes 67
Annex I – Additional questionnaire on specifications, software and procedures 67

List of Tables

Table 1: Data evaluators (DE) in the Studying Abroad pilot *14*
Table 2: Data owners (DO) in the Studying Abroad pilot *21*
Table 3: Cross-border interoperability status in Use case 1 ..... *27*
Table 4: Cross-border interoperability status in Use case 2 ..... *28*
Table 5: Cross-border interoperability status in Use case 3 ..... *29*
Table 6: Studying Abroad pilot goals *30*
Table 7: Criteria for Data Evaluators *31*
Table 8: Criteria for Data Owners *31*
Table 9: Criteria for students *31*
Table 10: Criteria for evaluation of common components *32*
Table 11: Students and tested services *34*
Table 12: Satisfaction with completed procedures *34*
Table 13: Duration of services *36*
Table 14: Usefulness of components *37*
Table 15: Support and testing *38*
Table 16: Quality of student data *38*
Table 17: Processing of student data *39*
Table 18: Estimated benefits to DE / Verifier *39*
Table 19: Evidence request processing effort *40*
Table 20: Estimated benefits to DO / Issuer *40*
Table 21: Estimated benefits to MS *41*
Table 22: Analysis and design *42*
Table 23: Customization, integration, and testing *44*
Table 24: Estimation of effort for the USI pattern *46*
Table 25: Estimation of effort for the VC pattern *47*
Table 26: Lessons learned for other WPs *47*
Table 27: Criterion A1 ..... *49*
Table 28: Criterion A2 ..... *49*
Table 29: Criterion D2 ..... *50*
Table 30: Criterion E2 ..... *50*
Table 31: Criterion B1 ..... *51*
Table 32: Criterion D1 ..... *51*
Table 33: Criterion E1 ..... *51*
Table 34: Criterion C1 ..... *52*
Table 35: Criterion D3 ..... *53*
Table 36: Criterion F1 ..... *53*
Table 37: Criterion F2 ..... *53*
Table 38: Criterion F3 ..... *54*
Table 39: Criterion F4 ..... *54*
Table 40: Reflection per technical common criteria *54*
Table 41: Connectathons *57*
Table 42: Eligible users for piloting in the first iteration *58*
Table 43: Questionnaire on specifications, software and procedures (2 sections) *67*

List of Figures

Figure 1: Pre-enrolment service at UJI 15
Figure 2: Explicit request at UJI 16
Figure 3: Prototype application portal at University of Lisbon 17
Figure 4: Acknowledged submission of diploma in the form of a verifiable presentation at University of Lisbon in UC#3 17
Figure 5: Preproduction portal at SI-MIZŠ 18
Figure 6: Explicit request at SI-MIZŠ 18
Figure 7: Grant application service at JSI 19
Figure 8: Explicit request at JSI 20
Figure 9: Data intermediation platform at SGAD 22
Figure 10: Preview at Spanish DO 22
Figure 11: ES VC Issuer 23
Figure 12: Preview at Portuguese DO 23
Figure 13: Preview at Slovenian DO 24
Figure 14: Overall status of combinations 27
Figure 15: Average satisfaction per aspect and use case 35
Figure 16: Share of satisfied students per aspect 35

List of Acronyms

Abbreviation / acronym	Description
AMA	Administrative Modernization Agency
API	Application Programming Interface
AS4	Applicability Statement 4
CEF	Connecting Europe Facility
DC	Data Consumer
DE	Data Evaluator
DE4A	Digital Europe for All
DID	Decentralized Identifier
DO	Data Owner
DP	Data Provider
DPO	Data Protection Officer
DR	Data Requestor
DT	Data Transferor
Dx.y	Deliverable number y, belonging to WP number x
EBSI	European Blockchain Services Infrastructure
EC	European Commission
eID	Electronic Identity
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
EU	European Union
eVŠ	Central evidence system for higher education in Slovenia
FERI	Faculty of Electrical Engineering and Computer Science
GDPR	General Data Protection Regulation
ID	Identity
INESC-ID	Instituto de Engenharia de Sistemas e Computadores: Investigação e Desenvolvimento em Lisboa
IST	Instituto Superior Técnico
IT	Information Technology
JSI	Jozef Stefan Institute
MIZŠ	Ministry of Education, Science and Sport of the Republic of Slovenia
MS	Member State
NREN	National Research and Education Network
OCSP	Online Certificate Status Protocol
OOP	Once-Only Principle
OOP TS	Once-Only Technical System for evidence exchange in the DE4A project
PKI	Public-Key Infrastructure
PST	Pilot Supervisory Team

Abbreviation / acronym	Description
SA	Studying Abroad
SDGR	Single Digital Gateway Regulation
SGAD	Secretaría General de Administración Digital
SMP	Service Metadata Publisher
SSI	Self-Sovereign Identity
STEM	Science, Technology, Engineering, Mathematics
TIR	Trusted Issuer Registry
UC	Use Case
UJI	Universitat Jaume I
UM	University of Maribor
USI	User-Supported Intermediation
VC	Verifiable Credential
VP	Verifiable Presentation
WG	Working Group
WP	Work Package
WP2	DE4A Architecture vision and framework WP
WP3	DE4A Semantic interoperability solutions WP
WP4	DE4A Cross-border Pilots for Citizens and Business and Evaluation WP
WP5	DE4A Common component design & development WP
WP6	DE4A Sustainability impact and new governance models WP
WP8	DE4A Stakeholder dialogue, dissemination and communication WP

Executive Summary

The Studying Abroad (SA) pilot of the "Digital Europe for All" (DE4A) project focuses on Higher Education students with virtual or physical mobility needs in the European Higher Education Area. By piloting three use cases (UC#1 - Application to public higher education, UC#2 - Applying for study grant, and UC#3 - Diploma recognition) it aims to prove the optimal processes/procedures (c.f. Annex II of SDGR[5]) for students from the three participating Member States (Portugal, Slovenia, and Spain) for registration to higher education and eventually applying for a student grant as well as for studies recognition. The pilot comprises two iterations, the first from February 2022 to July 2022, and the final (second) running from September 2022 to the end of the project.

This document reports the progress achieved in the studying abroad pilot at the end of the first iteration (mid-July). Following an internal development plan described in D4.2[2], pilot-specific Data Consumers and Data Providers have adapted their procedure and evidence portals and data services (Data Evaluators, Data Owners) and implemented the activities required to connect their infrastructures (eIDAS pre-production nodes, national OOP Technical System) to the respective common building blocks and components for interoperability across borders (Data Requestors - DRs, Data Transferors - DTs). In coordination with "WP3 Semantic Interoperability Solutions" and "WP5 Common Development Design & Development", common building blocks and components have been integrated and tested prior to the launch of respective combinations.

During this period, the procedure and evidence portals and data services have been set up in parallel with the deployment of national infrastructures necessary for providing cross-border interoperability between Data Consumers and Data Providers. The number of services ready for piloting has progressively increased since October 2021. In spite of delays caused by COVID-19, unexpected events such as log4J vulnerability, and the difficulties in moving the solutions into the preproduction and piloting environments the Studying Abroad pilot has reached six launched Member States combinations in UC#1 and UC#2 and two in UC#3. Three other combinations (one in UC#1 and two in UC#3) have been enabled for limited piloting with real users, while one combination was postponed to the second iteration.

The main characteristics of the initial running phase of the SA pilot are summarised below:

- Two interaction patterns (User-supported intermediation - USI, Verifiable credentials - VC) and one evidence type were piloted with a limited number of users;
- Six data evaluators/verifiers and five data owners/issuers have been successfully customized and integrated with the eIDAS infrastructure and the DE4A OOTS or EBSI infrastructure (see Section 2.1);
- Interoperability between all three MS (Portugal, Slovenia, Spain) has been achieved (see Section 2.3). Cross-border interoperability at use case functional level has been tested and validated during a series of testing meetings called Connectathons;
- Various strategies to mitigate infrastructure delays have been defined and applied;
- Feedback on the usefulness of the common components and specifications was collected from pilot partners and other organisations involved in the customization, implementation, deployment, and testing of Data Evaluators - DEs, Data Owners DOs, or infrastructure (see Section 3.2). Based on this feedback, lessons learned and suggestions for adoption were gathered in different steps. For the analysis and design phase, the pilot recommends re-evaluation of the scope of the SDG regulation to some higher education use cases, harmonization of the evidence data models defined separately by SDG WG and Europass, and a temporary solution for the use of non-notified eIDs in SDG procedures. The lessons learned in the customisation, integration, and testing phase mainly relate to the usefulness of the DE4A connector, the documentation, and the collaboration between the developers;
- Feedback on the satisfaction with the piloted services was obtained from a student focus group. A total of 52 students provided feedback on ten aspects of the procedures via an online questionnaire

(see Section 3.2). The most valued aspects of the piloted procedures (on the scale from 1 to 5) were control in managing own credentials (4.21), security and privacy protection (4.13), and duration of the procedure (4.00), while the least appreciated was the number of errors and interruptions (3.25). Majority of the students also appreciated clarity of the Explicit Request and Preview common functionalities. Feedback was used to generate results for corresponding pilot metrics in the first iteration and will be used to improve online procedures in the second iteration.

- The implementation plan for the final iteration of the pilot has been revised.

In addition to the Studying Abroad pilot, the pilot results will also be used by other DE4A activities, in particular "WP2 Architecture vision and framework" (validation of the project start architecture, the User-supported Intermediation pattern and the Verifiable Credentials pattern), "WP3 Semantic interoperability solutions" (validation of canonical data models for higher education), WP5 - Common component design & development (validation of the common components such as DE4A Connector and SSI Authority Agent, and the underlying evidence exchange infrastructure - DE4A OOP Technical System - and the integration achieved with EBSI infrastructure), "WP6 Sustainability impact and new governance models" (business models and new models for shared delivery of common services), "WP7 Legal and ethical compliance and consensus building" (legal outcomes of the first iteration), and "WP8 Stakeholder dialogue, dissemination and communication" (dissemination and communication activities).

1 Introduction

The Studying Abroad (SA) pilot of the "Digital Europe for All" (DE4A) project aims at demonstrating in practice the benefits for different European Higher Education Area stakeholders of realizing across borders the principles of "Once Only" and "Digital-by-default". By the combination of three use cases (UC#1 - Application to public higher education, UC#2 - Applying for study grant, and UC#3 - Diploma recognition) it will prove the optimal processes/procedures for students of the three participating Member States (Portugal, Slovenia, and Spain) for registration to higher education and eventually applying for a student grant as well as for studies recognition.

In the project initial running phase, the pilot partners focused on monitoring of pilot running services, gathering data and feedback from all stakeholders (Data Evaluators, Data Owners, Member States, end users), and support to pilot users. Use cases were officially launched after the different testing phases (of common infrastructure interoperability components and of the connected pilot services) were successful and the necessary trust conditions were satisfied.

This document is related to the previous pilot deliverables "D4.1 Studying Abroad – Use Case Definition & Requirements" [1] and "D4.2 Studying Abroad – Pilot Planning" [2] and assumes that the reader is somewhat familiar with their content, as more details on use cases, architecture, and pilot objectives were provided there. It also provides occasional updates on the two documents, e.g. by describing some changes to services and scope, and by updating planning activities for the final iteration of the pilot.

The document was produced in two steps. An initial version without the results obtained through students' feedback was prepared in February 2022 based on internal feedback from pilot partners (Des and DOs) while the current version is a complete version that includes additional subsections in Chapter 3 with the results from students for use and value piloting principles enabling to assess how well the metrics and success criteria have been met to date, as well as more complete coverage of the pilot procedures in Chapter 4.

1.1 Purpose of the document

The main purpose of this deliverable is to report on the execution of the pre-running phase activities that led to the pilot launch, describe the initial running phase of the SA pilot, evaluate the collected data and feedback according to the criteria and with metrics described in the pilot plan (D4.2 [2]), and present the results and findings.

Following an internal development plan described in D4.2, pilot-specific Data Evaluators and Data Owners have adapted their procedure and evidence portals and implemented the activities required to connect their infrastructures to the respective common building blocks and components for interoperability across borders. In coordination with WP3 and WP5, common building blocks and components have been integrated and tested prior to the first go live of the pilot.

The document has been prepared in close cooperation with all SA pilot partners. In the current project phase, the pilot partners attended weekly pilot meetings, carried out customization and integration activities, participated in regular Connectathons, assessed the common components and benefits of the integrated procedures, and actively participated in multiple project-wide alignment meetings and the alignment meetings with other initiatives, like EBSI/ESSIF [3].

1.2 Structure of the document

This document is divided into five main sections:

- Chapter 1 – The current section that describes the purpose and structure of the document.

- Chapter 2 – It describes the current pilot status, in particular the integrated Data Evaluators and Data Owners and their cross-border interoperability status, strategies used to mitigate infrastructure delays, and updates of the metrics since D4.2.
- Chapter 3 – Here, the pilot goals and success criteria are reviewed first and then take-up by pilot stakeholders, verified benefits, and lessons learned in the first running phase are described. This chapter also covers Use and Value results obtained from the pilot run with real users.
- Chapter 4 – This chapter describes pilot procedures of the initial running phase, such as cross-border interoperability testing and end users' engagement. Planned improvement following received feedback from the users is also presented.
- Chapter 5 - The main body of the document concludes with an overview of the main conclusions reached in the document, and description of the future steps.
- Annex I – At the end, a template of an additional questionnaire for collecting feedback on common components and technical specification is provided.

2 Pilot Status at the end of the first iteration

The number of services available for piloting in all three use cases of the Studying Abroad pilot has progressively increased during the last months. The first combination of DEs and DOs was successfully tested across borders at a Connectathon in October 2021. In spite of delays caused by different factors the Studying Abroad pilot has reached in July 2022 six launched MS combinations in use cases 1 and 2 and two in the third use case. Another three combinations were enabled for limited piloting with real users. One combination has been postponed to the second pilot iteration.

The main reasons of the delays include long procedure of obtaining CEF certificates for connectors and SMPs, COVID-19 and MS prioritization of activities, delays in security audits, unexpected events such as log4J vulnerability, complex troubleshooting, and the difficulties in moving the solutions into the preproduction and production environment involving complex coordination among different national teams with limited resources, and additional security audits.

2.1 Catalogue of services and status

2.1.1 Data evaluators

Table 1 summarises the endpoint URLs and status of the data evaluators at the end of the first iteration of the pilot. Four organisations in Portugal, Slovenia, and Spain have customized their eProcedure portals and integrated them either with DE4A OOTS or with the SSI Authority agent and EBSI. Six DEs have been launched so far, with two DEs only for Spanish students due to pending issues that still need to be resolved.

Table 1: Data evaluators (DE) in the Studying Abroad pilot

Data evaluator	Use case	URL	Status/launch date
ES-UJI	UC#1	https://preinscripcio.uji.es	Launched on 9.5.2022
PT-INESC-ID	UC#1	https://de4a-portal.gsd.inesc-id.pt:8443/	Launched on 24.6.2022 for testing with Spanish students
	UC#3	https://de4a-portal.gsd.inesc-id.pt:8443	Launched on 10.2.2022
SI-MIZŠ	UC#1	http://srvas2.rrc.si/prijava/	Launched on 17.6.2022 for testing with Spanish students
	UC#3	http://srvas2.rrc.si/prijava/	Launched for testing on 17.6.2022
SI-JSI	UC#2	https://grants.e5.ijs.si	Launched on 25.4.2022

Walkthroughs and guidelines for the launched DEs are available at https://www.de4a.eu/studyingabroadpilot.

Universitat Jaume I (ES-UJI)

The data evaluator ES-UJI from Spain is a corporate service for student programme pre-enrolment. Anyone wishing to apply for an opening in any of the offered education programmes at UJI will access this service during the official application periods and will be guided through the process, where all the required information and documentation will be provided for the programme managers consideration in order to award the openings. Students coming from countries participating in DE4A

can explicitly request to securely retrieve (through the User-Supported Intermediation evidence exchange pattern and DE4A OOP Technical System) their diploma from the official repository in the country where they took their undergraduate studies (see Figure 2).

The service is running in production. However, it can only be accessed during official periods when the students can apply for an opening in the offered courses, which happens at different times of the year, depending on the nature of each study programme. To facilitate access to real production tests of the application with focus groups outside of the official application periods, UJI has activated the test course pre-enrolment line whenever an official enrolment is not available, but to access this line students need to be whitelisted. Details on how to get whitelisted and how to use the service are provided in the Studying Abroad pilot microsite [4].

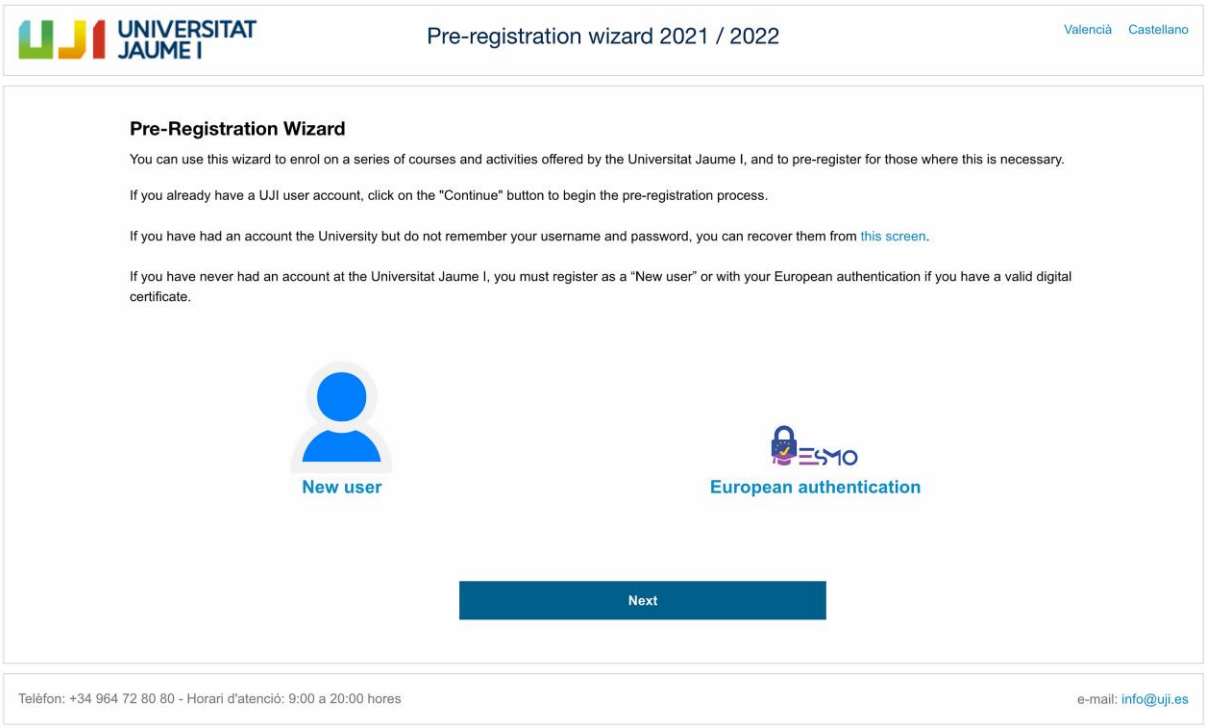


Figure 1: Pre-enrolment service at UJI

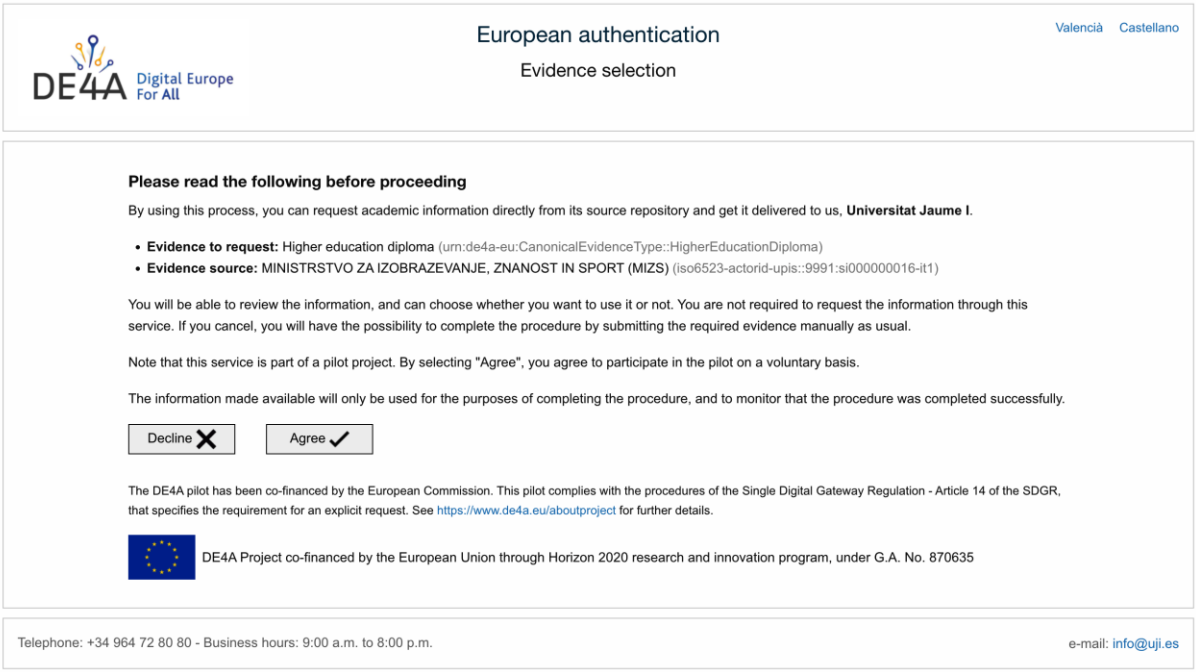


Figure 2: Explicit request at UJI

INESC-ID (PT-INESC-ID)

INESC-ID has set up a prototype portal for students to apply to Master programmes at Instituto Superior Técnico, the engineering school of Universidade de Lisboa and integrated it with the DE4A Connector and the SSI Authority Agent. Candidates willing to apply for Master programmes at IST will access this service during the official application periods and will be guided through the process, where all the required information and documentation will be provided for the programme managers consideration in order to award the openings. Students coming from countries participating in DE4A can explicitly request to use DE4A OOPT TS to securely retrieve their diploma data ("evidence") from the official repository in the country where they took their undergraduate studies, and this is done automatically (by means of the User-Supported Intermediation pattern).

The same portal can be used by students that finished their studies in another European country to have their diploma recognized. Students authenticate on the site, upload from their mobile wallets their diploma in the form of a Verifiable Credential (VC) and request the recognition. Later, they can authenticate again and get information about the success of the request. Details on how to use the services are provided in the Studying abroad pilot microsite [4].

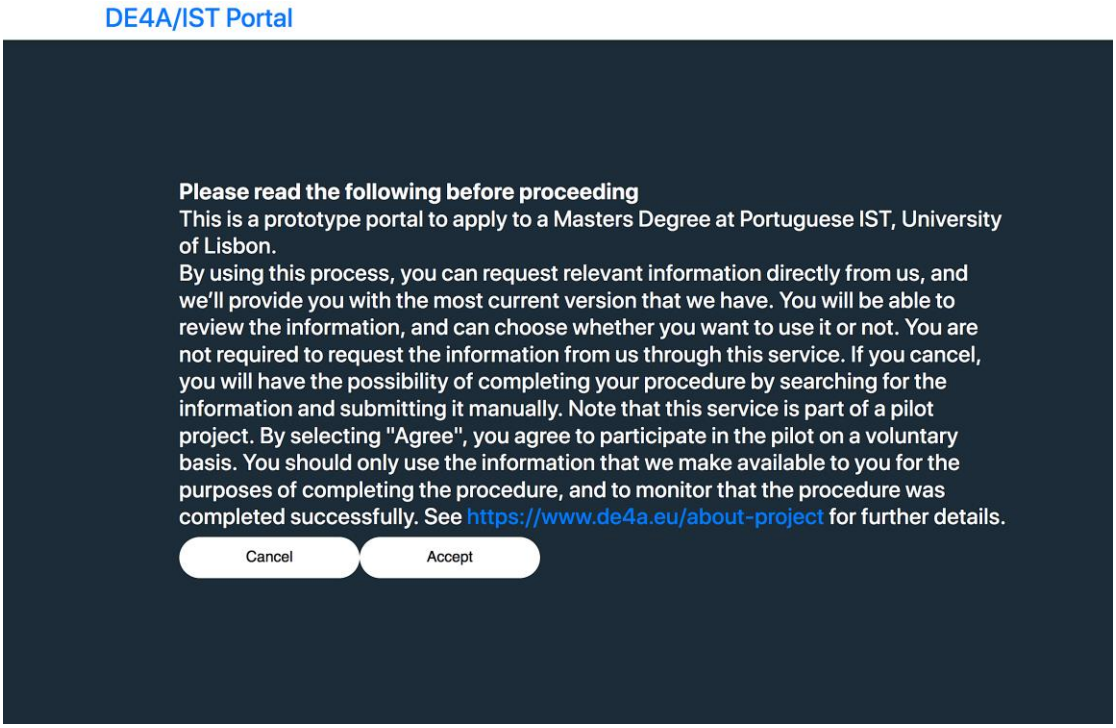


Figure 3: Prototype application portal at University of Lisbon

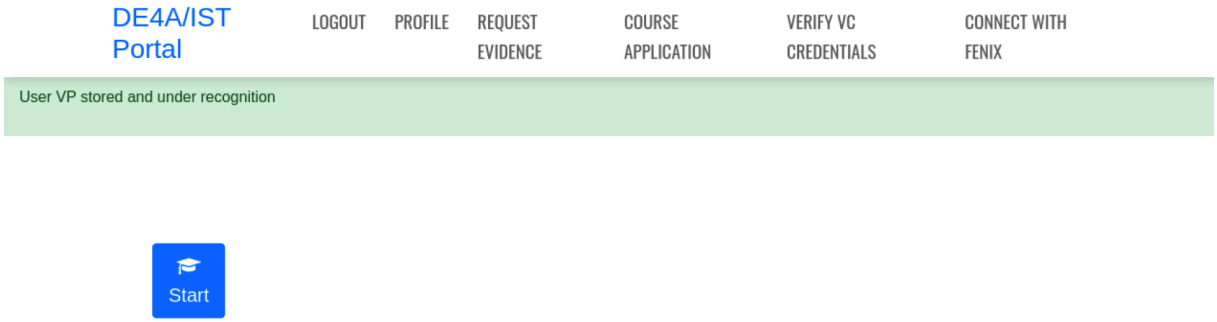


Figure 4: Acknowledged submission of diploma in the form of a verifiable presentation at University of Lisbon in UC#3

Ministry of Education, Science and Sport of the Republic of Slovenia (SI-MIZŠ)

Since 2012 the Ministry of Education, Science, and Sport of Republic of Slovenia has been operating the eVŠ system (the records and analytical information system of higher education in the Republic of Slovenia). Every candidate who wishes to enrol at one of the Slovenian higher education institutions must submit an application through this system.

For the initial running phase, the eVŠ service in preproduction has been integrated with the DE4A Connector and the SSI Authority Agent. As part of the procedure, real students can select the source of their real higher education degree diploma (authentic source in another country for the USI pattern or a verifiable credential on a mobile phone for the VC pattern) and use the service, but not with legal consequences (pilot students are not officially enrolled to higher education in Slovenia).

Figure 5: Preproduction portal at SI-MIZŠ

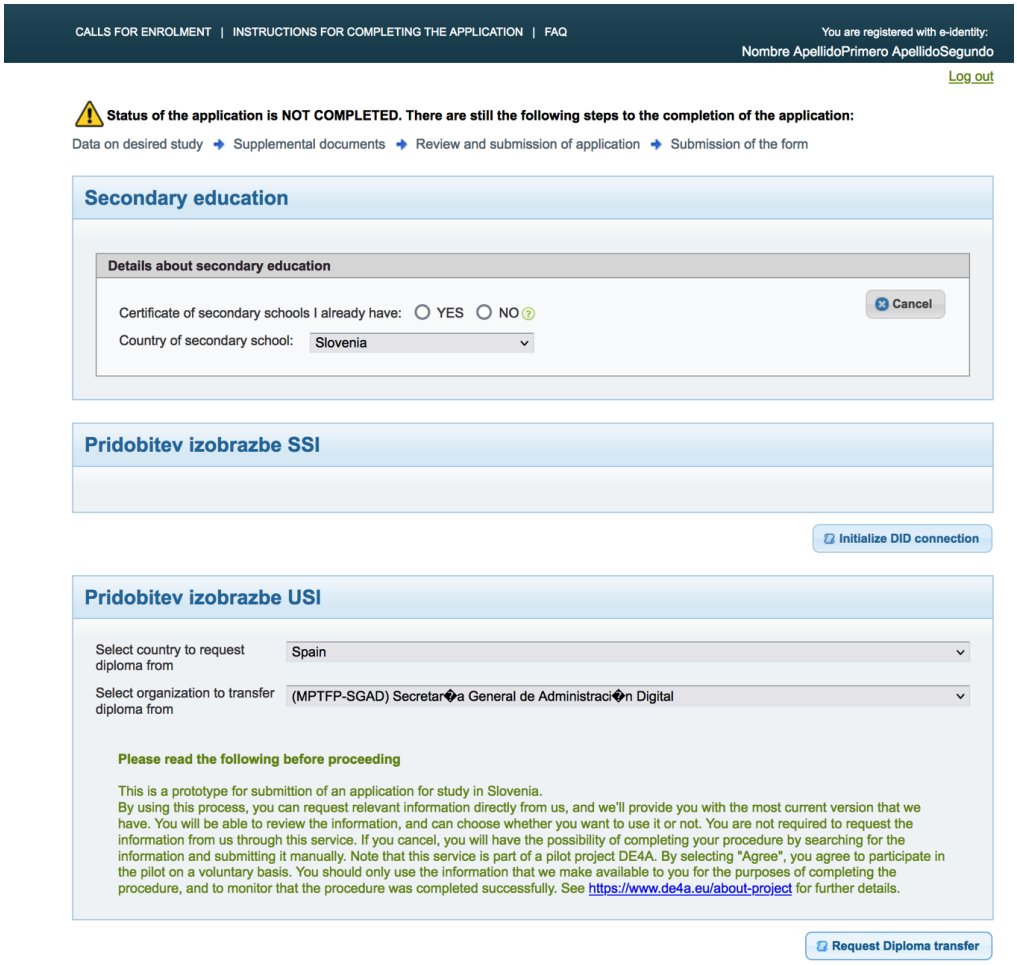


Figure 6: Explicit request at SI-MIZŠ

Jozef Stefan Institute (SI-JSI)

Jozef Stefan Institute is the biggest research institute in Slovenia. As part of the Studying Abroad pilot it has provided a preproduction service where real foreign students with real evidence can apply for study grants. Students coming from countries participating in DE4A can explicitly request to securely retrieve (through the User-Supported Intermediation evidence exchange pattern and DE4A OOP TS) their diploma from the official repository in the country where they took their undergraduate studies (see Figure 8). For the first running phase, a call for study grants has been defined, where STEM students from Portugal and Spain who are studying or will study at one of the higher education institutions in Slovenia and conduct their research work at the Institute can apply for a grant. Students should have already successfully completed their 1st Bologna degree studies in the respective fields. Details on how to use the services are provided in the Studying Abroad pilot microsite [4].

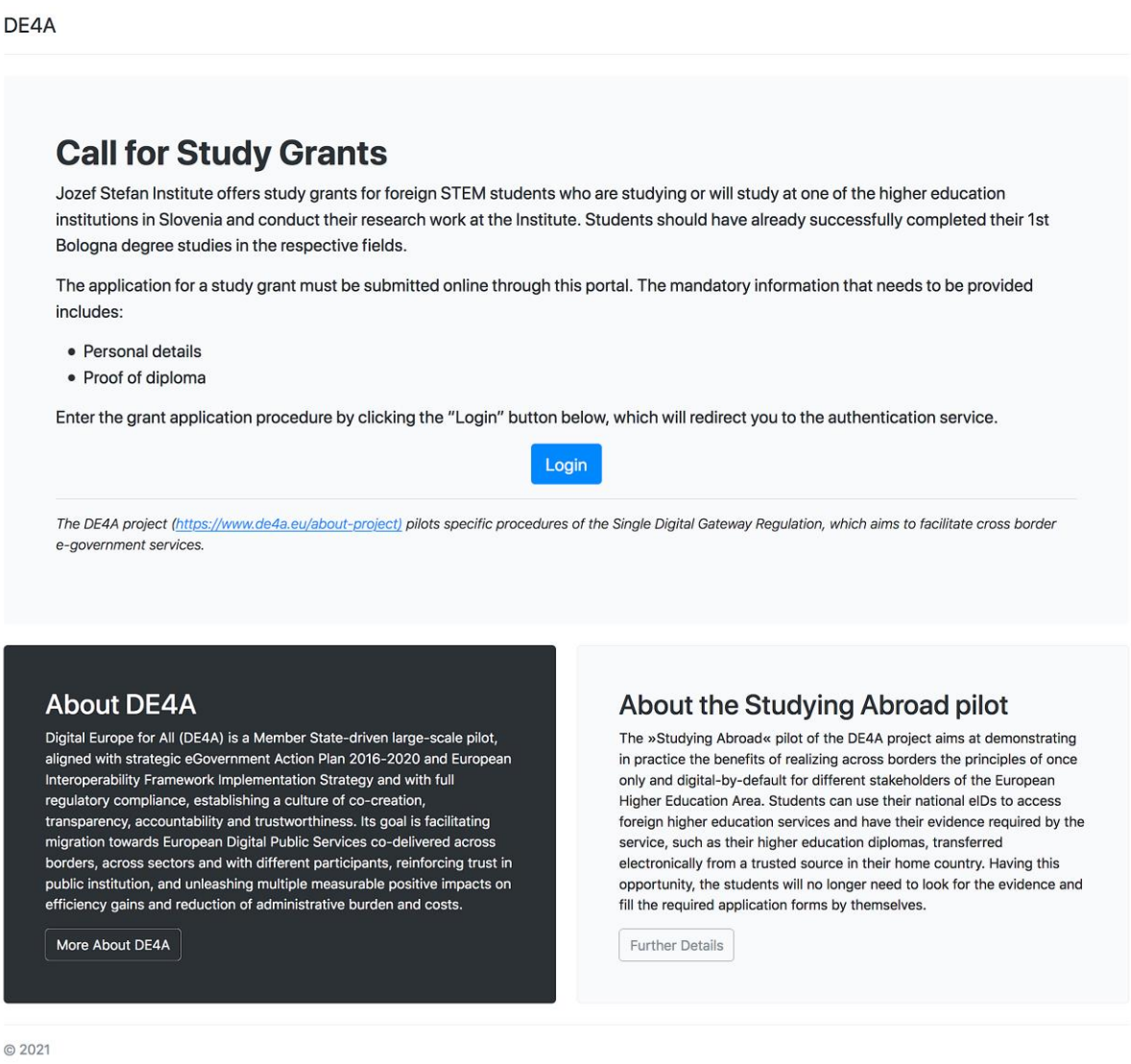


Figure 7: Grant application service at JSI

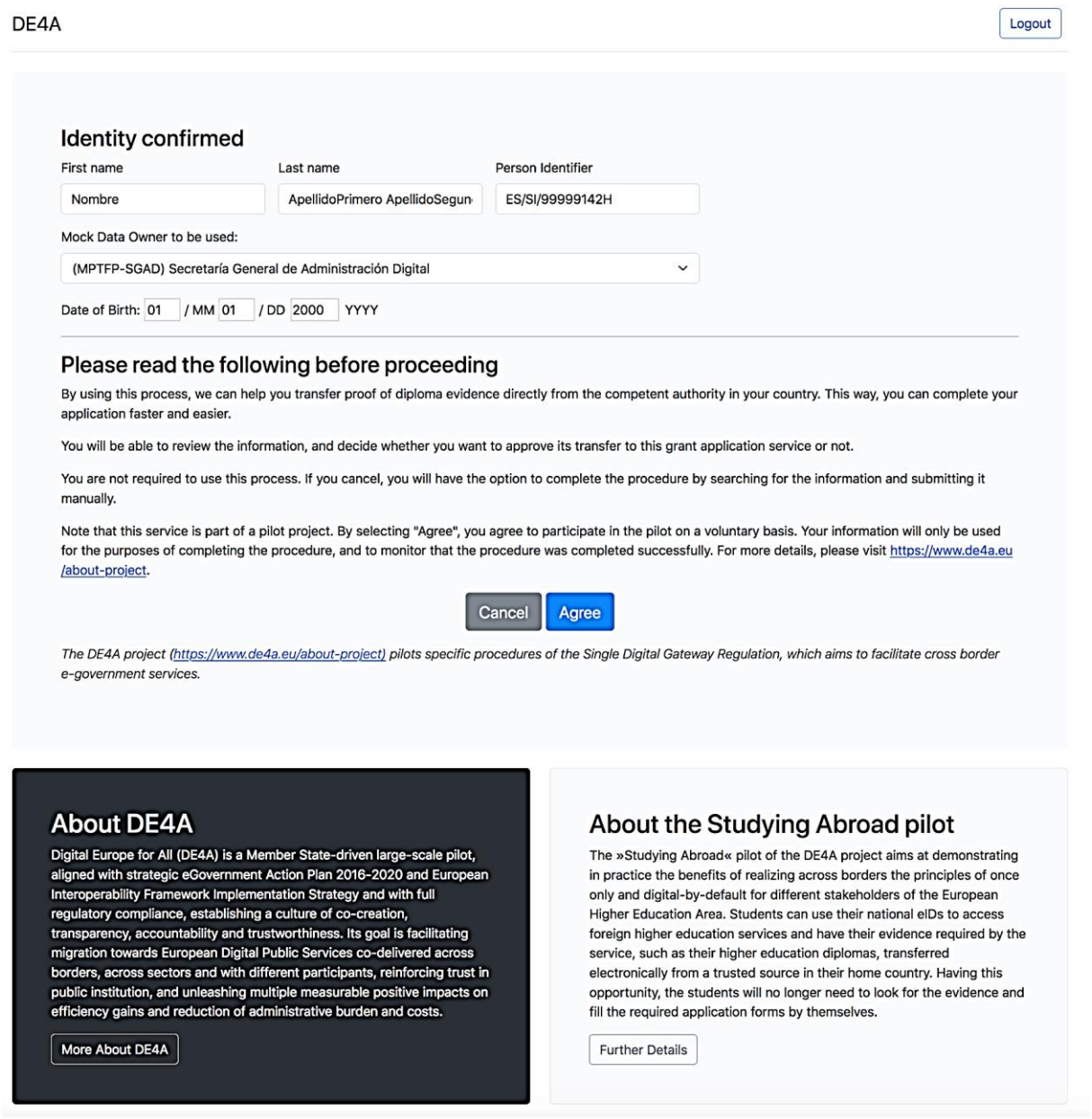


Figure 8: Explicit request at JSI

2.1.2 Data owners

Table 2 gives an overview of all data owners in the pilot. Three organisations in Portugal, Slovenia, and Spain have customized their Evidence portals and integrated them either with DE4A OOTS or with the SSI Authority agent and EBSI. Three DOs (ES-SGAD has the same DO for UC#1 and UC#2) and two Verifiable Credential (VC) Issuers have been launched so far, while one Issuer was postponed to the second iteration due to lack of resources.

Table 2: Data owners (DO) in the Studying Abroad pilot

Data owner	Use case	URL	Status/launch date
ES-SGAD	UC#1	/[1]	Launched on 25.4.2022
	UC#2	/[2]	Launched on 25.4.2022
	UC#3	SGAD Portal VC - Owner: https://pre-as4gw-dt-de4a.redsara.es/de4a-pid-owner/vc SSI Agent: https://pre-as4gw-dt-de4a.redsara.es/ssi-agent/ Aries Agent: https://pre-smp-dr-de4a.redsara.es/aries-inbound/ Webhook: https://pre-smp-dr-de4a.redsara.es/webhook	Launched on 25.2.2022
PT-INESC-ID	UC#1	http://130.61.108.235/de4a-connector (no VPN) http://172.31.201.82/de4a-connector (with VPN)	Launched for testing on 24.6.2022
	UC#3	https://de4a-portal.gsd.inesc-id.pt:8443/	Launched on 22.2.2022
SI-MIZŠ	UC#1	/[3]	Launched for testing on 25.4.2022
	UC#3	/	Postponed to the 2nd phase

SGAD (ES-SGAD)

Students from Universitat Jaume I can request their diploma evidence to be retrieved from the Spanish central data intermediation platform, where specific data services developed by Universitat Jaume I offer the necessary data to complete the already available Ministry of Education data in fulfilling the requirements for the canonical evidence issuance. The following figures show starting pages for the USI (Figure 9) and VC (Figure 11) patterns, as well as the preview functionality (Figure 10).

[1] UJI DO for UC#1 does not enable direct public access, as its evidence is retrieved through the Spanish central data intermediation service.

[2] UJI DO for UC#2 does not enable direct public access, as its evidence is retrieved through the Spanish central data intermediation service.

[3] SI-MIZŠ DO for UC#1 does not enable direct public access, as its evidence is retrieved by the Preview component at the Ministry of Public Administration of the Republic of Slovenia through a national OOP system Tray.

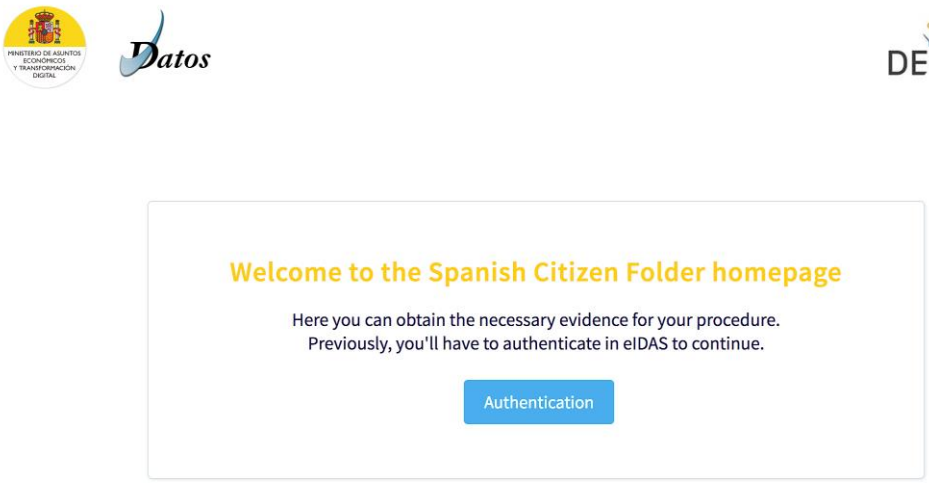


Figure 9: Data intermediation platform at SGAD

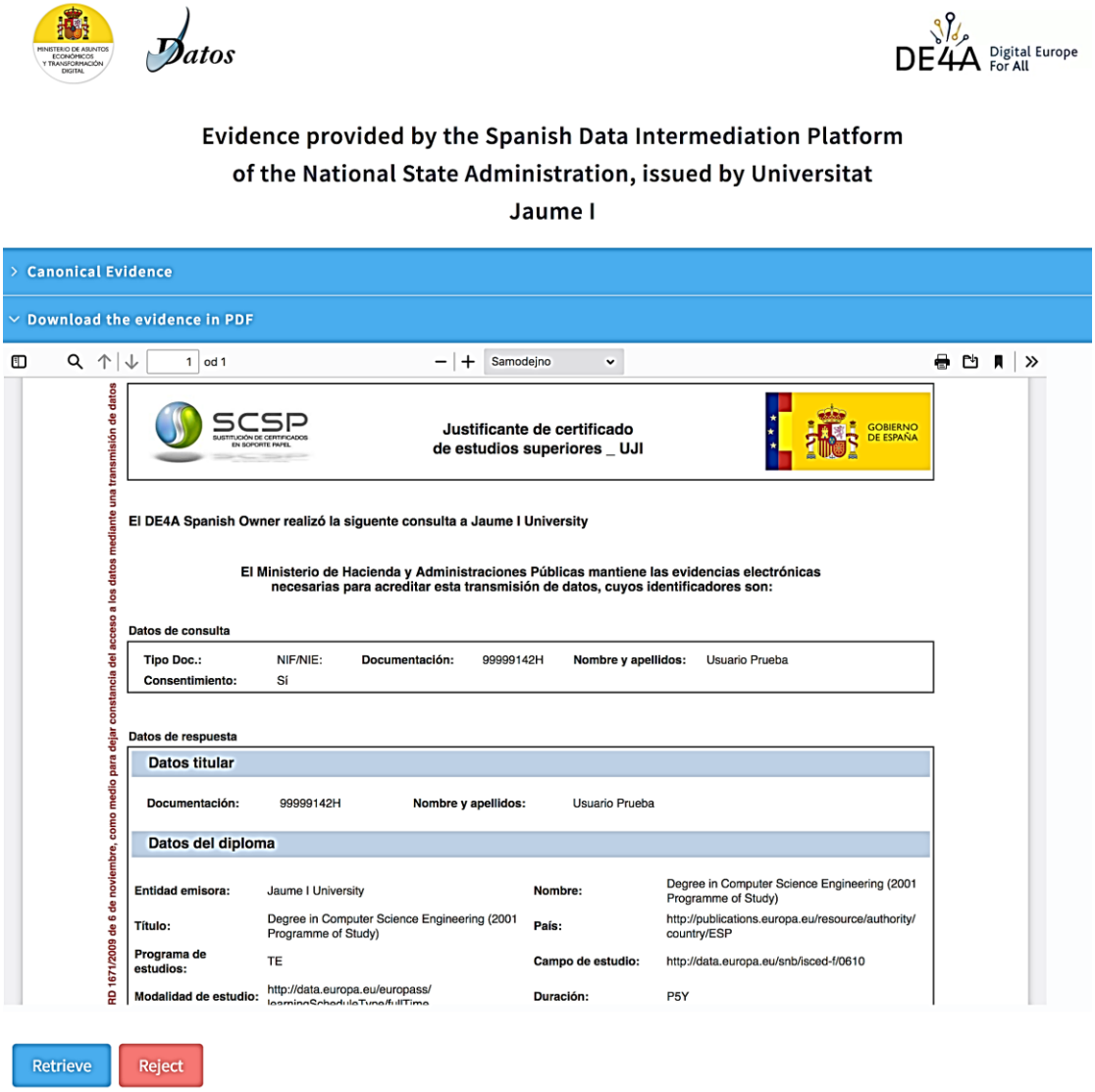


Figure 10: Preview at Spanish DO

Figure 11: ES VC Issuer

INESC-ID (PT-INESC-ID)

Graduates from Instituto Superior Técnico can request their diploma evidence to be retrieved from the school's information system Fenix. This involves using the DO, partially implemented by AMA and part by INESC-ID for UC#1.

Students can also use the portal to obtain a diploma in the format of a VC (UC#3). For that purpose, they must authenticate in the portal and request the diploma, which is granted if the student concluded the studies. Details on how to use the service to obtain diploma are provided in the Studying Abroad pilot microsite [4]. Figure 12 shows the Preview functionality of Data Owner for use cases 1 and 2. Since the service is not running in the production environment, the students from INESC-ID used test credentials and test evidence in UC#1 and UC#2.

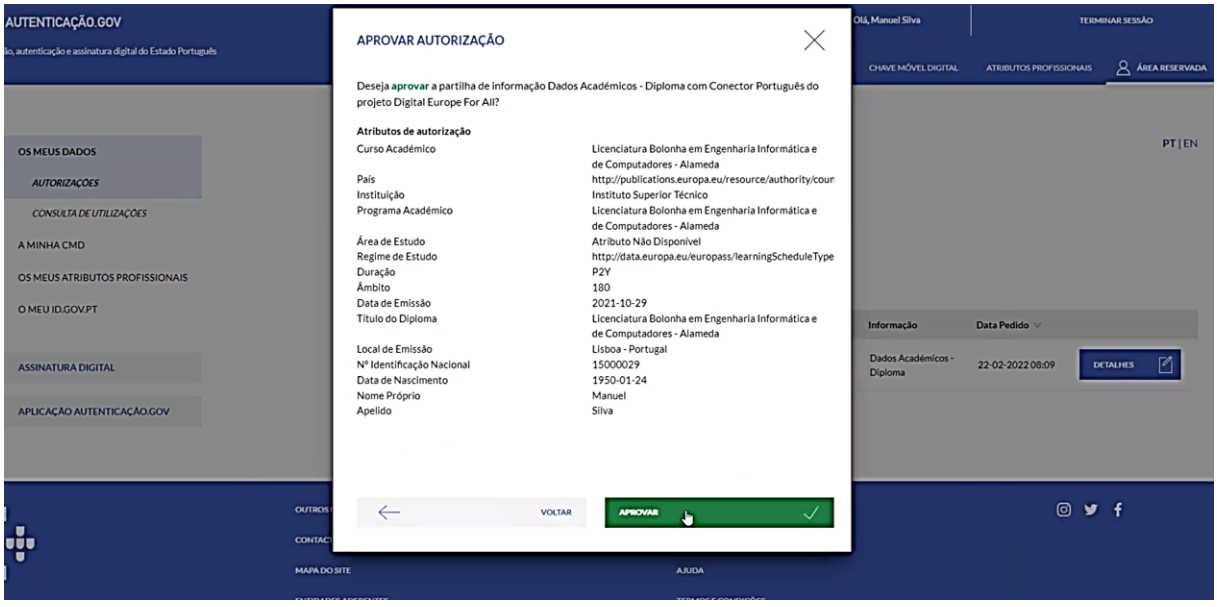
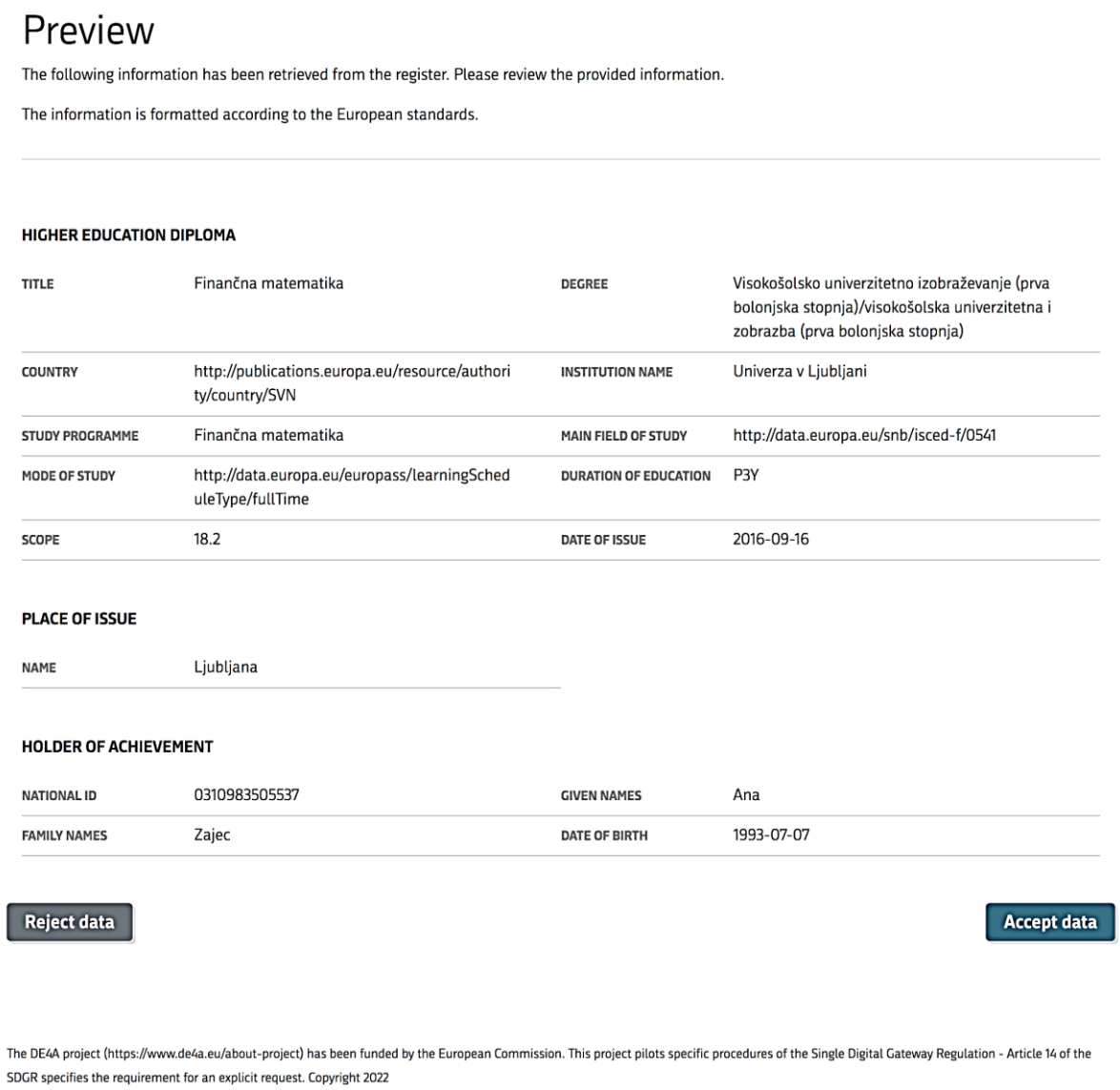


Figure 12: Preview at Portuguese DO

Ministry of Education, Science and Sport of the Republic of Slovenia (SI-MIZŠ)

The eVŠ system at the Ministry of Education, Science, and Sport of Republic of Slovenia contains information about all students studying or have studied at one of the Slovenian higher education institutions. For the initial running phase, the eVŠ service in preproduction has been integrated through the Slovenian national OOP system Tray and newly developed central Preview component into the DE4A OOP technical system (see Figure 13 for the Preview page). In the first pilot iteration, this service provides real data (higher education degree diplomas) only for preselected students who are members of the focus group.

Due to lack of resources, the development of the SI-MIZŠ issuer has been postponed to the second pilot phase. Instead, the University of Maribor enabled a selected group of its students to download real diplomas in the form of verifiable credentials to their mobile phones through a reference implementation of the VC issuer.



Preview

The following information has been retrieved from the register. Please review the provided information.

The information is formatted according to the European standards.

HIGHER EDUCATION DIPLOMA

TITLE	Finančna matematika	DEGREE	Visokošolsko univerzitetno izobraževanje (prva bolonjska stopnja)/visokošolska univerzitetna i zobrazba (prva bolonjska stopnja)
COUNTRY	http://publications.europa.eu/resource/authority/country/SVN	INSTITUTION NAME	Univerza v Ljubljani
STUDY PROGRAMME	Finančna matematika	MAIN FIELD OF STUDY	http://data.europa.eu/snb/isced-f/0541
MODE OF STUDY	http://data.europa.eu/europass/learningScheduleType/fullTime	DURATION OF EDUCATION	P3Y
SCOPE	18.2	DATE OF ISSUE	2016-09-16

PLACE OF ISSUE

NAME	Ljubljana

HOLDER OF ACHIEVEMENT

NATIONAL ID	0310983505537	GIVEN NAMES	Ana
FAMILY NAMES	Zajec	DATE OF BIRTH	1993-07-07

Reject data

Accept data

The DE4A project (https://www.de4a.eu/about-project) has been funded by the European Commission. This project pilots specific procedures of the Single Digital Gateway Regulation - Article 14 of the SDGR specifies the requirement for an explicit request. Copyright 2022

Figure 13: Preview at Slovenian DO

2.2 Strategy followed to mitigate infrastructure delays

The pilot was designed to have a wide variety of services to be piloted in different MS and under the responsibility of different institutions. The pilot also heavily depended on the results of other DE4A work packages, in particular WP5 and WP3. To prevent further pilot delays and facilitate integration of the services with the DE4A OOP Technical System several strategies have been put into place for the first iteration:

Integration of DEs and DOs using the playground

Testing was performed in the playground to facilitate the integration of DEs and DOs by having available a tool to validate the integration of the components by replicating the behaviour of the real components (Connectors acting as DR and DT, mocked DE and mocked DO) and providing processes to accomplish the different test cases allowing to test integration of endpoints with DE4A Connector and to test exchange of cross-border messages against mocks even before counterpart endpoints are ready.

Use of central SMP in the playground

The goal of setting-up a central SMP on the playground was to have one central component for testing while MS developed their national SMPs. Services metadata was also handled in this central SMP for stability, scalability, and consistency of the test environment.

Use of central SMP in production

To reduce the impact of the delays in setting up SMPs in production in some Member states participating in the SA pilot and other DE4A pilots, it was agreed to launch the pilot with a central SMP in production that was deployed in Slovenia.

Use of DE4A public key certificates for SMPs and DE4A connectors

For the public key infrastructure production certificates that are needed to secure AS4 Gateways and SMPs of piloting environments with real data, the project has decided to take advantage of the CEF PKI, which is offered to public administrations. Despite delays in clarifying the process, determining a CEF domain owner, processing the powers of attorney requested by CEF, and obtaining the production certificates for piloting environments, DE4A public key certificates could be used in all Connectathons and in the operational pilots with end-users.

Use of DE4A Connectors in preproduction

Until the piloting environments were in place and production certificates were also available, common components such as the DE4A Connector were implemented in the preproduction or testing environment in order to enable the various setups, configurations, and tests to be as close as possible to the real final infrastructure. MS were free to select whichever environment they seemed suitable for the deployment of the central components and production certificates and for piloting.

Use of eIDAS nodes in preproduction because of non-notified eID scheme in Slovenia

As of the mid of 2022, Slovenia has not yet notified its identification scheme. To ensure interoperability with the non-notified eIDs from Slovenia, the existing pre-production eIDAS nodes were agreed to be used to authenticate users of the three higher education procedures from Portugal, Slovenia, and Spain. Despite this agreement, Portugal still does not allow mixing pre-production eIDAS environment with the production DO, which means that Portuguese students were unable to use their real eIDs and real diplomas at the ES and SI endpoints.

Issuance of verifiable credentials for Slovenian students at the University of Maribor for UC#3

The Ministry of Education, Science and Sport of the Republic of Slovenia has postponed the implementation of their issuer of the diploma evidence in the form of verifiable credentials to the second pilot phase due to lack of resources. To enable the participation of Slovenian students already

in the first iteration, the University of Maribor has issued verifiable credentials to some of its students using a reference implementation of the VC issuer developed in WP5.

Use of simulated procedures and the procedures in preproduction in some cases

Given the current limitations in the participating MS in offering study grants to foreign EU students (UC#2), a service has been developed simulating the whole application process. Although real students applied for the service, their applications were discarded after submission, or the supervised students were instructed not to submit the applications in the final step. The applications were also discarded for the piloted procedures in preproduction in Slovenia and Portugal for UC#1 and UC#3.

Whitelisting of test users when the official calls are closed

Some of the piloted procedures that exist only in production, such as pre-enrolment to higher education in Spain, are available for a limited time each year. To enable testing of these procedures outside the official application periods, students have to submit their communication details before using the service in order to be allowed by a university for testing. These applications were submitted in special calls and discarded by the university after submission, or the supervised students were instructed not to submit the applications in the final step.

Use of test credentials and test evidence in some cases

Portuguese students were not able to use real data due to restrictions in the PT eIDAS preproduction environment that rejected real eIDs and the connector that had to be deployed in the test environment because of delayed security assessment. Students from Spain used test credentials and real academic data, but anonymized and bound to the personal data of a test credential. Despite test credentials being used the gathered data was therefore still production-relevant for the Spanish data provider.

Summary of the participants' information in wiki

Due to numerous technical issues encountered during the Connectathons, caused by the inconsistencies of the participants' and endpoints' data in the connectors and SMPs in the test, preproduction and production environments, a wiki page has been created to provide an overview of the pilot participants' information. Guidelines for participation in Connectathons are also planned for the second iteration.

2.3 Achieved cross-border interoperability status

This section gives an overview of all DE-DO combinations planned for the first pilot phase and their cross-border interoperability status at the end of the first iteration. Interoperability status is described below for each use case and summarised in several tables.

The status colour scheme for the upcoming tables is as follows:

Launched	Functioning	Postponed	Not planned

Launched: The combination has been officially launched for piloting with real users.

Functioning: The combination was enabled for limited piloting with real users.[4]

Postponed: Services and tests have been postponed to the second pilot phase.

Not planned: Combination of the DE and DO is not planned for cross-border testing.

The following figure summarizes overall status of the pilot combinations.

[4] Limited piloting means that some parts of the implemented procedures still had minor unresolved issues, e.g. display errors that prevented an official launch but allowed for supervised piloting (real users were informed of these difficulties prior to the piloting sessions), or that piloting had to be stopped due to errors caused by changes in the piloting environment.

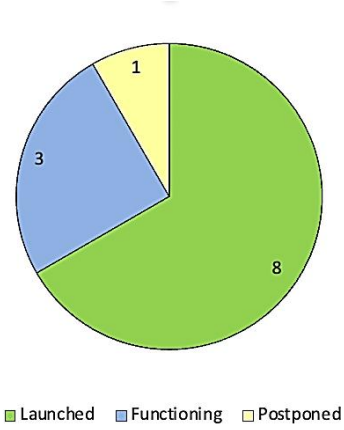


Figure 14: Overall status of combinations

2.3.1 Application to higher education (UC#1)

This service provides a platform for students to apply for admission to higher education institutions in another country, specifically to Master Degree studies (2nd Bologna degree) in the first iteration phase. The service largely corresponds to the procedure 'Submitting an initial application for admission to public tertiary education institution' of the 'Studying' Life Event in the Single Digital Gateway Regulation (SDGR)[3][5].

The use case was designed for students to use their national eIDs to access the service and explicitly request the use of the DE4A technical system to have their diploma evidence required by the service transferred electronically from a trusted source in their home country satisfying applicable provisions of the SDGR and the GDPR. This way, students no longer have to search for the evidence and fill in the necessary application forms by themselves. The evidence is previewed at the source after successful record matching, i.e. at Data Owners where students are redirected and need to (re-)authenticate (USI pattern).

Table 3 shows the achieved cross-border interoperability status between data owners (columns) and partners providing this service (rows). The postponed combination SI-MIZŠ DE - PT-INESC DO was not ready on time for piloting due to lack of resources at SI-MIZŠ. The combination PT-INESC-ID DE – SI-MIZŠ DO was piloted for a while with real students, but then the piloting had to be stopped due to issues in the changed piloting environment. Both combinations will be launched and piloted in the second iteration.

Slovenian students used real data when piloting Spanish and Portuguese services (combinations ES-UJI – SI-MIZŠ and PT-INESC-ID – SI-MIZŠ). Portuguese students were using fake evidence when testing the combination ES-UJI – PT-INESC-ID due to restrictions in the PT eIDAS preproduction environment that rejected real eIDs and the connector that had to be deployed in the test environment because the security assessment performed by Portugal took more time than expected. Spanish students were using test credentials and anonymized real evidences when testing the services (PT-INESC-ID – ES-SGAD, SI-MIZŠ – ES-SGAD), as explained in Section 3.2.1.

Table 3: Cross-border interoperability status in Use case 1

		Data owners		
		ES-SGAD	PT-INESC-ID	SI-MIZŠ
Data evaluators	ES -UJI			
	PT-INESC-ID			
	SI-MIZŠ			

2.3.2 Application for a study grant (UC#2)

The second service allows students to apply for a study grant abroad. This service largely corresponds to the procedure 'Applying for a tertiary education study financing, such as study grants and loans from a public body or institution' of the 'Studying' Life Event in the Single Digital Gateway Regulation (SDGR)[5].

The service helps applicants to explicitly request that their evidence (the diploma for the 1st Bologna degree in the first pilot iteration) is automatically sent to the procedure portal from a trusted source in their home country or countries where they previously studied. Students retain full control over which evidence is sent across borders and which is not, by explicitly agreeing to the transfer of evidence. The evidence is previewed at the source after successful record matching, i.e. at Data Owners where students are redirected and need to (re-)authenticate (USI pattern).

The following table shows the cross-border interoperability status between data owners (columns) and partners deploying this service (rows) at the end of the first iteration. Although PT-INESC-ID is not officially involved in UC#2, its DO for UC#1 was used for piloting in the first iteration, as the same evidence (higher education diploma) was needed by the services.

Portuguese students were using fake evidence and Spanish students real anonymized data when testing the service (combinations SI-JSI – ES-SGAD, SI-JSI– PT-INESC-ID) due to the same reasons as in UC#1.

Table 4: Cross-border interoperability status in Use case 2

Data owners			
Data evaluators		ES-SGAD	PT-INESC-ID
	SI-JSI		

2.3.3 Diploma recognition (UC#3)

The third set of services focuses on the diploma recognition in another country to facilitate the use of such information by government and other sectors. The services implement the Self-Sovereign Identity approach. Students can get their diplomas in the form of Verifiable Credentials from trusted data sources, such as universities where they have previously studied or Ministries of Education and store them in digital wallets on their mobile phones. In another Member State, they can then present these verifiable credentials in the form of a verifiable presentation to a competent authority and request their diplomas to be recognized in that country.

Table 5 shows the cross-border interoperability status between issuers of verifiable credentials (columns) and partners verifying verifiable presentation (rows) at the end of the first iteration. Due to lack of resources, the development of the SI-MIZŠ Issuer has been postponed to the second pilot phase. Instead, the University of Maribor enabled a selected group of its students to download real diplomas in the form of verifiable credentials to their mobile phones through a reference implementation of the VC issuer, developed at the university. SI-MIZŠ Verifier was enabled for limited testing by real students from Portugal and Spain.

Slovenian students used real data when piloting Portuguese verifier (combination PT-INESC-ID – SI-MIZŠ). Spanish students were using real anonymized data and Portuguese students were using fake evidence when testing the services (combinations PT-INESC-ID – ES-SGAD, SI-MIZŠ – ES-SGAD, SI-MIZŠ – PT-INESC-ID) due to various reasons, as explained in more detail in Section 3.2.1.

Table 5: Cross-border interoperability status in Use case 3

		Issuers		
		ES-SGAD	PT-INESC-ID	SI-MIZŠ
Verifiers	PT-INESC-ID			
	SI-MIZŠ			

2.4 Updates in metrics

Deliverable D4.2 defined quantitative and qualitative metrics for 11 success criteria and 5 pilot goals, as well as the sources for collecting the required data (competent authorities, Member States, and students) [2]. No metrics were updated after completing D4.2, only additional questionnaire on the DE4A central components and the testing procedure has been introduced. The main goal of the additional questionnaire was to collect additional data for evaluation of perceived quality of specification and software, ease of integration, potential for sustainability and adequacy for the pilot purpose for the following components and concepts: Solution Architecture, Information Exchange Model, DE4A Connector, DE4A Playground (mocked DE, mocked DO, central SMP, Kafka server), SSI Authority Agent, and SSI User Agent. The questionnaire is also used for evaluation of the quality of support and technical documentation, as well as the contribution of the testing methodology and Connectathons to the successful launch of the pilot. The questionnaire used to gather this feedback from the pilot partners is included in Annex I.

3 Pilot success criteria related to pilot dimensions

In this chapter, the pilot goals and success criteria are reviewed first and then take-up by pilot stakeholders (students, Data evaluators, Data consumers, Member States), verified benefits, and lessons learned in the first iteration are described. The chapter also covers Use and Value results obtained from the pilot run with real users. The success criteria results are summarised in relation to the metrics, and for each metric, a target value is provided. The chapter ends with description how each of the DE4A technical common criteria was met by the pilot in the first iteration.

3.1 Goals and pilot success criteria

The Studying Abroad pilot's main objective is to facilitate the mobility of European students across the European Higher Education Area, based on paperless cross-border procedures that support the Once-Only Principle and the use of electronic identities. The goals described in Table 6 were first described in D4.1 and then refined in D4.2.

Table 6: Studying Abroad pilot goals

Actor	ID	Goal
Public authorities	A	Reduce administrative burdens through improvement of the quality of student data and data processing effort within the eProcedures by re-using data from authentic sources
	B	Improve the processing effort of evidence provision
Students	C	Satisfaction of the students and effort and time reduction
Project	D	Evaluate the OOP-components supporting the cross-border information flow: ▸ Assess technical impact on national services already in place ▸ Evaluate connections of national systems to the DE4A OOP TS ▸ Evaluate deployment of DE4A OOP TS ▸ Define (functional) requirements for the OOP-infrastructure, different functional service patterns and semantic interoperability as well as technical requirements for national services that must connect to the OOP-infrastructure ▸ Promote the OOP within the Member States (higher education institutions and public administration).
	E	Evaluate the use of the Self-Sovereign Identities approach in higher education, based on innovative vendor independent blockchain framework
	F	Evaluate whether the once-only solutions designed to the SA specific challenges have proven adequate in piloting the SA eProcedures: ▸ Usability of harmonised higher education evidence model ▸ Usability and correct implementation and use of Explicit Request and Preview ▸ Record matching on natural persons in the context of direct interaction of the user with the evidence providing authority

The next tables display how the pilot goals are decomposed into success criteria that were used for the SA pilot, and maps these criteria to:

- the Common Pilot Principles (Use, Learning, Value and Adoption)

- the Technical Common Criteria (Openness, Transparency, Reusability, Technical Neutrality and Data Portability, User Centricity, Inclusion and accessibility, Security & Privacy, Administrative simplification, Effectiveness & Efficiency).

Success Criteria for Public Authorities

The first criteria are relevant for data evaluators and data owners. Both criteria and consequently the metrics relate more to Value, although other principles are also relevant. All Value related results are presented in Section 3.2.2.

Table 7: Criteria for Data Evaluators

ID	Criterion	Technical Common Criteria	Principles
Pilot goal A: Reduce administrative burdens through improvement of the quality of student data and data processing time within the eProcedures by re-using data from authentic sources			
A1	The DE recognizes the student data as of higher quality (e.g. student data is guaranteed to be valid, is more reliable, is in structured electronic format, is more meaningful, is more complete).	Reusability, Transparency, Effectiveness & Efficiency, Administrative Simplification	U, L, **V**, A
A2	The DE recognizes the student data as easier to process.	Reusability, Transparency, Effectiveness & Efficiency, Administrative Simplification	U, L, **V**, A

Table 8: Criteria for Data Owners

ID	Criterion	Technical Common Criteria	Principles
Pilot goal B: Improve the processing time of evidence provision			
B1	The DO recognizes the requests for evidence as easier to process.	Reusability, Transparency, Effectiveness & Efficiency, Administrative Simplification	U, L, **V**, A

Success Criteria for Students Applying for a Service

The criterion for students and consequently the metrics relate more to Use, although other principles are also relevant. All Use related results are presented in Section 3.2.1.

Table 9: Criteria for students

ID	Criterion	Technical Common Criteria	Principles
Pilot goal C: Satisfaction of the students and effort and time reduction			
C1	The user acknowledges the procedure for applying for a service as efficient, effective and secure (e.g. the procedure requires acceptable effort, the procedure is not complex, is reliable, is secure, is established	Reusability, Effectiveness & Efficiency, Administrative Simplification,	**U**, L, V, A

	with simple and effective communication, has no language barriers, the user experiences no errors during the eProcedure, control given when managing his/her evidence).	Transparency, Security and Privacy	

Success Criteria for Pilot Technical Goals

These criteria for the pilot technical goals and consequently the metrics relate more to Adoption and Learning, although other principles are also relevant. All Adoption and Learning related results are available in Section 3.2.3.

Table 10: Criteria for evaluation of common components

ID	Criterion	Technical Common Criteria	Principles
Pilot goal D: Evaluate the OOP-components supporting the cross-border information flow: ▸ Assess technical impact on national services already in place ▸ Evaluate connections of national systems to the DE4A OOP TS ▸ Evaluate deployment of DE4A OOP TS			
D1	The DO believes the cost and effort for customizing the Evidence portal and data service and integrating them to the DE4A Connector will eventually be outweighed by the benefits.	Openness, Technological Neutrality and Data Portability	V, **A**
D2	The DE believes the cost and effort for customizing the eProcedure portal and integrating them to the DE4A Connector will eventually be outweighed by the benefits.	Openness, Technological Neutrality and Data Portability	V, **A**
D3	The participating Member State believes the cost and effort for setting up and deploying the AS4 gateway, the SMP and the DE4A Connector will eventually be outweighed by the benefits.	Openness, Technological Neutrality and Data Portability	U, **L**
Pilot goal E: Evaluate use of the Self-Sovereign Identities approach in higher education, based on innovative vendor independent blockchain framework			
E1	The DO believes the cost and effort for integrating the SSI Authority agent will eventually be outweighed by the benefits.	Openness, Technological Neutrality and Data Portability, User Centricity	V, **A**
E2	The DE believes the cost and effort for integrating the SSI Authority agent will eventually be outweighed by the benefits.	Openness, Technological Neutrality and Data Portability, User Centricity	V, **A**
Pilot goal F: Evaluate whether the once-only solutions designed to the SA specific challenges have proven adequate in piloting the SA eProcedures			
F1	Real education services are developed, successfully connected, and piloted as fully online cross-border procedures to the DE4A interoperability infrastructure by the respective pilot partners	Openness, Technological Neutrality and Data Portability	U, **A**

F2	The Higher Education Evidence Models have proven adequate for cross-border exchange of information on students for the SA eProcedures.	Openness, Technological Neutrality and Data Portability, Reusability	U, **L**, V
F3	The Explicit Request and Preview requirements as specified in the SDGR have proven suitable for higher education eProcedures.	Administrative Simplification, User Centricity, Inclusion and Accessibility	U, **L**
F4	The mechanisms for record matching at the DO have proven adequate for the SA eProcedures.	Administrative Simplicity, Effectiveness & Efficiency	U, **L**

3.2 Pilot dimensions

3.2.1 Use

In this section, the take up of the pilot services by stakeholders and the feedback provided by them is analysed.

Feedback from focus group real users

This subsection provides a summary of the results obtained during the practical use of the pilot. The results are based on feedback from a limited number of students collected via an online questionnaire (see D4.2[2]), and the logs of DEs and DOs. As described in more detail in Section 4.2, local users testing services prior to their going live and focus groups were invited for piloting in the first running phase. The focus group included students who entered the pilot after the services went live and filled in the questionnaire. They had to belong to participating institutions (University of Maribor, University Jaume I, INESC-ID), as no other universities are integrated with the DE4A OOTS. The number of students was also limited because some combinations became ready for piloting beyond the real application periods or in the period when the students were not available for testing anymore. Despite the limited number, the feedback is still relevant to understand perceptions of the end users, strengths, and aspects to improve.

The number of users accessing the services and providing feedback through the online questionnaire amounted to 52 students. Half of the students were from Spain, 15 from Slovenia, and 11 from Portugal. The use cases UC#1, UC#2, and UC#3 were tested 18, 18, and 16 times respectively. The numbers of users for each service and country are shown in Table 11. Students from Slovenia used real data for UC#1 and UC#3. Students from Portugal used test credentials and test data in all three use cases. Portuguese students were not able to use real data due to restrictions in the PT eIDAS preproduction environment that rejected real eIDs and the connector that had to be deployed in the test environment because of delayed security assessment. Students from Spain used test credentials and real academic data, but anonymized and bound to the personal data of a test credential. Students were able to use real credentials if they had them (Spanish National e-ID card is not much used by the general public), but they would have to be manually added to a whitelist before the service use.

Table 11: Students and tested services

		Students			
Use case	Service	ES	PT	SI	Total
UC#1	ES-UJI		1	3	4
	PT-INESC-ID	5		5	10
	SI-MIZŠ	4	0		4
UC#2	SI-JSI	12	6		18
UC#3	PT-INESC-ID (Verifier, Issuer)	3	4	4	11
	SI-MIZŠ (Verifier)	2	0		2
	SI-UM* (Issuer)[5]			3	3

The students have rated their satisfaction with the completed e-procedures focused on various aspects, such as required effort, clarity of the procedure or simplicity. Table 12 summarizes the average values of the responses for each aspect and use case (1 = Very dissatisfied, 2 = Dissatisfied, 3 = Neutral, 4 = Satisfied, 5 = Very satisfied) as well as for all use cases together.

Table 12: Satisfaction with completed procedures

Aspect	UC1 (n=18)	UC2 (n=18)	UC3 (n=16)	Total
Required effort	3,50	3,94	4,13	3,85
Clarity of the procedure	3,44	3,56	3,75	3,58
Simplicity	3,33	3,61	4,00	3,63
Number of errors and interruptions	3,00	3,67	3,06	3,25
Language	3,67	3,78	3,75	3,73
Communication	3,61	3,61	3,81	3,67
Overall experience	3,28	3,67	3,75	3,56
Duration of procedure	3,83	4,00	4,19	4,00
Security and privacy protection	3,94	4,11	4,38	4,13
Control when managing own education credentials	4,00	4,28	4,38	4,21

These values are graphically presented in Figure 15.

[5] Since SI-MIZŠ Issuer has been postponed to the second iteration, a limited number of students from University of Maribor downloaded their higher education diplomas from a test portal implementation at UM.

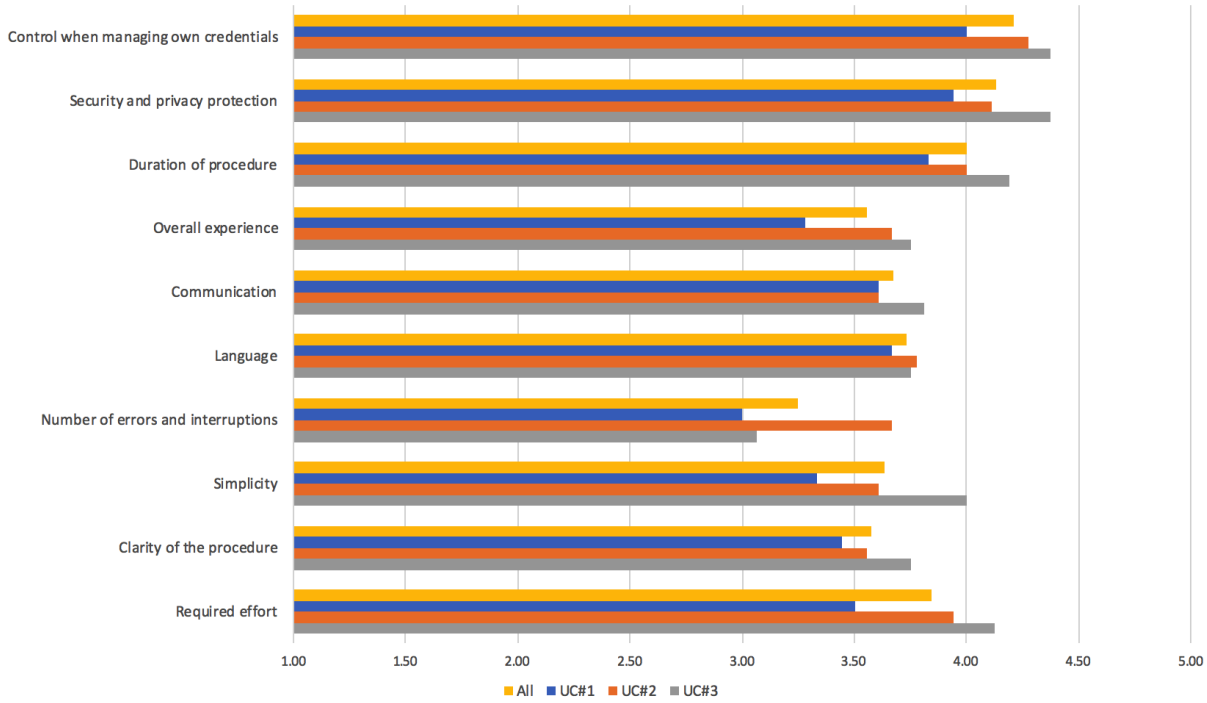


Figure 15: Average satisfaction per aspect and use case

Figure 16 shows the share of students who were satisfied or dissatisfied with each of the described aspects.

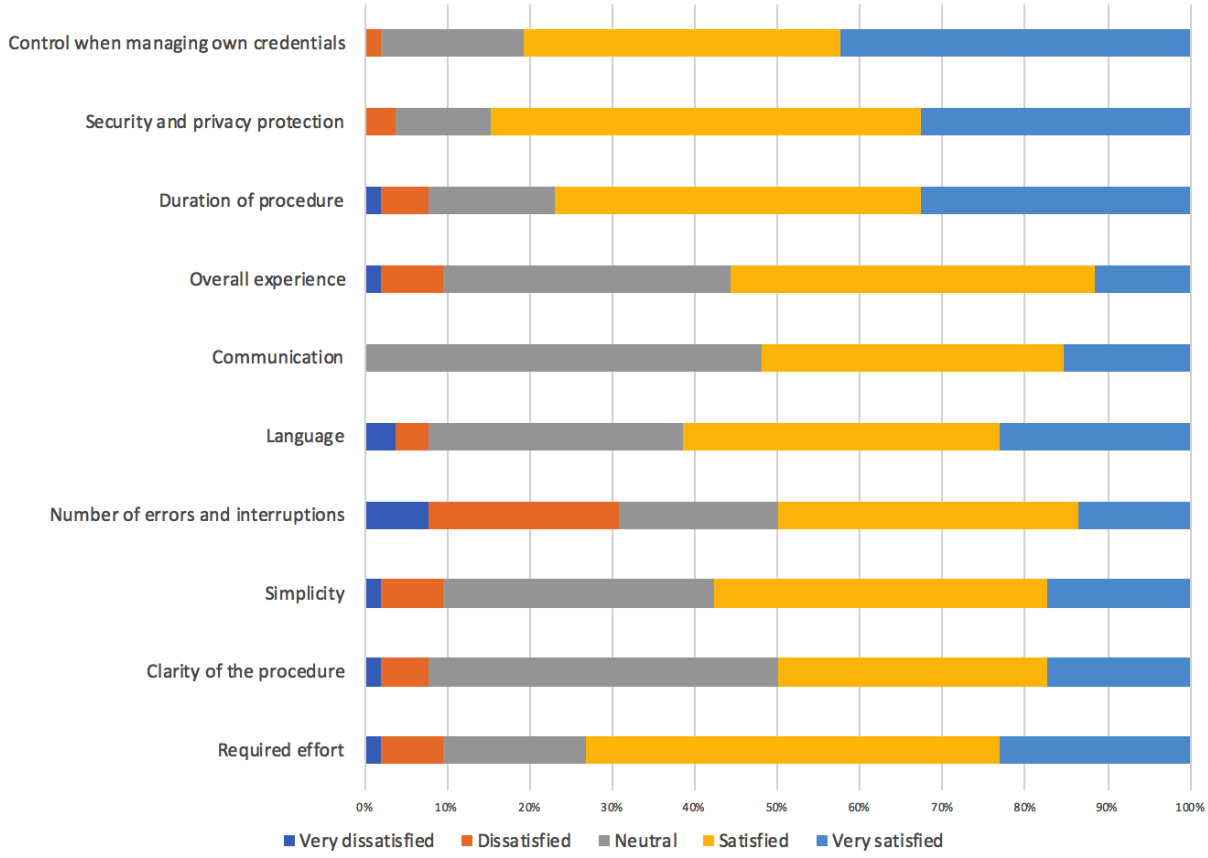


Figure 16: Share of satisfied students per aspect

As shown above, the most highly appreciated aspects of the piloted procedures were control in managing own credentials (4.21), security and privacy protection (4.13), and duration of the procedure (4.00).

The least appreciated was the number of errors and interruptions (3.25). As reported by students, the errors were mainly connected with the use of verifiable credentials in UC#3 and the DE4A mobile digital wallet (eight times) and instability of the preproduction eIDAS environment (twice). Clarity of the procedures could also be improved, as only half of the respondents were satisfied or very satisfied with it. The students mentioned that they would be lost without the help of the guidelines published in the microsite or the pilot supervisors. It should be noted here that the three procedures differ in complexity as they cover different life events in the area of higher education. The procedures also include eIDAS authentication, which can be a complex procedure by itself.

The students also commented on other specific functionalities, such as internationalisation, Explicit Request and Preview:

Internationalisation: Services are available in national language of each service provider and English. One of the students also wanted to have it in own language, e.g. in Spanish for a service in Slovenia. Another student had problems with constant language switching (from Spanish to English).

Explicit Request: Majority of the students (37 out of 52 or 71%) understood under which conditions they were using the service, or how and from where the evidence would be retrieved. The remaining 15 students (29%) provided negative comments.

Evidence Preview: Majority of the students (39 out of 52 or 75%) responded that they were fully informed what data would be transferred across border and felt in control of the evidence transfer. The remaining 13 students (25%) provided negative comments.

Use data from the logs

The logs of the DEs were used to measure the duration of the piloted procedures and to identify potential problems. Table 13 shows the duration in seconds for two services in UC#1 and UC#2. It should be noted that not only the service runs of the students who filled in the online questionnaire were considered, but also the logs of other service uses (e.g. additional tests by the pilot partners). For each of the services, the number of logs is given next to the service name and the average and median durations are provided. Median values were also provided to take into account the outliers affecting the average. For ES-UJI, the values indicate only the time spent on the specific DE4A evidence retrieval part of the application, not the whole time spent on the higher education application form. Some of the outliers caused by the tests have also been removed.

Table 13: Duration of services

Use case	Service	Average (sec)	Median (sec)
UC#1	ES-UJI (n=145)	74	44
UC#2	SI-JSI (n=156)	111	92

Usefulness of DE4A patterns and components

Pilot partners involved in customization, implementation, deployment or testing of DE, DO and DE4A Connector have provided feedback on the common components and specifications. The following results are based on 6 filled questionnaires from Annex I.

First, they rated different aspects of the common components, such as perceived quality of specification and software, ease of integration, potential to include the components in sustainability plan, and their adequacy for pilot purposes. Not all aspects have been rated by every partner. For example, the SSI authority agent and the SSI user agent were relevant only to the partners involved in

UC#3. The answers were assigned numerical values as follows: very low (1), low (2), neutral (3), high (4), and very high (5). Average values for each component and aspect are available in Table 14.

Table 14: Usefulness of components

Components	Perceived quality of specs/ software	Ease of integration	Potential to include in sustainability plan	Adequacy for pilot purpose	Overall assessment
Solution architecture (n=6)	3.67	3.20	3.67	4.60	3.78
Information exchange model (n=5)	3.80	3.75	3.80	4.50	3.96
Canonical data model (n=5)	3.80	4.50	3.80	4.50	4.15
DE4A connector (n=5)	3.80	4.40	4.00	4.75	4.24
Mock DE (n=5)	4.40	4.20	4.00	4.20	4.20
Mock DO (n=5)	4.40	4.20	4.00	4.20	4.20
Central SMP (n=4)	4.50	4.00	4.00	4.67	4.29
Kafka server (n=5)	4.60	4.00	4.25	4.75	4.40
SSI authority agent (n=3)	3.33	3.33	4.00	4.00	3.67
SSI user agent (n=3)	4.00	4.33	4.00	4.50	4.21

The results show that the usefulness of all components was generally perceived as high (with scores around 4.00), with the highest scores given to the usefulness of the Kafka server in the playground (4.40). Among the aspects assessed, suitability for the purposes of the pilot was rated highest by the pilot partners, and the potential to include all components in the sustainability plan was rated lowest, but still positive. Subcontractors who were not directly involved in the day-to-day project activities perceived integration as more difficult due to the lack of appropriate documentation and background knowledge.

The pilot partners would appreciate further technical and semantical analysis of the Solution Architecture, Connector, and data models from WP2, WP3 and WP5 to increase likelihood of adoption after the end of the project, for example authentication of requests/responses and their integrity, protocol design, security model, as well as higher education canonical data model. Reference implementations of specific functionalities, such as schema validation, in different languages (not just in Java) would also facilitate faster integration of the solutions, but this requires resources which are not available in the project.

Preproduction eIDAS environments in all three MS occasionally faced issues that prevented testing and made integration more difficult, e.g. maintenance, delays in changing expired certificates, changes in configuration, or unstable OCSP service. The eIDAs environments are maintained by organizations that are external to the project.

Technical support and testing

Another topic of assessment was quality of support, technical documentation, and testing methodology. The main support and communication channel for developers was Slack, complemented by the project mailing lists, Connectathons, and the discussions at pilot meetings. Pilot partners rated the adequacy of various aspects, and their responses were assigned numerical values as follows: absolutely inadequate (1), inadequate (2), sufficient (3), adequate (4), and perfectly adequate (5). As can be seen from Table 15, respondents were very satisfied with the support and communication channel (Slack) provided during integration and testing. On the other hand, there is still room for

improvement in the technical documentation, specifically to the transparency and structure. This has been considered for the second phase where all documentation will be published in wiki.

Table 15: Support and testing

Criteria	Score (n=6)
Quality of support and communication channel (Slack) provided by common components WP during the integration and testing	4.50
Quality of technical documentation	3.17
Contribution of testing methodology and Connectathons for testing with other MS to the successful launch of the pilots	3.67

Strategy on pilot use until final report

Giving consideration to the aspects described above, partners will make even greater efforts to maximise the usage. In the first iteration, only local users and focus groups used the services due to delays in the runnin of the pilot that made difficult to launch an awareness campaign to other students. In the final phase, which is expected to take longer than the first, students not belonging to the pilot participants' faculties and research groups will also be targeted, as described in D4.2 [2] and Section 4.2. However, the students will still have to belong to the participating organisations in the cases of Spain (UJI) and Portugal (INESC-ID).

3.2.2 Value

The value of the Studying Abroad pilot 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 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. The following results are based on filled questionnaires for DEs, DOs, and Member States. The questionnaires were described in more detail in D4.2 [2].

Data Consumers

The assessment of the quality of student data when using DE4A OOP TS, compared to the traditional situation where DE4A OOP TS is not used, focused on the following aspects: availability of evidence in electronic and structured formats, and completeness, reliability, and meaningfulness of the available data.

Table 16 summarises the scores assigned by three Data Evaluators in UC#1 and UC#2 and one VC Verifier. It should be noted that this initial assessment is not based on the piloting with real users and real data in a production environment over an extended period of time. The appreciation rates were assigned numerical values as follows: very low (1), low (2), neutral (3), high (4), and very high (5).

Table 16: Quality of student data

Aspect	USI (n=3)	VC (n=1)
Availability in electronic format	4.67	4.00
Availability in structured format	3.67	3.00
Completeness of available data	4.00	4.00
Correctness of available data	5.00	5.00
Reliability of available data	5.00	5.00

Meaningfulness of available data	4.33	4.00

Respondents have also rated the effort required for processing students' data when using the DE4A patterns and solutions compared to the traditional situation (1 = considerably more effort, 5 = considerably less effort):

Table 17: Processing of student data

Aspect	USI (n=3)	VC (n=1)
Amount of work	4.67	4.00
Interpretation of data	3.33	4.00
Solving transcription and translation errors, missing data and exceptions	3.33	4.00

Some of the data issues mentioned by respondents are the lack of officially translated content and normalised values for average grades. The benefits of the new procedure are higher compared to the traditional situation, but officially translated and normalised content would be crucial to increase the benefits of the system. 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. This can be exemplified with the inclusion of the average grade in Iteration 2, which will significantly lower the paper validation effort. If all required data is provided, the validation procedure can save significant time, as for example currently the validation procedure at UJI can take days because of the volume of e-mails and phone calls exchanged with some applicants.

Data Evaluators also estimated the benefits of the integrated procedure compared to the costs and effort of customizing eProcedure portals and integrating them with the DE4A connector. As shown in Table 18, the benefits exceed the cost and effort for almost all aspects, (1 = benefits are considerably less than cost and effort, 5 = benefits considerably exceed cost and effort).

Table 18: Estimated benefits to DE / Verifier

Aspect	USI (n=3)	VC (n=1)
Lower manual effort of processing	4.33	4.00
Lower communication costs	3.67	4.00
Lower risk of errors	4.33	4.00
Shorter duration of application processing	4.33	5.00
More complete, valuable, consistent and correct data	4.00	4.00
Trustworthiness of the data	5.00	5.00

As noted above, the ability to obtain normalised data and official translations in the local language would increase benefits. 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).

Data Providers

Similar to Data Evaluators, the pilot partners providing evidence have also estimated the benefits of data provision compared to the costs and effort required to customize evidence portals and integrate them with the DE4A connector or the SSI Authority agent.

Table 19: Evidence request processing effort

Aspect	USI (n=3)
Effort required for processing requests for evidence	4.33

The benefits depend on the existing procedures for issuing diplomas at each participating institution. In Spain, for example, there are currently two ways to obtain diploma information. The first way is to apply at the Higher Education Institution (no single point of contact), either in paper format (great effort for the DO, which needs an infrastructure to attend the student requests in person and print the certificates), or as a signed pdf (no effort for the DO, but not machine-readable for the DE, not all higher educational institutions can offer it this way, and in any case through different procedures). The newest process is through an electronic procedure on the Ministry of Education portal that allows checking the diploma personally or generate a verified link for a third party (not machine readable, no effort for the DO, but some effort for the DE).

Table 20 gives an overview of how two data owners from UC#1 and UC#2 and two VC issuers from UC#3 rate various aspects. Again, it should be noted that this assessment is not based on the piloting with real users and real data in production environment over a longer period of time.

Table 20: Estimated benefits to DO / Issuer

Aspect	USI (n=2)	VC (n=2)
Lower manual effort of processing	5.00	4.50
Lower communication costs	3.50	4.50
Lower risk of errors	5.00	4.50
Shorter duration of application processing	5.00	5.00

Aside from communication costs, it was estimated that all other benefits considerably exceed the cost and effort of customization and integration (the actual effort for the USI pattern is described below in Table 24 and the effort for the VC pattern in Table 25)

The effectiveness of record matching could not be fully evaluated as most students participating in piloting did not use real credentials and real data and the students with real evidence were selected for testing in advance. Nevertheless, record matching remains an important issue. In Spain, 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 to their passport numbers possibly and usually to 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 sensitiveness 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.

Member states

The participating member states were asked to estimate the benefits compared to the costs, effort and time required to setting up and deploying the AS4 gateway, the SMP and the DE4A Connector focusing on implementation, maintenance, training and the duration of application processing (1 =

benefits are considerably less than cost, effort and time, …, 5 = benefits considerably exceed cost, effort, and time). Only one MS provided answers.

Table 21: Estimated benefits to MS

Aspect	Score (n=1)
Effort and cost of implementation	4.00
Effort and cost of maintenance	5.00
Effort and cost of training	4.00
Shorter duration of application processing	5.00

Project and external communities

The pilot has contributed to the expected DE4A benefits as a project and relation to external community of SDG stakeholders in several ways. It has validated the project start architecture, the User-supported Intermediation and the Verifiable Credentials patterns, as well as the canonical model for higher education diplomas. The pilot has also validated the common components such as DE4A Connector and SSI Authority Agent and the underlying evidence exchange infrastructure. Finally, the pilot partners have provided feedback to the SDG semantic working group on the higher education evidence scheme.

3.2.3 Learning towards Adoption

This section describes the lessons learned from initial piloting the Studying Abroad use cases. The knowledge was built in different phases, from customization and integration to testing and was found useful for different purposes, namely to provide it to other work packages, help the adoption of services, and promote sustainability.

Approach to knowledge-building

Knowledge in DE4A was built up in several phases with different actors gaining experience and contributing to the various topics:

- End user feedback forms (online questionnaire for students published on the pilot microsite);
- Internal discussion between service providers and questionnaires for DEs, DOs, and MSs;
- Further discussion between service providers and other governmental institutions;
- Actors with a converging line of work, like other members of the EBSI Early Adopters programme.

Besides generating knowledge, the other aim for this pilot was to share and preserve it for the benefit of all stakeholders, especially other work packages and future adopters. The followed methodology was to keep a direct and ready interaction via e-mail and teleconference with interested parts, seeking a mutual benefit and with the intention to generate discussion. Wiki was also used to share information on the pilot endpoints, use cases, and cross-border interoperability status. The most relevant of these lessons will be documented and reported in this document and the final report, as a source for future adopters. To get more detailed information about the use, value, learning and adoption of the implemented procedures, students' questionnaires as well as questionnaires for DEs and DOs will be revised for the second iteration. Follow-up interviews are also considered for clarification of the feedback and elicitation of further knowledge.

Lessons learned from design, customization, integration and testing

Pilot partners designing, customizing, integrating, and testing their solutions learned various lessons that are gathered in this section. For each lesson learned, a suggestion for adoption is presented. Table 22 summarizes lessons for the analysis and design phase, while the lessons relevant for customization, integration, and testing are presented in Table 23. For every lesson learned, suggestion for adoption is provided in the form of advice to, for example, the European Commission and/or EU Member States.

Table 22: Analysis and design

ID	Topic	Suggestion for adoption	Lessons learned
1.	Design process	SA advises the Member States to invest time to bring together the eIDAS and OOTS knowledge.	The design of national integration required in-depth knowledge of both eIDAS and OOTS. This knowledge (especially the combination of both) is not broadly available in MS as integration with eIDAS and eDelivery infrastructures normally involves different experts. The knowledge of both domains should be brought together.
2.	Scope	SA advises the Member States to pay attention to the difficulties that may arise for some of the SDG procedures from the higher education domain due to national barriers.	Some of the SDG procedures are difficult to be implemented online due to various barriers in MS, such as regional jurisdiction over enrolment to the 1st Bologna degree in Spain, the lack of evidence required for the procedures (e.g. for grant applications, or disparity over the evaluation criteria (e.g. different interpretation of the data).
3.	Evidence	SA advises the Member States to consider burdens imposed by the variety of higher education evidences in MS.	It was difficult to find a common denominator of higher education evidence from the three MS for applications to higher education and applications for study grants (some data required by one MS might not be obtainable from another MS). This will become even more difficult when doing the same among all MS. Many MS also have difficulties to provide the evidence required for certain procedures, e.g. non-academic evidence for the applications for study grants that can contain privacy sensitive data.
4.	Evidence	SA advises the European Commission and Member States to harmonize evidence data models in higher education domain defined by SDG WG and Europass. Furthermore, workshops should aim to include analysis by the largest possible amount of MS to avoid issues where decisions on required evidence types and on mandatory/optional attributes	The pilot suggested to the DE4A Semantic Interoperability Solutions work package WP3 the Europass data model as the basis for the higher education diploma scheme in order to be able to use the same schema for both USI and VC pattern (and thus between SDG OOTS and revised eIDAS regulation).

ID	Topic	Suggestion for adoption	Lessons learned
		for procedures may conflict with data availability.	
5.	Preview	SA advises the European Commission and Member States to consider implementation of Preview at data providers in the case of procedures related to the Studying Abroad life event (this is now included in the final version of the Implementing Regulation).	The preview at DP improves the privacy of the users and allows a better record matching. On the other hand, user experience is somewhat limited by multiple authentications.
6.	Multiple evidence cases	SA advises the Member States to set up national OO gateways (e.g. national data exchange infrastructure acting as gateway/proxy towards cross-border peers and hiding internal details/complexity).	Evidences of multiple types are typically required by calls for study grants. These evidences can be provided by different data providers. National OOTS (e.g. acting as DT for multiple DOs) and centralised preview components that enable single request for multiple evidence types can reduce the complexity of the procedure.
7.	Multiple country scenario	SA advises Member States to focus first on 2-Member States scenario and then make an early start with the analysis of the SDG-implementation where data exchange can involve more than two Member States.	Applications to higher education or for study grants may involve multiple countries if students from MS A have completed part of their education in MS B and wish to access a service in MS C. This complex scenario will not be piloted in the second iteration.
8.	eIDAS non-notified eID	SA advises the European Commission and the MS without notified eIDs to agree on a temporary solution for the use of non-notified eIDs in the SDG procedures (as risk exists of having MS without notified eIDs by the time the SDG OOTS should be integrated with MS infrastructures and operational). Plans for notifications from these MS should be carefully assessed in order to determine negative impacts on citizens. Deployment timelines of eIDAS wallets also have to be considered.	Slovenia does not operate a notified eID at the time of piloting. On a bilateral basis, non-notified eIDs were accepted for piloting purposes, although pilot partners expressed their doubts regarding about acceptability of non-notified eIDs for large-scale SDG. Notification of eIDs is an important prerequisite for SDG implementation.
9.	Clarity and simplicity of the procedures	SA advises the MS to put special emphasis on the clarity and simplicity of the online procedures.	The procedures can become very complex and require multiple interactions with various components, such as eIDAS-based authentication, OOTS, portals, or devices. Clear and

ID	Topic	Suggestion for adoption	Lessons learned
			simple procedures are very important for higher adoption among users.

Table 23: Customization, integration, and testing

ID	Topic	Suggestion for adoption	Lessons learned
1.	Planning and organising tasks	SA advises to allocate a multi-month phase for establishing alignment, priorities, financial means etc. for all organizations involved. Furthermore, it is necessary to have a coordinating team (equipped with sufficient knowledge about the solution) in each Member State to make sure that legal, semantical, technical and managerial issues are being resolved in a timely manner.	The components deployed and used in the pilot were distributed over several authorities in a Member State, requiring the commitment from all authorities.
2.	Planning and organising tasks	SA advises MS to consider in their plans unexpected events that may delay customization, integration, and testing activities.	The unexpected log4J vulnerability at the end of 2021 forced partners to reassess the security of their components and infrastructures and to suspend their integrated services for several weeks. The lack of development resources due to COVID 19 also led to the delays of some of the services.
3.	Hand-over procedure	SA advises the European Commission to put additional efforts in explaining the workings of the SDG OOTS components to public authorities involved.	The design documents and specifications were sometimes interpreted in different ways by the different pilot partners.
4.	Documentation	SA advises the European Commission to invest in proper and clear documentation for developers in Member States, so they can get the OOTS up and running with as less as possible efforts.	The design documents and specifications sometimes lacked necessary details or were changed during the iteration. Clear and detailed documentation was especially important for the organisations that were not pilot partners involved in the day-to-day project activities and lacked the background, such as the subcontractors. It is expected that the Wiki will make life easier for the developers in the second iteration, as now anyone can access its information.

ID	Topic	Suggestion for adoption	Lessons learned
5.	Trust infrastructure	SA advises the European Commission to consider the bureaucratic burden imposed on MS to comply with some legal requisites to obtain the mandatory trust certificates.	The entire process of finding a DE4A domain owner for CEF PKI, clarifying the process for issuing certificates and obtaining production certificates for AS4 gateways and SMPs was considered significant administrative challenge. It has also been troublesome for some MS to satisfy legal requirements, such as the submission of Powers of Attorney, due to unanticipated complex internal procedures.
6.	Integration of DP and DC	SA advises Member States to consider the concept of national central services where different DEs and DOs can connect to.	The concept of a Connector with an integrated AS4 gateway allowed for easier integration of DEs and DOs in the USI pattern. Decoupling the exchange and business layers allows for abstraction and adds flexibility to the exchange model.
7.	Integration of DP and DC	SA advises the European Commission to prepare reference implementations of common components that Member States can use for integration.	The DE4A Connector reference implementation helped MS to integrate their data evaluators and data owners and enable connectivity between the states more easily.
8.	Integration of national components	SA advises Member States to foresee as much as possible the constraints of internal decision-making procedures inside MS.	Deployment delays were undergone in some Member States due to the complexity of internal IT department procedures, additional security audits and subsequent testing of the overall architecture and individual components.
9.	Integration of national components	SA advises Member States not to underestimate the effort to integrate national systems with the central components and infrastructure.	The system is very complex and required significant effort to learn the technical specifications. Integration with the project infrastructure and other national systems was more complicated than originally anticipated by the partners, also due to involvement of multiple organisations.
10.	Integration of national components	SA advises the European Commission to foresee probable different levels of progress in the MS development/deployments.	Multiple adjustments were required to cope with different states of progress in the MS internal developments and deployments.
11.	Integration of national components	SA advises the European Commission and Member States to make available Playground for integration testing.	The DE4A playground with mock DE, mock DO test connectors and shared test SMP proved successful for validating national connectors and

ID	Topic	Suggestion for adoption	Lessons learned
			SMP installations and easier DE and DO integration.
12.	Interoperability testing	SA advises to test thoroughly connectivity / interoperability between Member States prior to cross-border Connectathon sessions for endpoints.	Connectivity and cross-border interoperability between endpoints were successfully tested at DE4A Connectathons where developers from pilot partners had previously fixed other interoperability issues. Sharing of information about up-to-date key technical configurations (identifiers, redirection URLs…) was of paramount importance as end-to-end connectivity depends completely on having these configurations correctly implemented.
13.	Interoperability testing	SA advises the European Commission and Member States to arrange coordinated exchange of test credentials	Cross-border interoperability testing requires easy access to test credentials of the test users with various test evidences.
14.	Cooperation	SA advises the European Commission and Member States to establish a channel for collaboration of the MS technical experts	Slack appeared to be a good tool for collaboration between developers from different MS / WPs.

Pilot partners have also estimated the required effort for various steps, such as integrating the DE4A Connector or implementing the Preview functionality. Effort for both patterns is summarized in the following tables based on answers from three DEs and one DO for the USI pattern, two VC issuers, one VC verifier, and one MS. This effort excludes preparation of different environments (test, preproduction, production), obtaining production certificates, and additional security assessments required by IT departments of the pilot participants.

Table 24: Estimation of effort for the USI pattern

Phase	Mean effort (in person days)
Setting up and deployment of external AS4 gateway (n=1)	17.50
Setting up and deployment of DE4A Connector (n=1)	1.50
Setting up and deployment of SMP (n=1)	3.50
Integration of the portal with an eIDAS node (n=4)	8.00
Integration with DE4A Connector (n=4)	7.38
Implementation of Explicit Request (n=3)	7.33
Implementation of Preview (n=1)	2.50
Transformation to canonical format and provision of the requested evidence (n=1)	3.50
Transformation from canonical format and use of the received evidence (n=3)	6.33

Phase	Mean effort (in person days)
UI internationalization (n=4)	3.13
Overall effort for DE (n=3)	34.00
Overall effort for DO (n=1)	19.00

DE4A Connector already integrates Phase4 AS4 gateway, which makes setting up AS4 gateway very easy. More effort (17.5 person days) was needed by Spain in case of the test deployment of Domibus that is more complex and static configuration is highly dependent on other participants involved.

Due to a small number of respondents and the fact that DO was integrated with the connector by the developers of the connector (WP5 leader) that are more familiar with the DE4A central components than other partners, it is difficult to compare the overall effort for DE and DO implementation and integration. Other potential reasons on the difference between DO and DE could be that DO has a simpler application flow that feeds on pre-existing data sources, whereas the DE has to integrate a new data format and application flow changes on a pre-existing application, which is more difficult. A phase that might require further investigation in the second iteration is identity matching adaptation at DOs for cross-border users, as in the first iteration, all students were coming from an evidence providing country.

Table 25: Estimation of effort for the VC pattern

Phase	Mean effort (in person days)
Integration of the SSI Authority agent with the portal (n=3)	2.80
Customization of the portal (n=3)	2.80
Transformation to canonical format and provision of the requested evidence (n=2)	2.80
Data transformation from canonical format and use of evidence (n=1)	1.00
UI internationalization (n=3)	1.50
Overall effort for Issuer (without eIDAS integration) (n=2)	10.00
Overall effort for Verifier (without eIDAS integration) (n=1)	8.00

Technical, semantic and organisational/legal knowledge provided to other WPs

The Studying Abroad pilot has been in constant interaction with other work packages collaborating and providing mutual benefit through discussion and feedback. Several lessons learned have been beneficial to other WPs and are being considered for the second iteration.

Table 26: Lessons learned for other WPs

ID	Topic	Suggestions	Lessons learned
1.	Evidence	Evidence should be complete with normalized values and officially translated content. Different versions of a canonical evidence with only mandatory elements could be defined instead of one	The effort reduction in processing the evidence cannot be fully achieved if not all data required by the specific procedure is included in the evidence. For example, Spain requires (normalized)

ID	Topic	Suggestions	Lessons learned
		version that also includes optional elements.	average degree in a diploma for ranking enrolled students and official translations.
2.	Documentation	SA advises WP5 to improve the presentation of the technical documentation for the second iteration.	Clear specifications and integration guidelines are needed by the developers. The technical documentation still has room for improvement in structure, clarity and presentation.
3.	Implementation of the VC pattern	SA advises WP5 to simplify the flow and extend the mobile application with extended logging functionalities.	Clarity and simplicity of the implemented procedures in all three use cases could be improved. In UC#3, a student has to interact many times with both the portal and the mobile application. The students were also unable to provide richer information in the case of errors.

Other lessons from interaction with other initiatives

To pilot the UC#3, the proposed VC pattern requires an interaction between the SSI Authority Agent (deployed on the Issuer/Verifier side) and the EBSI (European Blockchain Service Infrastructure) using the APIs defined at the level of ESSIF (European Self-Sovereign Identity Framework). The interaction is of high importance, as the Issuers use EBSI-compliant DIDs to sign the issued VCs (i.e., Verifiable Attestations - Diplomas), whereas the Verifiers validate the submitted VPs from students by retrieving information about the diploma issuer from the EBSI Trusted Issuers Registry (TIR). Both parties need to be able to constantly communicate with EBSI DID Registry and TIR in order to ensure the validity and transparency of the entire process flow.

During the pilot implementation, the EBSI API endpoints were frequently changing due to new releases, which presented a bottleneck to the pilot implementation efforts, since new changes required changes in the SSI agent implementation. By the end of the first iteration, the EBSI APIs were more stable and mature and the interaction with EBSI was stable enough to proceed with the piloting the VC pattern in pre-production.

However, some features (e.g. registering the Issuer into the EBSI TIR) are still not supported by the EBSI APIs and cannot be done fully automatically at this point of time, so the Issuer organizations need to put additional efforts into the direct communication with EBSI Support team.

The diplomas issued in the VC form follow the Europass data model, which has also been implemented in the ESSIF's diploma schema. Nevertheless, the standardization of the ESSIF diploma schema is still an undergoing effort (including also the availability of relevant APIs), so the current VCs issued by the Issuers are using the W3C data model schema but introduce the diploma-related Europass data model's attributes as well (e.g. achievements).

Furthermore, the VC pattern focuses on immediate relation/connection between the SSI and the eID/eIDAS technical backgrounds, thus we excluded the idea of students having ESSIF Verifiable IDs (based on EBSI DIDs) and introduced the eIDAS Minimum Data Set as additional parameters in the VC. This additionally deviates from the EBSI/ESSIF VC schema, so the schema validation process on the Verifier side is performed "manually" by using HL Aries and external library instead of registering it in the EBSI Trusted Schema Registry. However, there are ongoing discussions with the EBSI/ESSIF schema development team to register the DE4A VC schema, but the process requires an approval from the EBSI team and, hence, it may be delayed.

3.2.4 Overview of the success criteria results

In this subsection, the success criteria results are summarised in relation to the metrics as defined in detail in D4.2. For each metric, a target value is provided. The target values were established beforehand to the piloting phase (see D4.2 [2]) and were discussed between the pilots considering piloting conditions and realistic expectations to find an adequate balance for them. The results are grouped by data evaluators, data owners, students, member states, and project-oriented goals.

Data evaluators

Table 27: Criterion A1

Criterion A1	The DE recognizes the student data as of higher quality.
Metric A1.1	The appreciation the DE expresses on quality of student data.
Target	More than 50% of respondents appreciate the quality (average of all perspectives) of student data when using the DE4A solution compared to the traditional situation where the DE4A solution is not used.
Results	All DE respondents appreciate the quality of the student data with an average value (of all perspectives) of 4.45 for the USI pattern and 4.17 for the VC pattern, as shown in Table 16, where 4.00 = 'high' and 5.00 = 'very high'.

Table 28: Criterion A2

Criterion A2	The DE recognizes the student data as easier to process.
Metric A2.1	The appreciation the DE expresses on the effort required for processing the student data.
Target	More than 50% of respondents appreciate the effort required for processing student data when using the DE4A solution compared to the traditional situation where the DE4A solution is not used.
Results	All DE respondents appreciate the effort required for processing the student data with an average value of 3.78 for the USI pattern and 4.00 for the VC pattern, as shown in Table 17, where 3.00 = 'same effort' and 4.00 = 'less effort'. The evidence validation procedure can save significant time, as currently it can take days because of the volume of e-mails and phone calls exchanged with some applicants

Table 29: Criterion D2

Criterion D2	The DE believes the cost and effort for integrating to the DE4A Connector will eventually be outweighed by the benefits.
Metric D2.1	The estimate of the DE on the benefits of the DE4A OOP TS in comparison with the effort and cost spent to customize the eProcedure portal and integrate with the DE4A Connector.
Target	More than 50% of respondents estimate that the benefits of using the DE4A OOP TS will exceed the costs and effort required to integrate the eProcedure portal with the DE4A Connector.
Results	All DE respondents estimate that the benefits of using the DE4A OOP TS will exceed the costs and effort required to integrate the eProcedure portal with the DE4A Connector with an average value (over all perspectives) of 4.28, as shown in Table 18, where 4.00 = 'exceeding cost and effort' and 5.00 = 'considerably exceeding cost and effort'.
Metric D2.2	The effort (measured in person days) for customizing and integrating the eProcedure portal to the DE4A Connector.
Target	None
Results	As presented in Table 24, the average effort for customizing and integrating the eProcedure portal to the DE4A Connector was 34 person days. The effort excludes preparation of different environments (test, preproduction, production), obtaining production certificates, and additional security assessments required by IT departments of the pilot participants. Due to the small number of pilot participants and the differences in their experience with the DE4A components (DO was implemented by the connector developers) it is difficult to compare the DE and DO implementation efforts.

Table 30: Criterion E2

Criterion E2	The DE believes the cost and effort for integrating the SSI Authority agent will eventually be outweighed by the benefits.
Metric E2.1	The estimate of the DE on the benefits of the SSI Authority agent usage in comparison with the effort and cost spent to customize the eProcedure portal and integrate it with the SSI Authority agent.
Target	More than 50% of respondents estimate that the benefits of using the SSI Authority agent will exceed the costs and effort required to integrate the eProcedure portal with the SSI Authority agent.
Results	All DE respondents estimate that the benefits of using the SSI Authority Agent will exceed the costs and effort required to customize the eProcedure portal and integrate it with the SSI Authority agent with an average value (over all perspectives) 4.33, as shown in Table 18, where 4.00 = 'exceeding cost and effort' and 5.00 = 'considerably exceeding cost and effort'.
Metric E2.2	The effort (measured in person days) for integrating the SSI Authority agent in the eProcedure portal.
Target	None
Results	As presented in Table 25, the average effort for integrating the SSI Authority Agent in the eProcedure portal was 2.8 person days. The total effort including customization of

Criterion E2	The DE believes the cost and effort for integrating the SSI Authority agent will eventually be outweighed by the benefits.
	the portal (excluding eIDAS integration) was 8 days. The effort excludes preparation of different environments (test, preproduction, production).

Data owners

Table 31: Criterion B1

Criterion B1	The DO recognizes the requests for evidence as easier to process.
Metric B1.1	The appreciation the DO expresses on the effort required for processing requests for evidence.
Target	More than 50% of respondents appreciate the effort required for processing student data when using the DE4A solution compared to the traditional situation where the DE4A solution is not used.
Results	Two thirds of the respondents appreciate the effort required for processing the evidence requests and one third find the effort the same as before. As shown in Table 19, the average value was 4.33, where 4.00 = 'less effort' and 5.00 = 'considerably less effort'.

Table 32: Criterion D1

Criterion D1	The DO believes the cost and effort for customizing the Evidence portal and data service and integrating to the DE4A Connector will eventually be outweighed by the benefits.
Metric D1.1	The estimate of the DO on the benefits of the DE4A OOP TS usage in comparison with the effort and cost spent to customize the Evidence portal and integrate with the DE4A Connector.
Target	More than 50% of respondents estimate that the benefits of using the DE4A OOP TS will exceed the costs and effort required to integrate the Evidence portal with the DE4A Connector.
Results	All DO respondents estimate that the benefits of using the DE4A OOP TS will exceed the costs and effort required to integrate the Evidence portal with the DE4A Connector with an average value (over all perspectives) 4.63, as shown in Table 20, where 4.00 = 'exceeding cost and effort' and 5.00 = 'considerably exceeding cost and effort'.
Metric D1.2	The effort (measured in person days) for customizing and integrating the Evidence portal to the DE4A Connector.
Target	None
Results	As presented in Table 24 the average effort for customizing and integrating the Evidence portal to the DE4A Connector is 19 person days.

Table 33: Criterion E1

Criterion E1	The DO believes the cost and effort for integrating the SSI Authority agent will eventually be outweighed by the benefits.
Metric E1.1	The estimate of the DO on the benefits of the SSI Authority agent usage in comparison with the effort and cost spent to customize the Evidence portal and integrate it with the SSI Authority agent.

Criterion E1	The DO believes the cost and effort for integrating the SSI Authority agent will eventually be outweighed by the benefits.
Target	More than 50% of respondents estimate that the benefits of using the SSI Authority agent will exceed the costs and effort required to integrate the Evidence portal and data service with the SSI Authority agent.
Results	All DO respondents estimate that the benefits of using the SSI Authority Agent will exceed the costs and effort required to customize the Evidence portal and integrate it with the SSI Authority agent with an average value (over all perspectives) 4.63, as shown in Table 20, where 4.00 = 'exceeding cost and effort' and 5.00 = 'considerably exceeding cost and effort'.
Metric E1.2	The effort (measured in person days) for integrating of the SSI Authority agent in the Evidence portal.
Target	None
Results	As presented in Table 25 the average effort for integrating the SSI Authority Agent in the portal is 2.8 person days. The total effort including customization of the portal (excluding eIDAS integration) is 10 days.

Students

Table 34: Criterion C1

Criterion C1	The user acknowledges the procedure for applying for a service as efficient, effective and secure.
Metric C1.1	The satisfaction the user expresses on effectively completing the eProcedure.
Target	More than 50% of respondents are satisfied with the implemented procedure.
Results	As shown in Figure 16, 56% of the students were satisfied or very satisfied with the overall experience of the completed procedures in the three use cases.
Metric C1.2	The satisfaction the user expresses on the eProcedure as being time-efficient.
Target	More than 50% of respondents are satisfied with the duration of the procedure.
Results	As shown in Figure 16, 77% of the students were satisfied or very satisfied with the duration of the procedures.
Metric C1.3	The appreciation the user expresses on the eProcedure security and protection of his/her privacy.
Target	More than 50% of respondents are satisfied with the security and privacy protection.
Results	As shown in Figure 16, 85% of the students were satisfied or very satisfied with the security and privacy protection.
Metric C1.4	Control is given to students when managing their education credentials
Target	More than 50% of respondents are satisfied with the control they have when managing their education credentials.
Results	As shown in Figure 16, 81% of the students were satisfied or very satisfied with the control they had when managing their education credentials. There is no significant difference between the students using the USI (80,6%) or VC (81,3%) pattern.

Member states

Table 35: Criterion D3

Criterion D3	The participating Member State believes the cost and effort for setting up and deploying the AS4 gateway, the SMP and the DE4A Connector will eventually be outweighed by the benefits.
Metric D3.1	The appreciation the Member State expresses on the effort, cost and time needed for deploying the AS4 gateway (if separate from the DE4A Connector), the SMP DE4A Connector.
Target	More than 50% of respondents believe the cost and effort for setting up and deploying the AS4 gateway, the SMP and the DE4A Connector will eventually be outweighed by the benefits.
Results	Only one MS provided these data for the first iteration. The MS believes that the benefits will exceed the effort and cost of implementation, maintenance and training, as shown in Table 21.
Metric D3.2	The effort (measured in person days) for deploying the DE4A OOP TS.
Target	None
Results	Only one MS provided these data for the first iteration. It takes approximately 3.5 days to set up an SMP and 1.5 day to deploy DE4A connector with an integrated phase4 AS4 gateway. Integration of an external AS4 gateway (Domibus in particular) takes between 15 and 20 days due to complex, static configuration highly dependent on other participants involved, as shown in Table 24.

Project oriented criteria

Table 36: Criterion F1

Criterion F1	Real education services are developed, successfully connected, and piloted as fully online cross-border procedures to the DE4A interoperability infrastructure by the respective pilot partners
Metric F1.1	The functional tests are successful, the cross-border services are in use, and the evidence is provided in electronic structured format from trustworthy sources.
Target	All tests are performed successfully
Results	Majority of the tests were performed successfully, but not all of them. As presented in Section 2.3, one combination was postponed and three were enabled for limited testing. Portuguese students also used test evidences for piloting in the first iteration.

Table 37: Criterion F2

Criterion F2	The Higher Education Evidence Models have proven adequate for cross-border exchange of information on students for the SA eProcedures
Metric F2.1	The appreciation of the DE on the extent to which the Higher Education Evidence Model fits their needs.
Target	None (research topic)
Results	In the first iteration, only one of the evidence models (Higher education diploma) was piloted. As shown in Table 14, its overall assessment was 4.15, where 4 = 'high' and 5 = 'very high'. Inclusion of the average grade information into the higher education

Criterion F2	The Higher Education Evidence Models have proven adequate for cross-border exchange of information on students for the SA eProcedures
	diploma evidence is required for the second phase to enable ranking of the applicants in Spain. The average grade element has already been added to the data model for the second pilot iteration.

Table 38: Criterion F3

Criterion F3	The explicit request and preview requirements as specified in the SDGR have proven suitable for higher education eProcedures
Metric F3.1	The users' appreciation on clarity of the Explicit Request and Preview steps.
Target	None (research topic)
Results	As described in Section 3.2.1, majority of users (71% for Explicit Request and 75% for Preview) appreciated clarity of the Explicit Request and Preview steps.

Table 39: Criterion F4

Criterion F4	The mechanisms for record matching at the DO have proven adequate for the SA eProcedures
Metric F4.1	The appreciation of the DO on the effectiveness and difficulties of record matching on students.
Target	None
Results	The effectiveness of record matching could not be fully evaluated as most of the students participating in piloting in the first iteration did not use real credentials (77%). Spanish students with test credentials user real, but randomly selected and anonymized data, while Slovenian students were preselected. This is planned to be more fully evaluated in the second iteration.

3.3 Technical common criteria

From a technical perspective, the services piloted in DE4A must adhere to several common criteria. The following Table 40 describes how each of the DE4A technical common criteria was met by the pilot in the first iteration.

Table 40: Reflection per technical common criteria

ID	Criterion	
1.	Openness	The services are based on open source software technologies to avoid a lock-in effect and allow fast adaptation to the business needs. The common components developed within DE4A are available in GitHub and the entire documentation is publicly accessible on DE4A wiki.
2.	Transparency	All pilot-related procedures are traceable and transparent for all the stakeholders involved and interoperability supported on availability of interfaces to systems and data. The procedures and their status are described in DE4A wiki and the DE4A SA pilot microsite. The students were informed on the piloting conditions and what it meant to participate in the pilot by their pilot session supervisors, through the microsite, an on the

ID	Criterion	
		procedure portals. Internally, a MoU also provides for MS authorities transparent information on requirements, assurances and limitations in relation to piloting.
3.	Reusability	The procedures use existing building blocks (e.g. CEF), standards, and infrastructure (e.g. eIDAS and authentic evidence sources), as well as DE4A building blocks, such as DE4A Connector or Authority agent (see Section 3.2.1). EBSI/ESSIF building blocks were used at their current stage of development by the Authority Agent to implement the functionalities of the DE4A SSI supporting framework (e.g. registering the identifiers of Issuers/Verifiers in the EBSI registries, i.e. ledger).
4.	Technological neutrality and data portability	The majority of the service infrastructure does not depend on vendor-specific technologies (e.g. specific AS4 gateway implementation) or specific technical implementations but rather re-uses open source software, which further enables the ease of data sharing/free movement of data. The only exception is a DE4A digital wallet that has only been developed for Android-based mobile phones given resource limitations, but which can be used with different Android versions.
5.	User-centricity	In all three use cases, users are given control when managing their educational credentials, i.e. higher education diplomas, and this control has been highly appreciated by the pilot participants, as shown in Figure 16. UC#1 and UC#2 implemented and piloted user-centric features of the USI pattern, such as reauthentication and Preview at the data provider side. User-centric SSI approach was piloted in UC#3.
6.	Inclusion and accessibility	The services offer an acceptable degree of usability that depends on the standards applied by the pilot partners. Nevertheless, the clarity and the simplicity of the procedures could be improved as mentioned by some of the pilot participants. This has already been considered for the second iteration by simplifying the procedure in UC#3. Most of the services are available in both English and national language.
7.	Security and privacy	Authenticity, integrity and confidentiality of data exchanged through the common infrastructure is guaranteed in UC#1 and UC#2 by the eDelivery systems and the TLS connections between DEs and DOs and connectors. Verifiable credentials in UC#3 are digitally signed to ensure authenticity and integrity. Secure communication in UC#3 is guaranteed with the DIDComm protocol and reading of a QR code to link mobile and PC sessions. For privacy-protection, a MoU was signed by all MS and Data Protection Officer (DPO) was designated before and during the project. Users preview their evidence before transfer across borders and decide by themselves whether to give consent or not for the transfer. No incidents occurred during the pilot run. Security and privacy have been highly appreciated by the pilot participants, as shown in Figure 16.
8.	Administrative simplification	As described in previous sections, DEs and DOs appreciate the reduction in effort required for processing of student data. Currently, non-DE4A evidence validation procedure at DEs can take days because of the volume of e-mails and phone calls exchanged with some applicants

ID	Criterion	
9.	Effectiveness and efficiency	The piloted procedures produce the intended result and enable the students, DEs and DOs to accomplish their goals. Students' overall experience of the procedures will be further improved in the second iteration, e.g. by offering an option to get multiple evidence with only one request and by simplified VC pattern implementation and improved DE4A mobile digital wallet.

4 Pilot Procedures

4.1 Cross-border pilot testing approach

Connectivity of the Member states and cross-border interoperability between data consumers and data providers was tested at several DE4A Connectathons (almost 30) where developers from all pilot partners participated.

First, connectivity of the DE4A connectors was tested with the help of mock DEs and mock DOs from the playground. Then, integration of real DEs and DOs was validated with mock DOs and mock DEs respectively. In the final stage, cross-border interoperability of real DEs and real DOs was tested. Both happy and unhappy flows were investigated:

- DE4A Connectivity
  - Happy flow, unhappy flow (no evidence, rejected preview)
    - Mock DE – DR (MS A) – DT (MS B) – Mock DO
    - Mock DE – DR (MS B) – DT (MS A) – Mock DO
- Integration of endpoints
  - Happy flow, unhappy flow (no evidence, rejected preview)
    - DE (MS A) – DR (MS A) – DT (MS B) – Mock DO
    - Mock DE – DR (MS B) – DT (MS A) – DO (MS A)
- Cross-border interoperability of endpoints
  - Happy flow, unhappy flow (no evidence, rejected preview)
    - DE (MS A) – DR (MS A) – DT (MS B) – DO (MS B)

Table 41 lists all Connectathons with participation of the Studying Abroad pilot partners and their main activities or results. The list could have been shorter and the Connectathons more effective, especially after April 2022, when numerous technical issues were encountered at Connectathons because of the inconsistencies of the participants' and endpoints' data in the connectors and SMPs in the test, preproduction and production environments. Guidelines for participation in Connectathons have been prepared for the second iteration that ask for more detailed preparation and configuration testing prior to the Connectathons.

Table 41: Connectathons

No.	Date	Activities/results
1.	6.10.2021	Validated DE4A connectivity between Slovenia and Spain; validated cross-border interoperability of JSI-SI DE and ES-SGAD UC#2 DO
2.	7.10.2021	Achieved DE4A connectivity between Portugal and Slovenia and between Portugal and Spain
3.	26.11.2021	Testing of JSI-SI DE and ES-UJI UC#1 DE with PT-INESC-ID UC#1 DO, testing of PT-INESC-ID UC#1 DE with ES-SGAD UC#1 DO
4.	17.12.2021	Testing preview functionality of SI-MIZŠ UC#1 DO, resolving connectivity issues with the new Kafka server
5.	21.12.2021	Testing of SI-MIZŠ UC#3 DE and SI-MIZŠ UC#1 DE
6.	11.1.2022	Testing of SI-MIZŠ UC#3 DE and SI-MIZŠ UC#1 DE
7.	18.1.2022	Resolving connectivity issues with PT connector
8.	25.1.2022	Testing of PT-INESC-ID UC#1 DE and PT-INESC-ID UC#1 DO

No.	Date	Activities/results
9.	1.2.2022	Validated cross-border interoperability of PT-INESC-ID UC#1 DE with SI-MIZŠ UC#1 DO, validated PT-INESC-ID UC#3 DE (Verifier) with test VCs
10.	4.2.2022	Testing of UJI-DE and JSI-DE with PT-INESC-ID UC#1 DO
11.	8.2.2022	Validated cross-border interoperability of PT-INESC-ID UC#1 DE with ES-SGAD UC#1 DO
12.	11.2.2022	Validated cross-border interoperability of JSI DE with PT-INESC-ID DO
13.	15.2.2022	Validated cross-border interoperability of UJI DE with SI-MIZŠ UC#1 DE
14.	18.2.2022	Testing of UJI-DE with PT-INESC-ID UC#1 DO
15.	22.2.2022	Validated PT-INESC-ID UC#3 DO (Issuer), testing of UJI-DE with PT-INESC-ID UC#1 DO
16.	25.2.2022	Validated ES-SGAD UC#3 DO (Issuer)
17.	1.3.2022	Validated cross-border interoperability of PT-INESC-ID UC#3 DE (Verifier) with ES-SGAD UC#3 DO (Issuer)
18.	22.3.2022	Testing of UC#1 MIZS DE with ES DO and PT DO
19.	29.3.2022	Testing of SI SMP and the preproduction environment
20.	5.4.2022	Testing of the preproduction environment
21.	12.4.2022	Testing of the preproduction environment
22.	19.4.2022	Testing of the preproduction environment
23.	26.4.2022	Testing of the preproduction environment
24.	3.5.2022	Testing of the preproduction environment
25.	17.5.2022	Testing of the preproduction environment
26.	17.6.2022	Validation of MIZŠ DE-ES DO and SI Verifier-ES Issuer
27.	21.6.2022	Troubleshooting of several combination in UC#3
28.	27.6.2022	Troubleshooting of several combination in UC#3

4.2 End users' engagement progress and dissemination/impact activities

The core of the user-engagement strategy was to ensure there was enough number of users for whom the cross-border services were aimed to in order to achieve a successful set of piloting activities. The following table shows the users who were eligible for the first iteration, as their data was available in the integrated data and could be exchanged through the DE4A OOP Technical System or with Verifiable Credentials/Verifiable presentations.

Table 42: Eligible users for piloting in the first iteration

MS	Data owner
ES	Students of University Jaume I with the 1st level Bologna degree diploma
SI	All Slovenian students with the 1st level Bologna degree diploma
PT	Students of Instituto superior Técnico (University of Lisbon) with the 1st level Bologna degree diploma

D4.2 considered four user groups for the Studying Abroad piloting: local users, focus group users, unknown but reachable users, and unknown users. Due to the postponement of the pilot launch from October 2021 to February 2022 and thus limited time for collecting and analysing feedback only the first two groups were targeted in the initial running phase. Other users from the three groups (Table

42) will be invited for piloting in the final running phase, e.g. students from other departments of the participating universities. We expect to increase the number of students using the services and providing feedback, but it should be noted that testing will again be mainly by invitation and supervised, as the testing period does not overlap with open official calls for enrolment and there will be no legal consequences of submitted applications.

Local users were students who used the pilot during the testing phase. This user group included a couple of users from each participating higher education institutions (University of Maribor, University Jaume I) and the research institutions with students (INESC-ID) who were somehow involved in the project activities.

The focus group included students who used the pilot once the service had gone live. These users also belonged to the participating higher education and research institutions mentioned in the previous paragraph. The users have been asked to provide formal feedback through an online evaluation tool to help us understand their views on the pilot. Prior to their participation in the pilot, the students were provided with participation guidelines, including service walkthroughs and the recordings of the procedures. The participation guidelines have been published in the pilot microsite (https://www.de4a.eu/studyingabroadpilot).

In the rest of this subsection, more details about user engagement activities of the participating Member States are provided.

4.2.1 Portugal

INESC-ID devised a strategy to engage students from IST for the pilot, as explained in D4.2. However, due to the complexities of the development, integration, configuration, and external to the pilot, there was not enough time for that process. Moreover, real students apply to programs in specific times of the year, that do not match the time the consortium was completing the first iteration of the pilot. Therefore, INESC-ID engaged in the pilot real students from IST that were doing their MSc or PhD at the lab or with whom they had direct contact, but that did not specifically aim to apply to a program in a university in Spain or Slovenia at this stage.

4.2.2 Slovenia

The Slovenian students who were participating in the pilot testing had been selected from the University of Maribor, Faculty of Electrical Engineering and Computer Science (FERI). Due to the short time period, UM directly engaged master's and PhD students currently studying at FERI with advanced IT skills. UM checked that the information about their previous study degrees in Slovenia can be provided by the relevant ministry. The selected students did not plan to apply for any international programmes at other universities, but they were willing to test the solutions developed within the pilot and consent that their education data was used for piloting purposes.

4.2.3 Spain

The student office and the international relations office in UJI have been contacted to request volunteering students to perform controlled tests outside of the official enrolment periods. Also, it has been requested to identify incoming students from the other participating member states, to check if they are eligible to perform production tests or, if they have already spontaneously used the DE4A data retrieval, survey their experience, both in the dimensions of usability and of acceptance. The dissemination of the pilot has gone through the common internal channels (meeting with other units/executive level representatives, publication on internal newsletter) and has been presented to national (informally, several times to the NREN, but planned contributions to upcoming NREN congresses are in scope) and international IT and education congresses (e.g. EUNIS22).

4.3 Pilot governance and internal progress reporting

This subsection outlines how the DE4A pilots' governance, proposed in D4.2, was executed. The main goals of the pilot governance were:

- Continuous supervision of pilot activities to ensure the execution of the pilots was aligned with project target outcomes and expected impacts. To achieve this the prompt reaction to any issue was necessary and advisory support to the follow-up of preventive measures. This monitoring facilitated the fulfilment of the Executive Board duties which have been periodically reported to the decision bodies of the project (i.e. MS-Council).
- Adequate and timely management of either those situations common to the three pilots requiring a common direction across them (Pilots Coordination with weekly teleconferences between Atos and the Pilot Leaders) and/or situations which require escalation to higher management levels and/or coordination from Technical Working Group, i.e. they could have a project-wide impact.
- Integrated reporting to the management work package (WP9) and DE4A management and decision bodies including the Project Coordinator and the Member State Council.

Effective coordination within the pilot management level was provided by the pilot supervisory team (PST), consisting of the pilot leader and representatives of each of the partners involved in the pilot. The PST meetings were the current regular weekly pilot meetings where all pilot partners were participating. In the meetings, internal decisions were taken on the pilot, continuously assessed the running of the pilot online services and on-going activities of the running phase and agreed on the problems that needed to be raised to the DE4A Technical Working Group and the DE4A Executive Board. Project partners not officially participating in the pilot but involved in the implementation of the common infrastructure (e.g. the partners responsible for the national connectors) were also invited to some of the meetings. The PST was chaired by the pilot leader. Due to the small number of people involved in the pilot, it was not necessary to set up special internal groups.

In terms of pilot governance, the Executive Board supported the management of the operational activities during the live running of the pilot as a decision-making body guided by the information provided by the PST (represented by the Pilot Leader).

The Executive Board shared with the PST the responsibility of governing the running phase of the pilots (including an effective implementation of the decisions of the MS Council). It provided advice supporting issue resolution based on feedback provided by the Pilot Leader on behalf of the PST.

The Executive Board focused on those problems that were common to all pilots and relevant issues related to running phase activities that required support beyond pilot level management, for example obtaining CEF certificates for the DE4A connectors and SMPs.

The Executive Board is chaired by Project Coordinator (ATOS) and the conference call is every two weeks. Minutes are being produced after every teleconference and the MS-Council is informed or asked for support for especially critical issues as well based Executive Board conclusions when needed.

4.4 Knowledge exchange among pilot partners

This section briefly summarizes how the pilot partners exchanged knowledge they gained from running the pilot. There were five main channels to exchange knowledge among themselves: regular pilot meetings, e-mailing list, Owncloud, Slack, and Wiki. Pilot meetings were organized every week to discuss the pilot progress and share experience with the common components, DEs, DOs, Verifiers, and Issuers. Between the meetings, the pilot and project e-mailing lists were mainly used as well as various Slack channels focused on different patterns and the DE4A connector. Owncloud served as the main document repository to document gained knowledge. Wiki was primarily used to describe the three use cases, pilot objectives, as well as status of endpoints and cross-border interoperability status.

4.5 Stabilisation of pilot experience and user support

Experience gained during the first iteration of the pilot will mainly be used for improvements in the second iteration (see Section 4.6). In the first phase, participating guidelines and the Frequently Asked Questions section were regularly updated in the Studying Abroad pilot microsite (https://www.de4a.eu/studyingabroadpilot). Frequently Asked Questions, for example, help the students to understand goals of the pilot, who and how can participate in the pilot, and where to get a valid eID and a DE4A digital wallet for a mobile phone. For each launched service, a walkthrough was prepared that demonstrates the service use and published in the microsite. Supervised students were also given support during piloting by their supervisors, if needed.

4.6 Planned improvement following received feedback

This section summarizes planned changes and improvements based on the feedback on the design, customization, implementation, and testing in the first iteration.

4.6.1 Canonical scheme of the diploma evidence

The canonical scheme of a higher education diploma evidence was defined in collaboration with WP3. The data owners from the pilot also prepared examples of the canonical evidence for each MS for the DE4A playground. Following feedback from DOs and DOs, two issues could be considered for the final phase:

- ***Average grade***: The average grade information is required on UJI to rank applicants and was identified as mandatory information for the application process in production. The element was not included in the final version of the schema for the first iteration, because it cannot be provided by the Slovenian Ministry of Education, Science and Sport (DO in the pilot). The pilot partners have agreed to include the average grade in the scheme in the final iteration. In Slovenia, the University of Maribor has to provide this information to the Ministry. WP3 has already updated the canonical scheme with a new element that also enables the specification of a grading scheme needed for the translation of grades between two MS.
- ***Mode of study***: The original diploma evidence in Slovenia does not contain information about the mode of study as currently defined in the canonical scheme (full-time, part-time, distance learning). Instead, the Central evidence system for higher education in Slovenia (eVŠ) includes in production information on the method of study, with similar values but with different meanings. Part-time study in Slovenia has the same scope and level of difficulty as the full-time study but differs in the organisation and distribution of study work and requirements. Part-time students must also pay fees.

4.6.2 VC pattern and mobile application

As a result of the testing with students, the VC issuance and verification procedures in UC#3 will be simplified by reducing the number of user interactions with the portals and mobile application. Extended error logging functionality will also be added to the DE4A digital wallet to obtain richer data in the case of errors or interruptions.

4.6.3 Feedback collection

Questionnaires for students, DEs, DOs, and MSs will be revised for the second iteration to obtain more detailed information on specific issues, e.g. parts of the procedures that are not clear or simple enough.

4.6.4 Updates to the final iteration plan

The final iteration of the pilot will run from September 2022 till one month before the end of the project. This section summarises its scope and the updates to the iteration plan as compared to D4.2.

Scope:

Use case 1 (Application to higher education)

- Application to Bachelor studies (1st Bologna level) will be enabled in Slovenia and Portugal as DEs and in Spain as DO;
- Additional evidence type will be used proving completion of secondary education;
- Average grade will be included in the higher education diploma evidence;
- New way of user redirection in the USI pattern will be implemented;
- Multi-evidence case (multiple evidences of the same type) will be supported in PT: students will be able to submit two higher education diplomas.

Use case 2 (Application for study grants)

- Additional non-academic evidence type will be used;
- New way of user redirection in the USI pattern will be implemented;
- Multi-evidence case (multiple evidences types) will be supported: the students will be able to request at the same time evidence of different types from a trusted source. Test data will be used for the large-family and disability evidences as Spain cannot provide real data from the competent authorities involved.

Use case 3 (Diploma recognition)

- Complete VC flow: students will start their procedure at Verifiers;
- Automatic anchoring of issuers' DIDs;
- Content-wise validation of VC;
- Acceptance or rejection of the issued VC or the DID connection invitation;
- Multiple connections.

The following updates of the final iteration plan as compared to D4.2 have been made as a result of the feedback from the first iteration.

Roles of pilot partners

As the Ministry of Education, Science and Sport of the Republic of Slovenia and INESC-ID cannot provide evidence on completion of secondary education, they will only act as data evaluators for application to Bachelor studies (1st Bologna level).

Non-academic evidence

Calls for study grants typically require students to submit both academic and non-academic evidence. The pilot initially planned to use household composition and household income information in UC#2 based on modelling feedback from a MS workshop in SDG WG4 (with participation of quite limited number of MS). Since SGAD, as the only DO in this use case, is not able to provide this evidence, other types of evidence were considered, such as disability data or large family data. This data is under responsibility of regional administrations in Spain and would require special permissions due to the privacy sensitivity of the data. Therefore, it was agreed to use test evidence of disability data and large family data instead.

Updates to the USI pattern

The User-supported Intermediation pattern will include the multi-evidence feature that allows to apply for one or more evidence in the same request. To accomplish the task, the data model will be updated to afford some changes and improvements regarding the message's schemas and the data structure.

From a more technical perspective, the redirection URLs exchange process will take place over the eDelivery channel, relying on its protocol for all the security and integrity aspects.

Updates to the VC pattern

For the next iteration, the current implementation of the VC pattern will include the support for alternative scenarios, such as rejection of the offered VC or the DID Connection invitation. Therefore, the SSI solutions will be adjusted to support alternative students' response scenarios. Furthermore, efforts will be made towards further aligning the issued VC schema with the ESSIF standardized schema for university diplomas. The VC pattern flow will also support the possibility of re-creating DID connections between the student's mobile wallet and the Issuer/Verifier portal, which is relevant for cases when the student loses information about the previous DID connection due to e.g. mobile application update or re-installation, loss of mobile phone and similar.

5 Conclusions and major achievements of the first iteration

Over the past several months, the pilot partners have customized and integrated various Data Evaluators and Data Owners and established interoperability among all MS participating in the pilot. This document is the report on the pilot activities of the first iteration.

The main results achieved in the first iteration and presented in this report include:

- Two interaction patterns (User-supported intermediation - USI, Verifiable credentials - VC) and one evidence type were piloted with a limited number of users;
- Six data evaluators/verifiers and five data owners/issuers have been successfully customized and integrated with the eIDAS infrastructure and the DE4A OOTS or EBSI infrastructure. Six Member States combinations were launched in UC#1 and UC#2 and two in UC#3. Three other combinations (one in UC#1 and two in UC#3) have been enabled for limited piloting with real users, while one combination was postponed to the second iteration (see Section 2.1). Students from Slovenia used real data for UC#1 and UC#3. Students from Portugal used test credentials and test data in all three use cases. Portuguese students were not able to use real data due to restrictions in the PT eIDAS preproduction environment that rejected real eIDs and the connector that had to be deployed in the test environment because of delayed security assessment. Students from Spain used test credentials and real academic data, but anonymized and bound to the personal data of a test credential. Students were able to use real credentials if they had them, but they would have to be manually added to a whitelisted before the service use.
- Technical interoperability between all three MS (Portugal, Slovenia, Spain) has been achieved (see Section 2.3). Cross-border interoperability at use case functional level has been tested and validated during a series of testing meetings called Connectathons (see Section 4.1);
- Various strategies to mitigate infrastructure delays have been defined and applied (see Section 2.2);
- Initial feedback on the usefulness of the common components and specifications was collected from pilot partners and other organisations involved in the customization, implementation, deployment, and testing of DEs, DOs, or infrastructure. Based on this feedback, lessons learned and suggestions for adoption were gathered in different steps. For the analysis and design phase, the pilot recommends re-evaluation of the scope of the SDG regulation to some higher education use cases, harmonization of the evidence data models defined separately by SDG WG and Europass, and a temporary solution for the use of non-notified eIDs in SDG procedures. The lessons learned in the customisation, integration, and testing phase mainly relate to the usefulness of the DE4A connector, the documentation, and the collaboration between the developers (see Section 3.2);
- Feedback on the satisfaction with the piloted services was obtained from a student focus group. Despite the limited number of students participating in piloting and the use of test eIDs or test data in a few combinations, the feedback is still relevant to understand perceptions of the end users, strengths, and aspects to improve. A total of 52 students provided feedback on ten aspects of the procedures via an online questionnaire (see Section 3.2). The most valued aspects of the piloted procedures were control in managing own credentials (4.21), security and privacy protection (4.13), and duration of the procedure (4.00), while the least appreciated aspect was the number of errors and interruptions (3.25). Majority of the students also appreciated clarity of explicit request and preview. Feedback was used to generate results for corresponding pilot metrics in the first iteration and will be used to improve online procedures in the second iteration.
- The implementation plan for the final iteration of the pilot has been revised (see Section 4.3).

In addition to the studying abroad pilot, the pilot results will also be used by other DE4A activities, in particular WP2 – Architecture vision and framework (validation of the project start architecture, the User-supported intermediation pattern and the Verifiable credentials pattern), WP3 - Semantic

interoperability solutions (validation of data models for higher education), WP5 - Common component design & development (validation of the common components such as DE4A Connector and SSI Authority agent, and the underlying evidence exchange infrastructure - DE4A OOP Technical system and the EBSI infrastructure), WP6 – Sustainability impact and new governance models (business models and new models for shared delivery of common services), "WP7 Legal and ethical compliance and consensus building" (legal outcomes of the first iteration), and WP8 – Stakeholder dialogue, dissemination and communication (dissemination and communication activities).

The second iteration phase that will run from September 2022 until the end of the project will be reported in D4.4 Studying Abroad Pilot – Final Running Phase.

References

[1] DE4A D4.1 Studying Abroad - Use Case Definition & Requirements v1.0. https://www.de4a.eu/_files/ugd/2844e6_cd8abc5ce50048fa8fc32bb283775bc9.pdf

[2] DE4A D4.2 Studying Abroad – Pilot Planning v1.0. https://www.de4a.eu/_files/ugd/2844e6_ffa28b48da674cd6b283cdaf44c5aa86.pdf

[3] European Commission, "European Blockchain Service Infrastructure", https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/ebsi, retrieved on April 6, 2021.

[4] DE4A Studying Abroad pilot microsite, https://www.de4a.eu/studyingabroadpilot

[5] Single Digital Gateway Regulation, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.295.01.0001.01.ENG&toc=OJ:L:2018:295:TOC, 22-02-2022

Annexes

Annex I – Additional questionnaire on specifications, software and procedures

Table 43: Questionnaire on specifications, software and procedures (2 sections)

Components	Perceived quality of specs/software	Ease of integration	Potential to include in sustainability plan	Degree of adequacy for pilot purpose	Overall assessment (automatic calculated or request to responder)	Comments (in case very low or low rate)
	(Rates from: Not relevant, No opinion, Very low, Low, Neutral, High, Very high)					
Solution Architecture						
Information Exchange Model						
Canonical data model						
DE4A Connector						
DE4A Playground						
• Mocked DE						
• Mocked DO						
• Central SMP						
• Kafka server						
SSI Authority agent						
SSI User agent (mobile)						

#	Criteria	Evaluation	
		Rate (*)	Comments
1	(DO) How easy was to implement transformation to canonical evidence? (*)		
2	Quality of support and communication channel (Slack) provided by common components WP during the integration and testing (*)		
3	Quality of technical documentation (*)		

#	Criteria	Evaluation	
		Rate (*)	Comments
4	Contribution of testing methodology and Connectathons for testing with other MS to the successful launch of the pilots (*)		

(*) Rate= Absolutely inadequate, Inadequate, Sufficient, Adequate, Perfectly adequate

#	Criteria	Evaluation
		Comments
5	Please, indicate organizational challenges (or other) that have impacted on the delivery according to plan (free text)	
6	Please, indicate what resulted most complex from your organization point of view in terms of pilot activities for launching the pilot (free text)	

Other questionnaires for students, data evaluators, data owners, and Member States can be found in Annex C of D4.2 [2].