D4.13 Methodology and Mid-Term Evaluation Report

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List of Acronyms

Abbreviation / acronym	Description
AS4	Applicability Statement 4
BRIS	Burisness Registers Interconnection System
CA	Certification Authority
CEF	Connecting Europe Facility
DBA	Doing Business Abroad
DC	Data Consumer
DE	Data Evaluator
DE4A	Digital Europe for All
DP	Data Provider
DPO	Data Protection Officer
DO	Data Owner
Dx.y	Deliverable number y, belonging to WP number x
EBSI	European Blockchain Services Infrastructure
EC	European Commission
EDCI	Europass Digital Credentials Infrastructure
EESSI	Electronic Exchange of Social Security Information
EHEA	European Higher Education Area
eIDAS	Electronic Identity and Trust Services
EIF/EIRA	European Interoperability Framework/Reference Architecture
ESSIF	European Self-Sovereign Identity Framework
EUDI	European Digital identity (Wallet)
FGPV	Fine Grained Powers Validation
GDPR	General Data Protection Regulation
IM	Intermediation
ISA2	Interoperability solutions for public administrations, businesses and citizens
KPI	Key Performance Indicator
MA	Moving Abroad
MOR	Multilingual Ontology Repository
MoU	Memorandum of Understanding
MS	Member State
MVP	Minimum Viable Product
OOP	Once-Only Principle
OOTS	Once-Only Technical System
SA	Studying Abroad
SDG(R)	Single Digital Gateway (Regulation)
SMART	Specific, Measurable, Achievable, Relevant and Time-Bound
SME	Small and Medium Enterprises
SMP	Service Metadata Publisher

Abbreviation / acronym	Description
S&N	Subscription & Notification
SSI	Self-Sovereign Identity
TLS	Transport layer Security
UC	Use Case
UML	Unified Modelling Language
URL	Uniform Resource Locator
USI	User-Supported Intermediation
VC	Verifiable Credentials
WP	Work Package
XSD	XML Schema Definition

Executive Summary

This is the first deliverable of the task of DE4A's "Cross-border Pilots for Citizens and Business and Evaluation", corresponding to the Mid-term Evaluation of the achievements and results obtained so far -with respect to pilot and project objectives- for the three DE4A Pilots: Studying Abroad (SA), Doing Business Abroad (DBA) and Moving Abroad (MA). These pilots act as point of convergence for results of the whole project and serve the purpose of demonstrating the extent to which DE4A technical and semantic concepts, architectural models, building blocks and interoperability enablers can be successful when put to test for their intended use, under realistic conditions and with direct involvement of real users and eGovernment authorities. The ambition is that the knowledge and hands-on experience of the pilots serve the community of practitioners at European Commission C and Member States levels

The scope of this fact-based Mid-term Evaluation is to provide an objective assessment with independent advice to the pilots for improvement of piloting activities and maximization of pilots' benefits realization, learning and positive impacts in the wider SDG and pilot-specific communities until the end of the project. It focuses on providing answers to the fundamental question of whether each pilot focused with coherency, completeness and correctness from its design and planning on the right targets of the project and to determine the execution and progress of piloting activities against planned scope in terms of actual outcomes. It differs from the Final Evaluation in that the latter will be an ex-post assessment of final results and complete progress of the pilots considering also their evolution from Minimum Viable Product to final extended scopes with enhanced focus on pilots' contribution to DE4A sustainability from adoption perspective.

The document describes the methodological approach followed for this evaluation, explaining the common and key concepts of piloting principles and "Benefits Logic approach" with its bi-directional trail relating objectives, success and common technical criteria and S.M.A.R.T. metrics, used throughout the evaluation process. It broadly covers two clearly distinct but interrelated scopes offering common (between pilots) and pilot-specific recommendations for each of them:

- To assess (based on pilots use cases definition and requirements deliverables from the first year of the project and, especially, pilot plans delivered in the second year of the project) the solidness of pilots' respective set-ups towards execution of running phase activities, including their ability to proof concepts and practical outcomes from other technical work packages and to realize tangible benefits according to general piloting principles of Use, Value and Learning, considering elements chosen by each pilot to build the framework that connects technical and business goals, success criteria and metrics for analysis of collected results;
- To evaluate fulfilment of pilot goals examining pilot results (reported in Initial Running Phase reports delivered in year 3 of the project) classified along the Use, Value and Learning for Adoption piloting principles and to which metrics, success criteria and goals are also mapped for analysis facilitation purposes. Feedback from the pilots combines both qualitative and quantitative aspects and the assessment is objectively undertaken considering both pre-defined targets for metrics grouped under logical groupings of "success criteria" which serve as high level KPIs and also considering common categories of technical common criteria (related to ISO/IEC 9126, EIF Interoperability and DE4A principles), placed under initial general considerations which are important to provide the context which has shaped the execution of each pilot in the current phase of the project.

3The general question regarding focus from each pilot on the right targets is also analysed in detail from three perspectives: (i) adherence to Use, Value and Learning pilot principles based on objective facts and findings, (ii) consistency of the pilot goals defined with respect of pilot definition and overall DE4A objectives and pilot's perspective on the technical common criteria and (iii) clear and consistent

relation between goals, success criteria and quantitative and qualitative metrics and availability of means to collect results (mainly feedback forms and questionnaires for users and authorities).

In respective comparative tables, observed factors underpinning adherence to Use, Learn and Value principles are provided including existence of suitable criteria and metrics assessing different aspects of user satisfaction, benefits, etc; definition of user engagement strategy and set-up of usable cross-border use cases considering legal requirements; availability of lessons on deployment of DE4A Once Only Principle components and impact on integration with national systems (with cost and effort assessments), on pilot-specific aspects and approaches and on adequacy of DE4A solutions to pilot different cross-border eProcedures and common processes like record matching, preview, etc. It also captured how the pilots address other pilot planning aspects relevant for the evaluation of pilots setting up (how use cases were characterised and data models designed, how iteration scoping was done, how Solution Architectures allowed to design generic pilot processes and provided a common framework for MS specific process designs, use of common components for Once Only Technical System (OOTS), eIDAS authentication and Self Sovereign Identity (SSI) framework and activities required for implementing the pilots (components deployment, trust frameworks configuration, integration with eIDAS and EBSI/ESSIF, etc.).

The document then delivers thorough analyses focused on each pilot following a common structure. Readers are introduced to the basic context, aims, actors and use cases of every pilot. Every pilot is verified to demonstrate high level of awareness of piloting principles and how the benefits logic was established, with selection of success criteria and definition of related qualitative and quantitative metrics in respective deliverables. Pilots' adherence to piloting principles (Use, Value and Learning) with reference to respective objectives and success criteria and what is covered in each case. Pilots are verified as able to demonstrate interoperable cross-border services based on Once-Only and Digital by default principles in multiple cross-border combinations between different MS and realizing evidence exchange patterns (Intermediation (IM), User Supported Intermediation (USI) or Verifiable Credentials (VC)) and also how Use information (satisfaction with different aspects) is obtained directly from end-users and how the pilots engage different types of users with different strategies.

For each pilot, the Evaluation determines how the objectives align with pilot definition and how the pilot contributes to general DE4A objective to reinforce trust in public institutions and to unleash positive impacts for efficiency gains and reduction of administrative burden, costs and barriers in cross-border public services. Finally, the specific success criteria are analysed in their relation to pilot goals as well as metrics defined and results collection mechanisms where all pilots are seen to establish a sound trail between these elements.

A common major finding is that the three pilots are adequately set up as true pilots (prepared in ther scopes and designs to validate DE4A OOP common semantic and technical components), embracing in each case the "Benefits Logic" approach from early stages by defining success criteria well linled to technical and functional goals and with metrics of quantitative and qualitative nature with clear target thresholds.

Pilot plans are found to be sufficiently detailed and consistent, comprising all relevant required activities (customization, integration, testing and user involvement activities) for launching in a phased manner cross-border pilot interactions and establishing common milestones against which pilot activities are aligned and which serve heterogeneous project teams to synchronize work.

General recommendations include revisiting critically metrics and underlying feedback forms considering the new scope for the second iteration to replace or add metrics (in particular for MA pilot) or questions as necessary to properly collect new sets of result and detailed analysis of possibilities with results collection mechanisms (including interviews, logs, etc.) to extract more detailed knowledge on user satisfaction or issues detected.

The deliverable also 4 assesses pilot progress: based on actual results analysed through S.M.A.R.T. metrics gathered from DE, DO competent authorities and MS agencies responsible for deploying and configuring DE4A common technical and semantic components and from real users (in the case of Studying Abroad and Doing Business Abroad pilots), the progress achieved so far with respect to success criteria and pilot goals.

A difference is observed between number of combinations that could be launched (with respect to those planned) which is comparatively higher in the case of SA pilot and more modest for DBA pilot (due to specific circumstances in specific MS involved in the latter case), whereas MA pilot couldn't finally launch combinations in the first iteration given its specific configuration with only 3 MS and only one having the role of DE which experienced different organisational and technical delays affecting the pilot as a whole. The number of users remains relatively low, except for SA pilot that managed to reach higher numbers with over 50 users and 11 cross-border combinations, but the quality of obtained feedback is highly relevant from a qualitative viewpoint. SA and DBA pilots have confirmed users satisfaction with the eProcedures carried out through DE4A patterns and technical solutions, covering multiple aspects where duration of procedure (2 minutes or less) and time savings, control and management of evidences exchanges and security and data protection are the most appreciated. All pilots provided results as well obtained from MS authorities, who rated as with high values aspects of quality of adequacy of canonical models and quality of the data for the needs of eProcedures, highlighted the effort reductions achieved to process evidence received (without DE4A processing of evidence takes days or weeks) and with less errors, provided estimates for the customization of endpoints and the deployment of common and semantic components with positive perception of benefits when compared with involved costs and high scores for appreciation of suitability of such DE4A patterns and components for the purposes of the pilot as well as with technical support throughout piloting activities. Lessons learned are also very rich in the current phase covering a wide range of topics and challenges of interest for EC and MS stakeholders that need to implement the SDG OOTS (or will also explore synergies with initiatives like eIDAS EU Digital Identity Framework). These cover efforts quantification to customize and integrate DEs (29-34 person days), DOs (19-21 person days) or to deploy common components (5 person days when using DE4A Connector). Multiple recommendations are provided for a wide range of topics: ensuring adequate prioritisation and national-level coordination with availability and direct communication of teams covering different areas of technical expertise, clear and detailed documentation and guidance mechanisms for integration of common building blocks, challenges with identity and record matching and need for solutions for authentication of representatives with validation of powers, set-up of testbeds and well-prepared cross-borders testing sessions, solutions for MS that have not completed eID notification, harmonized user experience for common steps like Explicit Request and Preview based on proposed wireframes, flexible planning and phased roll-outs accommodating differences in pace of implementation and integration, streamlined management of certificates lifecycle, etc.

Besides specific recommendations for each pilot, common recommendations to all pilots include stronger interactions with "Sustainable impact and new governance models" work package to provide adequate feedback useful for better understanding requirements for future sustainability of Member States investments for OOTS infrastructure and pilot data services and eProcedures; leveraging opportunities for dissemination of results and pilot knowledge and experience in different sectoral opportunities; safeguarding of pilot learning through DE4A Wiki and in some cases making available discussion papers on different topics produced during the project (DBA Pilot), more precise formulation of achieved administrative simplification and burden reductions; possibilities to extract more knowledge from logs and other results collection mechanisms.

1 Introduction

1.1 Purpose of the document

The main purposes of this document are three-fold:

- To present the comprehensive methodological perspective defining the overall approach followed in DE4A for iterative evaluation of its pilots aimed at benefits realisation. The key common questions are presented which structure and orient the evaluation. The respective scopes of Mid-Term Evaluation (focus of this deliverable) which corresponds to the first iteration of pilots, and the Final Evaluation (that will be addressed in D4.14 Final Evaluation Report) are also presented.
- To deliver the actual outcome of the evaluation, covering both (i) the assessment of the different set-ups of the DE4A Pilots vis-à-vis pilot and project principles and targets (adherence and consistency) and (ii) the assessment of fulfilment so far of pilot goals based on pilot reported results and findings for Use, Value and Learning for Adoption principles (pilot progress and execution).
- To provide recommendations, both common between pilots and specific to each pilot, towards improvement of piloting activities and maximization of their impact for the remaining piloting period.

The outcomes of this deliverable are of interest:

- Internally, to DE4A partners involved in, or supporting, the piloting activities and the work packages for which pilots realise and proof concepts, components and solutions;
- Externally, to a more general audience of stakeholders similar to those involved in the pilots (competent authorities, public agencies, end users) and in particular the wider community engaged in the Single Digital Gateway implementation.

1.2 Structure of the document

The deliverable is structured as follows:

- **Chapter 1** – The current section that describes the purpose and structure of the document.
- **Chapter 2** introduces the multiple aims and methodological pillars of the evaluation following a benefits realisation logic and approach involving a consistent bidirectional trail of functional and business goals, success and technical common criteria and quantitative and qualitative metrics aligned with Use, Value and Learning principles.
- **Chapter 3** presents the assessment performed over the set-up of each of the pilots, as described in use cases definition and requirements and pilot plans, with respect to the pre-defined targets and the consistency between them and the pilot-specifc metrics, success criteria and common technical criteria. At this level, some common pilot recommendations are introduced. For each pilot, the adherence to pilot principles is assessed, as are the consistency of pilot goals with pilot definition and over-arching piloting objectives of DE4A and, finally, how the pilots implement in a consistent manner a biderational trail relating goals to success criteria and metrics.
- **Chapter 4** provides the outcomes-based (first iteration results) assessment of pilot progress against planned scope, taking into account fulfilment so far of success criteria and related goals. The analysis for this assessment is delivered for each pilot in turn covering general considerations (overview of piloting conditionings and high-level achievements and approaches), results and findings analysis for Use, Value and Learning dimensions which include pilot-specific recommendations in each case.
- Finally, **Chapter 5** summarizes mid-term evaluation conclusions and offers the outlook for upcoming final evaluation work.

2 Aims and methodological pillars of evaluation

In this section the overall goals of the current mid-term evaluation phase are provided together with an overall description of the methodological approach applied. This approach aligns with the general methodological approach commonly applied to DE4A pilots oriented to the realization of benefits also known as "Benefits Logic"; it is is based on international standards and it has been successfully applied in previous Large-Scale Pilots.

The general purpose of evaluation work in DE4A, from a process standpoint, is to provide the three pilots with strategic check-points -Mid-term and Final evaluations- which respectively correspond to both planned pilot iterations. Thus, evaluations assesses, at the end of each of these piloting phases, the achieved results as reflected in pilot reports against pilot and project objectives relative to each iteration scope. These results also relate to the wider contribution and impact of the pilots in support of the implementation of Digital Government strategic policies and principles, specifically the Single Digital Gateway (SDG), and are closely linked to the realization of the Once-Only and Digital-by-default Principles, as envisaged by the SDG Once-Only Technical System (OOTS).

This is particularly relevant considering the orientation of DE4A as a Member State-driven project, the fundamental role of Member States in the implementation of this system and the fulfilment of obligations related in particular to Art. 14 of the SDGR. The pilots' evaluation process is based in traceable and evidence-based findings and aims to improve the piloting activities in DE4A towards their solid execution, including their expected ability to proof concepts and practical outcomes from other technical work packages[1]. The methodology followed across all piloting activities, from pilot's inception and planning to execution and evaluation aims to maximize the realisation of Use, Value and Learning benefits towards sustainable adoption.

Methodologically, the Evaluation is performed with a relative outsiders' position in the project, aiming to abstract from internal conditionings or internal pilot activities (including management) for delivery of independent advice based on an objective fact base of results collection and analysis which are part of the pilot activities. Close collaboration with pilot leaders is an integral and natural part of making the evaluation process effective and efficient, i.e. when pilot findings in pilot iteration reports require clarification.

The DE4A pilots integrate and help to validate in realistic conditions, with direct involvement of real users and eGovernment stakeholders, a significant number of relevant building blocks: the DE4A Common Components and the DE4A Semantic Framework and Toolkit, developed in other technical work packages of the project to realize technical and semantic interoperability. Thus, pilots generate with their results knowledge and hands-on experience for the EC and the Member States on key Use, Learn and Value dimensions[2]. This is of direct relevance for these stakeholders as they enter a decisive phase of the SDG (online procedures and OOTS) implementation, integration, deployment and testing.

In short, DE4A pilots' evaluation judges whether the pilots prove the concepts implemented in DE4A, including those delivered in other work packages towards joint outcome of the Action, in this way helping to ensure the fulfilment of the DE4A objectives. In this regard, particular focus is put as well on achievements and findings (barriers and pragmatic solutions) for the different interoperability aspects (technical, semantic, organisational and legal), as covered from the perspective of every pilot.

[1] Most notably such as semantic and common components, assembled in alignment with "application collaborations" specified in respective Solution Architectures for the multi-pattern interoperability architecture the project as a whole advocates for, towards the implementation of European public service interoperability solutions in light of the SDGR with a mid-term future time horizon in mind of 2025+.

[2] For example, pilots have generated a better understanding of challenges that MS face for implementing the SDG OOTS, providing strong bases for positive influence in the process leading to the Implementing Regulation on technical specifications for SDG OOTS and where the evidence exchange pattern adopted very clearly matches the DE4A USI pattern.

When focusing on the Mid-term Pilots Evaluation, the focus is double:

A. On the one hand (see section 3) it assesses -with regard to coherency, completeness and correctness- whether the plans of the pilots (as reflected in Pilot Planning deliverables D4.2[1], D4.6[2] and D4.10[3] completed in 2021) put the right focus on realising planned pilot benefits through success and common technical criteria[3] and adhering to general piloting principles of Use, Value[4] and Learning. This enables a good understanding of how the pilots are designed to enable and maximize DE4A project-wide benefits realization;
B. On the other hand (see section 4) it evaluates the fulfilment of the pre-defined pilot goals and their contribution to overall project (DE4A) objectives, considering the progress of the first iteration, namely examining pilot results (reported in deliverables D4.3[4], D4.7[5] and D4.11[6] "Initial Running Phase Reports"). In this regard, the mid-term evaluation could be seen to address this fundamental question for each pilot:

Does the pilot planning focus on the right targets of the project and does the execution of the pilots take place according to defined plans i.e. what is actual progress of the pilots against the planned scope in terms of outcomes achieved so far?

The *Mid-term Evaluation* significantly provides the pilots with specific *recommendations* for improvement and also delivers common conclusions from the first phase of piloting. This serves the double purpose of: (i) correcting detected issues or preventing future recurrence of similar issues where possible and (ii) strengthening the maximization of benefits, demonstration of their realization and widen the basis for longer-term impact generation of the pilots. Such impact will be assessed at the end of the second iteration in the final evaluation[5].

The *Final Evaluation* will assess the final results of the pilots in their second and final iteration vis-à-vis promised results and is therefore an evaluation of the development of the pilots over time: from Minimum Viable Products approach to the extended scope and fuller realisation of their respective operational set-ups, results and goals. It will thus consider an increased emphasis on the Adoption dimension and the extent to which pilots' final outcomes contribute to the overall sustainability strategy of DE4A. Other principles and methodologies followed in the project like Agile approach can also be assessed based on the complete experience of piloting.

Figure below depicts the respective targets of both evaluations and the common elements involved:

[3] These technical common criteria are Openness, Transparency, Reusability, Technological Neutrality and Data Portability, User-centricity, Inclusion and Accessibility, Security and Privacy, Administrative Simplification and Effectiveness and Efficiency. They are related both to characteristics for software quality first introduced in ISO/IEC 9126 (Software engineering – Product quality)[7] and principles in the European Interoperability Framework (EIF) [8], also reflected in DE4A D2.1 Architecture Framework[9].

[4] These two dimensions are evaluated by assessing the related monitoring of the activities performed by the pilots during the execution of respective running activities for the different launched combinations.

[5] While the scope of the second iteration has been defined for each pilot prior to this deliverable (in Pilot Planning deliverables and updated in Initial Running Phase reports) and also preparatory activities for each of the pilots are well under way, pilots are expected to address as much as possible the recommendations in this evaluation report during the phased running activities for the different use cases and combinations launched for the second and final iteration.

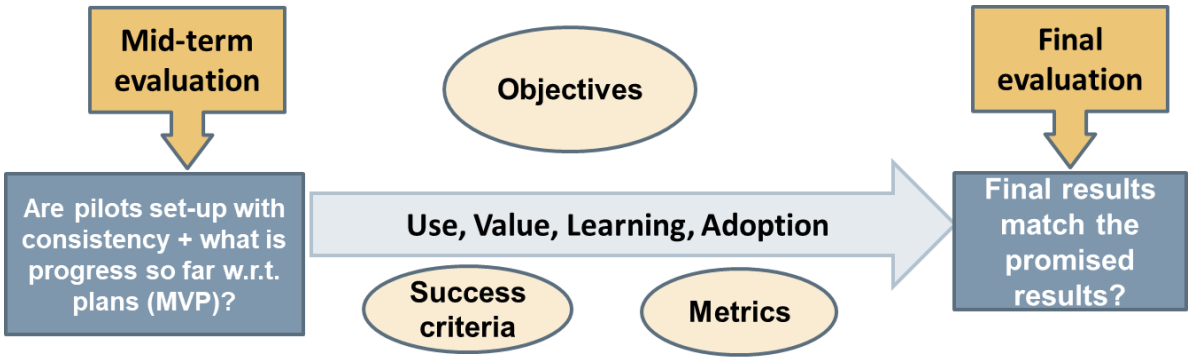

Figure 1: DE4A Mid-term and Final Evaluations

In section 2 of the pilot Planning Deliverables (D4.2[1], D4.6[2], D4.10[3]) the Benefits Logic approach was introduced of which a summary is given below. It provides the overall framework categorising results and their assessment along 4 key piloting principles that were defined as follows:

- **Use**: measurable results related to the use of the procedures piloted and usability of the implemented cross-border once-only procedures and implemented evidence exchange patterns (e.g. does the interoperability model/solution work; which barriers are being encountered);
- **Learning**: whether the pilot helps to prepare the stakeholders for the future (i.e. collecting and distributing lessons learned/ creating feedback loops);
- **Value**: whether the pilot improves efficiency or effectiveness of the end-users and organizations involved (e.g. do the citizens, data consumers and data providers experience added values, such as administrative burden reduction);
- **Adoption**: whether the pilot facilitates the process where a Service Provider (Data Consumer) or Data Provider introduces new IT tools provided by the pilot to support a (new) way of working. Adoption is in the context of the current pilots limited to the adoption by service and data providers that are part of the pilot but has a wider horizon beyond project termination for adoption by similar stakeholder from other Member States that did not participate in DE4A, but which must implement the SDGR. Adoption is not merely focused on whether a provider was finally able to introduce/integrate with DE4A but rather on all the possible lessons to be learned from this process.

Note: in this phase of piloting and for this Mid-term Evaluation, this principle is combined with the Learning principle, whereas it is expected that in the final evaluation (corresponding to the last iteration of pilots), Adoption will have a more prominent relevance considering contributions to project sustainability of the pilots.

In the figure below, the piloting principles and some of the aspects typically related to them are depicted:

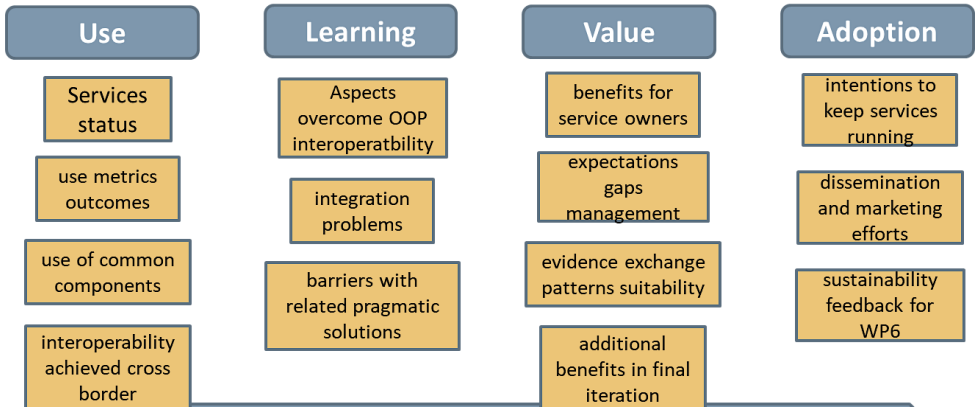

Figure 2: Key Piloting Principles

Evaluation of end-users' and institutional stakeholders' perception of usability and value will take place by assessing the related monitoring activities performed by the pilots: these pivot on evidence captured during the respective running phases through specifically designed questionnaires (see Annexes of Pilot Planning deliverables) and interviews, which pilots have also analysed already in the Initial Running Phase reports. Lessons learned are also consolidated, as part of an ongoing effort, in the latter deliverables and is also a major aspect considered in the current evaluation as much of the pilots' future legacy and contribution to DE4A sustainability depends on the knowledge building achieved in this dimension, leveraging the unique orientation of DE4A towards real-life piloting.

In the following diagram the Benefits Logic approach, adopted from similar Large Scale Pilot STORK 2.0, is depicted:

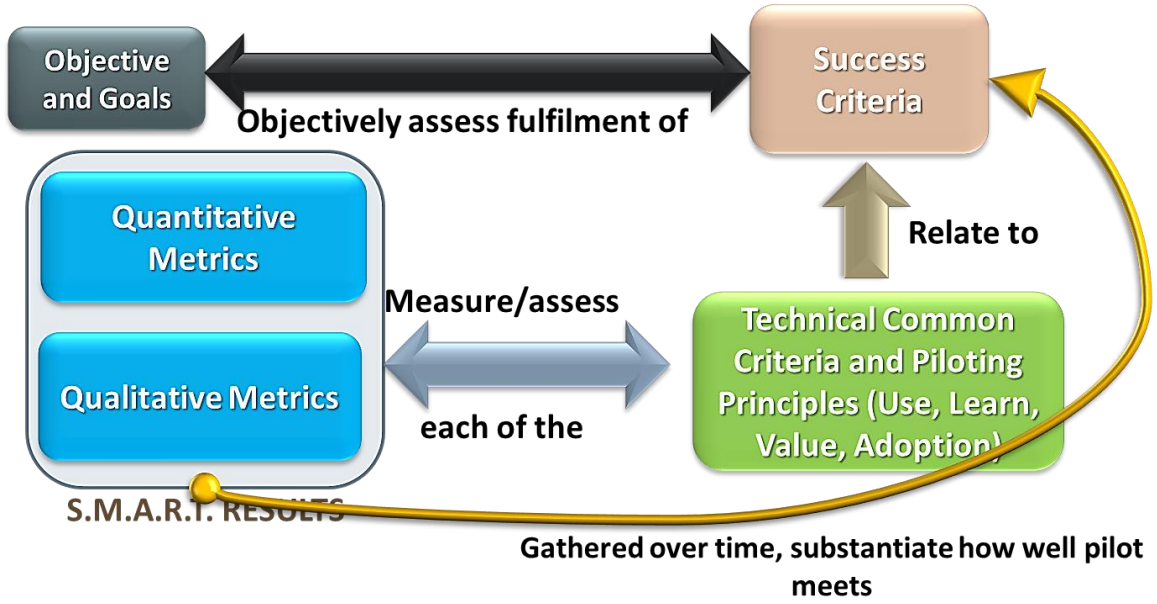

Figure 3: Benefits Logic approach

This approach provides a suitable framework in order for pilots to:

- Measure over time their results and achievements (Metrics)
- Provide the information in a structured and consistent way (Success and Technical Common Criteria)
- Consider the expectations and actual feedback of pilot experience of various stakeholders (Use)
- Analyse the perceived benefits (Value)
- Boost the value of the lessons learned (Learning for Adoption)

As seen in the diagram, the pilots are expected to demonstrate a clear and consistent trail from Pilot Main Objective and its Technical and Business Goals, as established at the beginning of the project and reflected in respective «Use Cases Definition and Requirements» deliverables D4.1[10], D4.5[11] and D4.9[12]) to Success and Technical Common Criteria and finally to the qualitative and quantitative Metrics that function as pilot-wide S.M.A.R.T.[6] Key Performance Indicators. The latter facilitate the measuring of pilot success while criteria orient the pilot towards maximization of its output with regard to Common Pilot's Principles of Use, Value, Learning and Adoption. Both criteria and metrics were agreed between the pilot partners and provided in the pilots' Planning deliverables (D4.2, D4.6 and D4.10). As can be seen below, this trail flows a bi-directionally, allowing to define from higher level Goals, through Success and Technical Common Criteria, the concrete Metrics to be collected over time (pilots execution or running phase). Once results are available in each pilot, they are used as evidence

[6] Specific, Measurable, Achievable, Relevant and Time-Bound, see https://www.atlassian.com/blog/productivity/how-to-write-smart-goals

and assessed, allowing to substantiate the fulfilment of success criteria and finally, of the overarching goals. At this stage of piloting, the aim of this evaluation is to provide reasoned indication of how strongly the pilots support pilot-specific and common objectives. As Success Criteria and their underlying Metrics are further referenced to the Use, Learning, Value and Adoption dimensions, the consistency of the overall framework is reinforced. This enables a multi-dimensional analysis of pilot outcomes and more structured, consolidated knowledge-building for the project and its future sustainability.

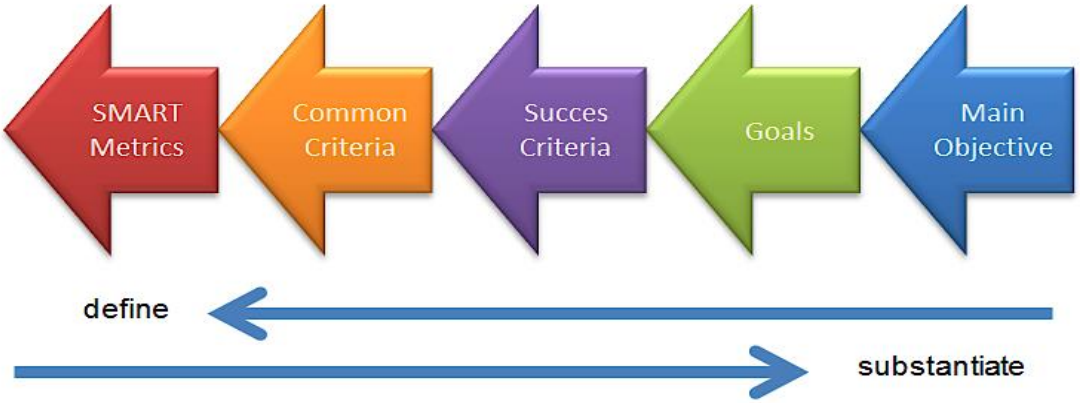

Figure 4: Bi-directional trail linking objectives to metrics through criteria

Both for the assessment of pilots' alignment with goals and benefits realisation principles and for assessment of pilots' progress in respective iterations, specific consideration is given to aspects which are concrete to each pilot while identifying as well cross-cutting and common aspects and recommendations. A draft of the present report was shared with the pilot leaders for review in terms of its correctness and completeness.

3 Assessment of pilots' setup and alignment with targets and principles

This section puts the evaluation focus on the main question that the mid-term evaluation tries to address: *does each pilot (in its planning) focus on the right targets of the project?* In particular, and to facilitate the analysis of this broad question, this can be broken down into three more specific sub-questions:

1. *Does the pilot adhere to general pilot principles?*

2. *Are the pilot (business and technical) goals consistent with the pilot's definition and related to DE4A objectives, including the common objectives for the three pilots of DE4As « Cross-border Pilots for Citizens and Business and Evaluation » Work Package?*

3. *Are pilot objectives consistent with pilot Key Success and Performance indicators, products and activities and plans? (Pilot consistency)*

The aim of the first sub-question is to determine whether the pilots are correctly set up with the intent to test consistently Use, Learning and Value general piloting principles, thus creating a solid basis for Adoption. The pilot potential to sufficiently demonstrate interoperable services in a real-life setting and to include real natural and legal persons representatives (engagement strategy) is checked. It is also considered how the pilots are set to use results from -and are supported by- activities from the Semantics and Common Components work packages (internal feedback loops). Also, consideration is given to how they will collect factual evidence of use and value and finally how they are set to build a structured body of learning for future adopters in terms of documented insights on findings/major considerations and including rationale for decisions taken.

The second question refers to the link between the pilots and DE4A's overarching objectives and main criteria set for the DE4A solution. Pilot goals and success criteria must be sufficiently documented to check that defined success criteria are well derived from the objectives as their purpose is to substantiate their fulfilment. While during the second year goals and criteria were revised and made more concrete, it was purposedly considered by pilots not to make the criteria and also related (quantitative) measurements too low-level detailed, at least in the first iteration which corresponds as well with a more limited scope of "Minimum Viable Product". This was also in order to avoid an overly complex results analysis and (Mid-term) evaluation of the pilots. Taking such considerations into account, a limited, carefully chosen set of criteria and metrics was designed. Such criteria and metrics target the core goals and value of the pilots and are aligned with the research objectives of the DE4A programme.

Last versions of these metrics and criteria are assessed for consistency in comparison to the pilot objectives stated in the initial DE4A or pilot documents. By considering the respective business and technical goals, it can be determined how each pilot is aligned with overall DE4A and pilots work package objectives, and how it is set to contribute to overall policy and strategic objectives, including alignment with OOTS and SDGR and other domain-specific objectives, where relevant.

For the third and last question, the focus is on assessing whether the pilot is set up in a coherent and consistent way that can be expected to yield the necessary results to test under realistic conditions the DE4A interoperability solutions and to reach fulfilment of its different goals. For this to happen, pilot goals must be sufficiently reflected in use cases, and success criteria consistently established as well, enabling a consistent bi-directional trail from objectives towards metrics and back.

For this part of the evaluation, the methodological approach is based mainly on internal desk research taking as starting point the Description of Work for the pilots and pilot-produced documents describing their functional, technical and results framework (benefits logic) set-ups, in particular the respective « Use Cases Definition and Requirements » deliverables D4.1[10], D4.5[11] and D4.9[12]) and Pilot

Planning deliverables D4.2[1], D4.6[2] and D4.10[3]. It is to be noted that while in pilot deliverables describing the goals, success criteria and metrics there is an m:n relation between these concepts and the pilot principles of Use, Value, Learning and Adoption it has been discussed for evaluation analysis purposes to focus in a more direct connection between each goal (and consequently success criteria and metrics) and the principle of Use, Value of Learning for Adoption to which a predominant correspondence can be established more clearly.

It also needs to be considered that the "Benefits Logic" approach has been established between both sets of documents mentioned in the above paragraph, whereas results stemming from evidence collected in piloting is reflected and analysed in the last batch of deliverables that are assessed in section 4 further below.

A general observation is that all three pilots are adequately set up as true pilots with the intent to test Use, Learning, Value and Adoption principles. They have been prepared in their scoping and design to validate the DE4A OOP infrastructure and concepts with orientation to tangible benefits realization and adhering to the general piloting principles: pilots have indeed embraced the "Benefits Logic" approach and mindset in early stages of the project (i.e. first use case and requirements deliverables) by identifying Success Criteria linked to Pilot Technical and Business Goals and by defining quantitative and qualitative metrics that allow to substantiate their fulfilment. Pilots have addressed refinements that can be observed as well in the key elements of success criteria and metrics between the phase of definition of use cases and requirements and the planning phase, which also comprised the more detailed definition of the Solution Architectures in collaboration with other technical work packages.

Regarding *Use, Value and Learning principles, adherence observed facts* in the three pilots are summarized below in three tables:

Table 1: Factors Underpinning Adherence to Pilot Principle: Use

General Pilot Principles: Use	Criteria+Metrics to assess satisfaction with Procedures (Efficiency, Effectiveness, Security, privacy and control)	Definition of User Engagement Strategy	Set-up of usable cross-border use cases incl. legal requirements, microsite
Studying Abroad	++ (1st iteration)	++ (complete and implemented in some cases with test data)	++ (MoU signed, micro-site complete for 1st iteration)
Doing Business Abroad	++ (1st iteration)	+ (complete but with limitations mainly due to low number of combinations in first iteration)	++ (MoU signed, micro-site complete for 1st iteration)
Moving Abroad	++	+ (almost complete but implementation to be completed when postponed combinations are launched)	-/+ (MoU signed, micro-site to be completed with further information on new services, walkthroughs for all planned combinations)

Table 2: Factors Underpinning Adherence to Pilot Principle: Value

General Pilot Principles: Use	Criteria+Metrics to assess suitability and increased quality of data (canonical evidence models)	Criteria+metrics to verify benefits for DE/DO Competent Authorities (business value)	Criteria+metrics to verify benefits for end-users in respective Use Cases (operational excellence)
Studying Abroad	++ (1st iteration)	+	+
Doing Business Abroad	+	+	+
Moving Abroad	+ (pending validation in actual running combinations)	+ (pending validation in actual running combinations)	+ (pending validation in actual running combinations)

Table 3: Factors Underpinning Adherence to Pilot Principle: Learning for Adoption

General Pilot Principles: Learning for Adoption	Lessons on Deployment of DE4A OOP components and impact on integration with national systems (cost and effort assessments by MS, DEs & DOs)	Lessons on Pilot-specific aspects and approaches (Powers and Mandates, SSI framework, multilingual forms…)	Adequacy of DE4A solutions in piloting different eProcedures (realistic services piloted across borders, experience with Explicit Request and Preview, identity and record matching…)
Studying Abroad	+	+	+
Doing Business Abroad	+	+	+
Moving Abroad	-	-	?

Legend for three above tables:

++	Complete
+	Almost complete
-/+	Weak
-	Insufficient
?	No information

Updates to the metrics and underlying data collection mechanisms are recommended by evaluators to be further implemented for the second iteration considering, on the one hand, extensions in respective scopes of each pilot and, on the other, possibilities to extract more detailed results from pilot partners and end-users with more fine-grained questionnaires and logs analysis.

Based on the results of this part of the evaluation, it can be generally concluded that the focus and intentions of all three pilots, as reflected in the set-up of their technical and business goals and in the selection of both success and common technical criteria and SMART metrics, are in line with the DE4A objectives. Nonetheless, additional effort is needed in a number of areas, further elaborated below to ensure deeper realization of (and reflection upon) Use related aspects, verified benefits as Value (generated for both competent authorities and users of online procedures depending on once-only and cross-border exchange of evidence) and the consolidation of a body of lessons learned (with direct relevance for adoption of major DE4A outcomes).

Regarding *consistency with pilot Key Success and Performance indicators, products and activities and plans,* in table below it is summarized how the pilots are set up in a coherent and consistent way which may be expected to yield the result necessary to test the DE4A interoperability solution:

Table 4: Consistency and Documentation for Objectives, KPIs and Metrics

Consistency	Pilot objectives are consistent with overall DE4A objectives and Description of Work for the Pilot	Pilots Success Criteria are consistent with technical and business goals	Goals, Success Criteria and metrics are sufficiently documented
Studying Abroad	++	++	++ (D4.1, D4.2)
Doing Business Abroad	++	++	++ (D4.5, D4.6)
Moving Abroad	++	++	++(D4.9, D4.10)

Legend:

++	Complete
+	Almost complete
-/+	Weak
-	Insufficient
?	No information
0	Not yet applicable

To finalize this part of the evaluation, a common overview for the three pilots with some comments of other aspects covered in the Pilot Planning deliverable relevant to complete evaluation of pilot setup, is given in table below:

Table 5: Pilot Planning Aspects Relevant for Evaluation of Pilots Set-Up

Use cases characterisation and Data Models Design	Scoping of Iteration	Generic Pilot Processes and MS specific detailed process design	Common components for OOTS, eIDAS, SSI framework	Implementation Activities and Planning
All Use Cases have interaction patterns correctly mapped to them and are described in detail i.e. how they are to be carried out in terms of integration with systems and services from competent authorities in the participating MS. Detailed designs of data models used were provided in	Minimum Viable Product (iteration 1) scope is provided, including agreed simplifications particularised to each use case and with MS specific constraints where applicable. Design decisions are adequately motivated related to different application components in the Pilot Start	Solution Architectures for the pilots are provided in Annex of Pilot Planning deliverable describing design choices as well as shared eIDAS and OOTS solutions and DC and DP-specific solutions with requirements scoping each	Solution Architectures provide details for all common and DP and DC-specific components covering eIDAS, OOTS and SSI subsystems and how they support application services for process realization while sections 3.6 and 3.7 of Pilot Planning	Sections 4-6 of Pilot Planning deliverables cover all generic and MS-specific activities required to develop, customize, adapt, deploy, configure, connect and test software (in particular for DE, DO endpoints and

Use cases characterisation and Data Models Design	Scoping of Iteration	Generic Pilot Processes and MS specific detailed process design	Common components for OOTS, eIDAS, SSI framework	Implementation Activities and Planning
UML and XSD formats with explanation of each attribute and relation to external semantic models (e.g. EDCI, multilingual forms, ISA2 Core Vocabularies, BRIS…).	Architecture, with clear explanation of roles and intentions to involve real users and real data for each UC, eIDAS network details, and explanation of how Explicit Request, Preview and record matching will be handled in each MS.	iteration. MS-specific detailed process designs have been based on Solution Architectures and national customisations and integration activities and gaps have been identified to a sufficient level of detail.	deliverables give more details on roles the components help to deliver, organisations responsible for deployments and national applications integrated with them.	also considering deployment and configuration of common and semantic components), certificates management, integration with external infrastructures (eIDAS, EBSI), testing and user involvement.

The pilots planning deliverables show a detailed and consistent planning approach in particular for all customization, integration, testing and user involvement activities undertaken by all pilot participants in order to launch the pilots, including prerequisites and dependencies for performing the activities as well as risks identified. These are further refined with details of MS specific tasks and common milestones corresponding to increments[7] to which multiple teams in MS and in the project (semantic and common components work packages) needed to align. While the plans are very detailed and this helps to understand the breadth and scope of all tasks and interdependencies that need to be addressed, the complexity becomes clear when considering that the required effort to and availability of specialised teams to develop each infrastructural component (including for eIDAS integration, eDelivery infrastructure set-up, and portals and data services customizations) varies between all participating MS: each of them has their own internal challenges, opportunities, resource-availability and approval processes that determine when certain activities will start. Consideration of scope for the second iteration and planning at milestone level is also provided in Pilot Planning and refined in Initial Running Phase deliverables.

A few important common **recommendations** stem from evaluation assessment covered in this chapter:

- Within the overall framework of selected success and common technical criteria, perform a critical assessment of quantitative and qualitative metrics to replace those metrics that are no longer valid for the extended (and also different) scope of the second iteration that aims for a more ambitious set-up of pilot solutions (beyond minimum viable product mindset) and featuring (in some cases) more participating MS and more complete sets of cross-border combinations with (also in some cases) new evidence exchange patterns (or optimized implementations of previously piloted patterns). In the case of MA pilot, additional questions to citizens (duration of activities within the procedure, feedback on Explicit Request and Preview) would need to be included in the online feedback form for a complete coverage of success criteria B2 and D2 (see further below in section 3.3).
- Related to the above point, revision of the possibilities offered by results collection mechanisms, especially questionnaires for end-users, DC / DP or MS authorities and logs from common

[7] Increments and activities are modelled and monitored in Agile approach within the internal DE4A JIRA tool as Epics and User Stories.

components and endpoints with the aim to extract more detailed knowledge in relation to understand better which parts of the pilot flows generate higher satisfaction or on the contrary where have issues been found and what are the likely reasons for them.

Subsections below explore further details on facts and findings that are specific for each pilot to substantiate respectively adherence to common piloting principles, consistency of pilot goals with pilot definition and overarching project objectives and consistency of KPIs and metrics with activities in plannings to collect and analyse results.

3.1 Studying Abroad Pilot

The Studying Abroad pilot aims to demonstrate in practice the **benefits for different European Higher Education Area stakeholders of realizing across borders the principles of Once Only and Digital-by-Default**. The Studying Abroad pilot focuses primarily on a specific category of persons in Europe: Higher Education students with virtual or physical mobility needs in the European Higher Education area to learn on the usability as well as the level of adequacy of the solutions that are set up in the DE4A project. The pilot follows a pragmatic approach with the ultimate ambition to provide a working realisation of the SDGR Studying Life Events in real-life environments and targeting real groups of users, in order to validate and explore different aspects of the DE4A environment and platform, including innovative technologies.

In this regard, the pilot is set up to verify how trusted electronic channels for retrieving the evidence will reduce time and effort of the involved participants and decrease the chance of mistakes making existing trustworthy data from trusted sources available in electronic format for exchange. The overall contribution by these use cases to learning mobility will generate long-lasting benefits for students fostering their confidence, independence, social integration and the creation of a sense of European identity.

Different actors (students, data providers, data consumers, higher education institutions) will benefit from the integrated cross-border procedures and the Once-Only Principle (OOP):

- Students will be able to successfully complete the procedures from anywhere using only their electronic identities and digital credentials, provided that procedure-specific conditions are also fulfilled. Secure user authentication will be transparent to the service providers, as trusted identity providers will perform it.
- The organisations providing the procedures (i.e. requesting enrolment to higher education courses, application for study grants) will increase the security level of their services and reduce manual validation work by relying on academic evidence from trustworthy sources. Administrative burdens of such academic service providers will also be reduced, saving time and associated costs.
- Role of innovative technologies (self-sovereign identity framework and underlying blockchain infrastructure) in eGovernment services provision is researched and piloted with real end-users and integrated with competent authorities' services and systems.

Through the combination of three use cases that match SDGR "Life Events" (Application to public higher education, Applying for study grant, and Diploma recognition), the pilot is set to prove the optimal process/procedure for students of the participating three EU MS (Portugal, Slovenia, and Spain) for registration and eventually applying for a student grant as well as for studies recognition.

The pilot use cases must prove technical viability of functional requirements and also gauge the performance and degree in which other non-functional requirements can be accommodated. The three use cases are logically linked to each other, as the recognized diplomas from Use case #3 are examples of evidence required when a student applies to public higher education (Use case #1) or for a study grant (Use case #2).

In addition to USI pattern, SA pilot implements and pilots Verifiable Credentials (VC) pattern: this is the most human-centric pattern piloted in DE4A (in the use case of Diploma Recognition) with the user

taking the central role and orchestrating the interactions with DC and DP and with no direct exchange of messages between these authorities. It is foreseeably as well the closest to the future interactions in the context of the eIDAS revision and its EUDI wallet concept (see section 4.2.6 of D2.7[14] where this pattern is called Supported User-Managed Access pattern based on known high level architectural specifications of eIDAS Toolbox).

3.1.1 Pilot Adherence to General Pilot Principles

When it comes to the **question of pilot adherence to general pilot principles (Use, Learn and Value),** it is verified that the pilot has demonstrated high-levels of awareness of the principles through an explicit set up in its documentation from early stages of a consistent and coherent framework. This goes from technical and business goals to metrics through success criteria, and has focus on collecting and analysing results in real-life conditions over those general principles:

- D4.1 [10] defined the scope of the pilot, established its functional boundaries in terms of use cases (described through user journeys, flows and requirements with involved actors and definition of required and available data for exchange, all of which were used as input by the other technical work packages), set specific pilot main objective and specific technical and business goals, and presented a preliminary identification of corresponding pilot success criteria suitable to assess them. It also provided the sectoral context of strategic EU policies and other relevant initiatives (SDGR procedures in education domain, EHEA and Bologna process, EDCI, EBSI, etc.). At this initial stage, the pilot also identified several political, legal, technical and organizational issues.
- D4.2 [1] provided the final list of success criteria (table 2 of section 2.1.2) and corresponding quantitative and qualitative metrics mapped to respective Use, Learn and Value principles (section 2.2).
- Furthermore, in section 3.1 of D4.3[4] each of the different criteria (and consequently the related metrics) were confirmed as relating mainly to one of the principles (Use, Learn, Value or Adoption), see below further details on objectives and criteria.

Please note that when adherence to principles is explored in this section, the potential shown by the pilot in its set-up and corresponding documentation is often considered. The actual realisation of this potential is assessed in section 4 based on actual results and findings from the activities leading to the launch of the use cases and actual running of the pilot's first iteration with real end-users.

Facts and findings on Adherence to Use Principle

- The pilot, through its defined and planned use cases and requirements along both iterations, has potential to sufficiently demonstrate use of interoperable services based on Once-Only Principle in multiple cross-border combinations between 3 MS and involving multiple competent authorities as DC and DP as well as the MS infrastructure for authentication using eID of natural persons (eIDAS preproduction nodes) and to do so deploying DE4A's semantic (« Information Desk », see [23]) and common components (« Connector » including eDelivery AS4 gateways, SMP).
- The pilot implements in realistic conditions for use by real students two different evidence exchange patterns: USI, aligned with OOTS Implementing Regulation, and VC which is more related to eIDAS EUDI wallets approach and which is aimed to integrate with EBSI infrastructure through self-sovereign identity framework. Both have been jointly designed at Solution Architecture level between pilot architects and architects from « Architecture Vision and Framework » work package and have also been aligned with the « Semantic Interoperability Solutions » and « Common Component Design & Development » work packages.
- Mainly related to Objective C (see below) the pilot is set to obtain "Use" information and feedback from students regarding overall satisfaction with the procedures for applying for a service (i.e. efficiency with effort and time reduction, effectiveness to complete the procedure, security and privacy appreciation and self-control to manage their education credentials). In this regard, D4.2[1] specifies related metrics (section 2.2) and end-user feedback forms (Annex C), where the latter are

implemented available as on-line questionnaires in pilot microsite: https://www.de4a.eu/studyingabroadpilot.

- The pilot identified, in its user engagement strategy (section 4.4 of D4.2[1]), students from the higher education institutions in the 3 MS both as local and focus group users for the respective testing and running phases of the first iteration. Number of users were acknowledged from the onset to be limited due to the inherent limitations observed (e.g. only students from the participating universities can be enrolled). To cope with other limitations, the universities prepared approaches to guarantee that the different services would be feasible to pilot even outside of official enrolment periods and a micro-site has been published with complete information about piloting conditions for students (consistent with recommendations from the « legal and ethical compliance and consensus building » work package), and with videos and walkthroughs for the procedures.

Facts and findings on Adherence to Value Principle

- Mainly related to objectives A and B (see below) the pilot defined criteria and corresponding metrics to elicit from competent authorities (Data Evaluators / Verifiers and Data Owners / Issuers) aspects related to the quality of student data (used for automated and human-centric evidence exchange) in terms of its validity, reliability, completeness, adequate electronic structure (harmonized canonical evidence definition), etc.
- Collection of feedback on easier processing of evidence requests by DOs/Issuers and of data received by DEs/Verifiers.
- Value in respective use cases is set to be realized both for students and authorities, aligned with corresponding « Life Events » of the SDGR: students' application to Master studies (in the first iteration) in a digital-by-default and once-only manner, with full validation in 2-MS combinations of exchange of evidences through USI pattern and using real services, limited to one DP per MS and one type of evidence in the first iteration; application for study grants using a demonstration service in Slovenia also with USI pattern (with academic evidence in the first iteration and same constraints as the first use case) and exchange of higher education diplomas aligned with Europass-EDCI model for cross-border recognition, using self-sovereign framework integrated with EBSI that comprises server and client (mobile app) components and follows Verifiable Credentials evidence exchange pattern.

Facts and findings on Adherence to Learning (for Adoption) Principle

- Success criteria defined for Objectives D-E-F (see below) and corresponding metrics are all related to generating and consolidating a body of lessons learning gathered both from end-users in their testing of offered cross border services (SDGR type of eProcedures) and authorities integrating national infrastructures and endpoints for cross-border evidence exchange.
- Learning areas cover as well, for DEs and DOs, estimates of the costs and efforts spent to customize respective endpoints (multiple aspects) versus expected benefits. This is required for integration with DE4A common and semantic components (Connector, Authority Agent, Information Desk, eIDAS) in the piloted patterns (USI and VC). Member States also assess costs and benefits of deploying the DE4A Connector and SMP. For VC pattern this cost-benefit approach refers to the integration of the SSI Authority Agent by DC and DP authorities (Verifiers and issuers).
- During the actual lead to the phased launch of running combinations the pilot has in addition studied organizational and technical challenges which had an impact in pilot delays, and which are valuable lessons learned (see section 3.2.3 of D4.3 [4]).
- Learning finally covers successful connection and piloting across borders of data services and eProcedures through DE4A interoperability infrastructure and proof of adequacy of canonical evidence models developed by DE4A for the respective DC and DP authorities, of record matching at DP side as well as students' perception of clarity for Explicit Request and Preview steps.
- The pilot also consolidates information for internal and external consideration in the DE4A Wiki (https://wiki.de4a.eu/index.php/Studying_Abroad_Pilot), covering multiple knowledge aspects

(goals, use cases with details about their implementation, interaction patterns, components, data models, processes, legal status…).

3.1.2 Consistency of Pilot Goals with Pilot Definition and general DE4A Objectives

Regarding the question of ***consistency with the pilot's definition and relation to DE4A objectives*** the pilot's main objective and the pilot technical and business goals needs to be considered:

- The main objective of the pilot is defined as follows: **to facilitate the mobility of European students across the European Higher Education Area, based on paperless procedures enabled by the widespread cross-border use of eIDAS-compliant electronic identification and authentication schemes.** The pilot will also enhance data exchange among national portals/websites of Higher Educational institutions.
  This main objective is consistent with the pilot objective in the Description of Action to provide solutions which bring about real improvements by addressing the need of and effectively facilitating the mobility of European students across the European Higher Education Area, based on paperless procedures enabled by the widespread cross-border use of eIDAS-compliant electronic identification and authentication schemes, also allowing the use of self-sovereign identities in the pilot, based on innovative vendor-independent blockchain framework. It also relates directly to the overall DE4A objective of reinforcing **"trust in public institutions' transparency and protection of users' information and to unleash multiple qualitative and quantitative positive impacts in terms of efficiency gains and reduction of administrative burden, costs and barriers in cross-border public services through substantiation of the innovation and transformative technologies potential and the use of stakeholder expertise" in that the pilot**:
  1. Defines, designs, integrates and pilots with real users and in realistic conditions use cases that effectively promote students' mobility supported on fully online eProcedures realizing the Once-Only Principle through evidence exchange patterns. These patterns promote secure interactions reinforcing trust perception in public institutions' transparency (i.e. mechanisms like Explicit Request, record matching, or Preview) and protect users' information (e.g. self-empowerment with Verifiable Credentials).
  2. Verifies with competent authorities' efficiency gains and administrative burden reduction (pilot Value).
  3. Generates valuable lessons learned with hands-on experience on the organizational, technical, legal and semantic barriers towards sustainable adoption beyond the pilot itself, with learning that also covers transformative self-sovereign identity framework which integrates with underlying European blockchain infrastructure and servics (EBSI/ESSIF).

  The pilot is thus designed to simplify the cross-border user interaction with the selected educational procedures, systems and platforms and to demonstrate in practice the benefits for different stakeholders of realizing across borders the principles of Once-Only and Digital-by-Default. It is making existing and new building blocks and solutions work together in real life cases, adhering to the Project Start Architectures developed with other technical work packages. It also aims to increase the uptake and use of the eID digital service infrastructures by facilitating the access of citizens to public services across borders with their own electronic identities. Both European Higher Education federations, National Research and Education Networks and policy makers will be supported in understanding the implications of integrating with and using DE4A technical system for the cross-border automated exchange of evidence and application of the 'once-only' principle and of blockchain technology for multiple activities within education.
- Pilot-specific business and technical goals are targeted to generate benefits to public authorities (A-B), students (C) and the project as a whole (D-F) as can be seen in list below (as presented slightly reordered and refined from the initial deliverable in section 2.2 of D4.2[1]):

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;
C. Satisfaction of the students and effort and time reduction (related to building cross-border education services that support the once-only principle, paperless procedures, and the use of electronic identities);
D. Evaluate the OOP-components supporting the cross-border information flow:
    - Define (functional) requirements for the OOP-infrastructure, for different functional service patterns and for semantic interoperability as well as technical requirements for national services that must connect to the OOP-infrastructure;
    - Assess technical impact on national services already in place;
    - Evaluate connections of national systems to the DE4A OOP Technical System;
    - Evaluate deployment of DE4A OOP Technical System;
    - Promote the OOP within the Member States (higher education institutions and public administration);
    - Evaluate use of the self-sovereign identities approach in higher education, based on innovative vendor independent blockchain framework (e.g. EBSI / ESSIF).
E. Evaluate whether the once-only solutions designed to the Studying Abroad specific challenges have proven adequate in piloting the Studying Abroad 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.

When it comes to technical common criteria, the pilot determined its specific view on the general categories below. These were taken from the main underlying EIF Interoperability Principles as presented in EIRA v3.0.0 (p.65) [17] and are also matching "DE4A Principles" (see Chapter 7 in DE4A D2.1 "Architecture Framework"[18]):

- **Openness** – The services should be based on open-source software technologies to avoid a lock-in effect and to allow fast adaptation to the business needs.
- **Transparency** – All pilot-related procedures should be traceable and transparent for all the stakeholders involved and interoperability supported on availability of interfaces to systems and data.
- **Reusability** – The procedures should depend on already existing building blocks (e.g. CEF), standards, and infrastructure.
- **Technological neutrality and data portability** – The service infrastructure should not depend on vendor-specific technologies or too specific technical implementations but rather re-use open-source software, which further enables the ease of data sharing/free movement of data.
- **User-centricity** – Users' needs, and requirements should guide the design and development of the services leading as well to user empowerment. The services must also offer an acceptable degree of usability and preferably comply with commonly accepted standards in that area. Users should be given control when managing their educational credentials, like diplomas or achievements.
- **Inclusion and accessibility** - Inclusion is about enabling everyone to take full advantage of the opportunities offered by new technologies to access and make use of the piloted services, overcoming social and economic divides and exclusion. Accessibility ensures that people with disabilities, the elderly and other disadvantaged groups can use the services at service levels comparable to those provided to other citizens.
- **Security and privacy** - Availability, integrity and confidentiality of data exchanged through the common infrastructure must be guaranteed. It is extremely important for the success of the pilot to respect the rights of the users on this aspect and ensure compliance with national and European regulations, for example GDPR.

- **Administrative simplification** – The piloted procedures should simplify administrative processes of public administrations and Higher Educational Institutions with tangible reduction of administrative burden.
- **Effectiveness and efficiency** – The piloted procedures should produce the intended result and enable the students to accomplish their goals in the best possible manner and with the least waste of time and effort.

3.1.3 Consistency between Pilot Objectives and KPIs and Planning of Activities for Expected Results

Lastly, considering the ***question of consistency between pilot objectives and pilot key success and performance indicators, and whether its products, activities and plans represent a pilot set up that can yield the necessary results to test DE4A evidence interoperability solutions and enable the fulfilment of pilot goals,*** it is necessary to assess how the goals are considered in the use cases and how the success criteria and metrics are established in logical relation between each other.

Success criteria were initially sketched in D4.1 [10] and the final list was consolidated and refined in D4.2 Pilot Planning [1] and comprises the following list where it can be seen how the pilot has satisfactorily established a direct correspondence between the *13 success criteria* it defines with its *6 business and technical goals*:

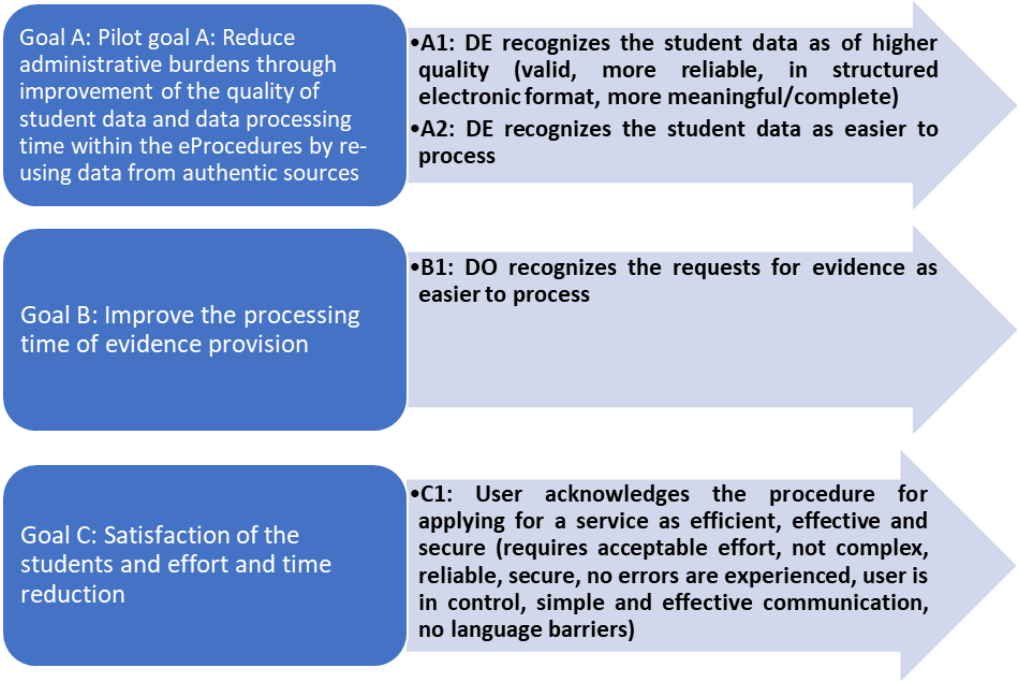

Figure 5: Correspondence of SA Pilot Functional and Business Goals and Success Criteria

Objectives A-B-C-D-F and corresponding success criteria and metrics are directly applicable for results collection in the 3 use cases of the pilot, whereas Goal E and its 2 associated success criteria and metrics are focused on the third use case of Diploma Recognition where DE4A self-sovereign identity supporting framework facilitated integration with EBSI blockchain infrastructure.

While Criteria A.x and B1 focus more on Value principle, criterion C1 focuses on Use and D.x-E.x-F.x focus on Learning and Adoption and serve to assess pilot technical business goals. It can thus be verified that all key piloting principles are addressed in a top-down manner as corresponding success criteria and that metrics also become linked to Use, Value and Learning.

Derived from the *13 success criteria* above, the pilot established *21 quantitative and qualitative metrics* together with corresponding quantifiable *targets* that allow to verify objectively their fulfilment (see section 2.2 of D4.2 [1]). The pilot has established some metrics of a directly quantitative nature (such as efforts required to deploy components or customize endpoints), while also using, for qualitative metrics that collect appreciations / level of satisfaction from end-users and pilot stakeholders, 5-point Likert scales [19] in order to allow a quantitative assessment of the answers against metric-defined targets. Each metric is well connected to a pilot process step to specify when the measurement should be executed.

Analysis of the established metrics and targets shows an adequate mapping to the related success criteria and a wide coverage of multiple topics of interest to elicit facts and findings and deriving pilot

knowledge, adequate for assessing at this stage progress towards fulfilling the different goals (see section 4.1).

Aligned with these metrics and designed to collect results to feed them, the Pilot also produced online feedback forms for students and internal questionnaires for DE eProcedure portal owners, DO data service providers and MS authorities in charge of common infrastructure components (with drafts provided in Annex C of D4.2[1] and Annex A of D4.3[4]). The questions appear well-designed and formulated in clear and concise terms to collect the necessary feedback for subsequent analysis of fulfilment of the defined success criteria, asking in several cases about multiple aspects in detail. Care has been taken, in particular for students' feedback forms, to keep questions limited in number while focusing on the most important areas where end-user feedback is required. For non-positive answers, respondents are required to provide justification in order to understand better any gaps or weaknesses and in particular, for internal questionnaires, also comments boxes are provided to collect from stakeholders' in free text details that allow formulation of lessons learned about different challenges and complexities faced in pilot preparation activities.

Based on the evidence gathered in this section and common tables in the first part of section 3 about these substantive facts and elements, it is fair to conclude that the pilot established in a sound manner a trail from the objectives to success criteria and finally to metrics which, when generating corresponding results for them, will allow to traverse the path back towards fulfilment of objectives.

3.2 Doing business Abroad Pilot

As described in D4.5[11], the Doing Business Abroad Pilot aims to **demonstrate the benefits of the Once-Only Principle and the Digital-by-Default Principle for companies and public authorities across borders, involving four EU MS (Austria, The Netherlands, Romania and Sweden) and validating in two use cases (Starting a business abroad and Doing business abroad) the Once-Only process for enrolment of a company and applying for services in another country** (online procedures listed in Annex II of the SDGR under the Life Event "Starting, running and closing a business"). The business registers as competent authorities participating in the role of data owners and the public service providers in the role of data evaluators, both act as main actors of harmonized company data exchange across borders[8].

Aligned strategically with ambitions of eGovernment Action Plan 2016-2020, leveraging Company Law Package (rules on opening a company/branch) and the Services Directive, the pilot contributes to Digital Single Market efforts to lower administrative burden for businesses. It does this by improving automation within administrative processes to make them more efficient and reducing or eliminating the frequency with which manual interactions happen to submit or update company data or business events towards competent authorities. It relies on and interacts with several programmes, components and initiatives such as eIDAS for authenticating with extensions for companies representatives' powers validation[9], SDGR OOTS for automated evidence exchange, GDPR for data processing, BRIS data exchanges between business registers, national Once-Only infrastructure and existing services for data provision and services for business also in the MS.

The Doing Business Abroad pilot is set up with focus on real life experience with the *specific aspects* of companies in Once-Only implementations: authenticating a representative, identifying the company, validating the representative's powers, retrieving company information from cross-border (authentic) sources, Explicit Request and the Preview under SDGR in case of company representation, keeping the data consumer informed on business events, semantic interoperability of company information,

[8] In some of the piloting scenarios, the company ('s branch) enrols to the authentic business register of a data consuming Member State and in others the Data Consumer operates a portal-specific company registration (non-authentic).

[9] Developed in SEMPER project, https://www.a-sit.at/en/semper/

differentiation in public availability of company information for cross-border exchange of company information, among others. Departing from the fact that there is no quick fix or existing solution to several of these aspects, the pilot strives for detailed analysis, functional solution design, consensus and agreements on a European level, validating proposed solutions in a pilot that runs in realistic conditions with real users and company data where possible. A very good example of this is the « company representation » dimension and associated complexity (authentication on behalf of a company / validation of representative's powers is not common practice across borders), which needs to be addressed for procedures aimed at companies, compared to use cases that focus on services for natural persons only.

The pilot (re-)uses operational solutions for company data provisioning, i.e. business registers and their currently available information as much as possible. While it does not redesign national business registers the pilot acknowledges differences in national legislation, the way (highly complex) procedures for businesses are organised nationally, semantic challenges or differences in national software solutions (e.g. OOP-infrastructures that need to be integrated to DE4A OOTS), etc. Even small step improvements implemented by the pilot to address these challenges are expected to yield huge benefits.

The pilot aims to confirm benefits for different actors in the domain of starting and doing business across borders. These are considered and reflected in pilot business goals:

- Public authorities will improve the quality of company data re-using data from authentic sources and receiving notifications in case of changes to company status/data. This will also reduce manual work and lower processing costs improving efficiency of services for companies.
- For companies applying for services, they will benefit from significant reductions in manual work and transactions costs with improved enrolment speed.

Pilot technical goals are related to the evaluation of OOP components supporting cross-border information flows with assessment of technical impact on national services already in place and testing of national OOP-to-(DE4A)-OOTS principles and solutions, all of which accompanies assessment of solutions to pilot challenges (company representatives authentication and powers validation, implementation of explicit request and preview obligations as well as direct interactions between competent authorities in scenarios where legal basis allows it).

3.2.1 Pilot Adherence to General Pilot Principles

Regarding ***pilot adherence to general pilot principles*** **(Use, Learn and Value)**, it is verified that the pilot exhibits high-level of awareness of these principles with an explicit set up in its documentation from early stages of a consistent and coherent framework; it goes from technical and business goals to metrics through success criteria, which focus on collecting and analysing results in real-life conditions over those general principles:

- D4.5 [11] as in the case of other pilots, provided the pilot scoping, established its functional boundaries in terms of use cases for both iterations (described through user journeys, flows and requirements with involved actors and definition of required and available data for exchange all of which were used as input by the other technical work packages), set specific pilot main objective and specific technical and business goals, and presented a preliminary identification of corresponding pilot success criteria suitable to assess them. It also provided the sectoral context of strategic EU policies and other relevant initiatives (SDGR, Tallinn and Berlin Ministerial declarations, EIF Implementation Strategy, Company Law Package, Services Directive, BRIS). At this initial stage, the pilot also identified several political, legal, technical and user involvement issues.
- During the first year of the project, the pilot also internally produced discussion papers with focus on specific challenges: cross-border authentication (identity and record matching), powers validation, explicit request and preview, use of BRIS outcomes and piloting in production. The papers characterised the challenges and analysed advantages and disadvantages of options to address

them, leading to decisions for implementation by the 4 participating MS in DBA pilot scenarios and thus a better understanding of work to be done.

- D4.6 [2] provided the list of success criteria (table 2 of section 2.1.2) and corresponding quantitative and qualitative metrics related to respective Use, Learn and Value principles (section 2.2).
- Furthermore, in section 3.1 of D4.7 [5] each of the different criteria (and consequently the related metrics) were mapped (to facilitate analysis) as pertaining mainly to one of the principles (Use, Learn, Value or Adoption), see below further details on objectives and criteria.

Please note that when commenting on adherence to principles in this section, the potential shown by the pilot in its set-up and corresponding documentation is often considered. The actual realisation of this potential is addressed in section 4 based on actual results and findings from the activities leading to the launch of use cases and actual running of the pilot's first iteration with real end-users.

Facts and findings on Adherence to Use Principle

- The pilot, through its defined and planned use cases and requirements along both iterations, has the right potential to sufficiently demonstrate use of interoperable services based on Once-Only Principle in multiple cross-border combinations. It is set to do so between 4 MS and involving multiple competent authorities (including business registers) as DC and DP, as well as MS infrastructure for authentication using eID of natural persons representing companies and identification of companies using EU-wide standards like EUID as defined by BRIS (2015/884). The pilot MS agreed to implement its own pilot-specific eIDAS nodes capable of managing SEMPER project extensions while integrating national systems with DE4A semantic (« Information Desk ») and common components (« Connector » including eDelivery AS4 gateways, SMP).
- The pilot implements, in realistic conditions for use by real company representatives and obtaining real company data, three different evidence exchange patterns:
    - Intermediation pattern (IM), which is closely aligned with initial architecture for OOTS from CEF OOP team and piloted in the first iteration;
    - Lookup and Subscription & Notification patterns, which enable respectively repetitive requests of previously requested evidence without user interaction for near-real time use of information and to push from DP to DC notification of business events through subscription of the latter to a predefined catalogue of company events by the former.

  These interaction patterns have been jointly designed at the level of Solution Architecture between pilot architects and architects from « Architecture Vision and Framework » work package (see D2.5[20] and https://wiki.de4a.eu/index.php/Reference_Architecture), ensuring alignment with the « Semantic Interoperability Solutions » and « Common Component Design & Development » work packages.
- Mainly related to Objective B (see below), the pilot is set to obtain Use information and feedback from company representatives (in the case of UC#1 and IM pattern) regarding overall satisfaction with the procedures for applying for a service and covering: effective and efficient procedures and methods to proof authorisation, acceptable duration of completion of online eProcedures to apply for a service and time and/or cost savings when completing eProcedures with DE4A OOTS. In this regard D4.6 [2] specifies related metrics (section 2.2) and end-user feedback forms (Annex 2) which are also published as on-line questionnaires in pilot microsite (https://www.de4a.eu/doingbusinessabroadpilot).
- The pilot identified in its user engagement strategy (section 4.4 of D4.6[2]) three different categories of users (different partners participate to provide/contact users depending on MS involved in different cross-border combinations): on the one hand, employees with different roles working at DEs and DOs to provide feedback related to goals and criteria A, C and D (see further below) and, on the other, representatives and companies as end-users which will be either fictitious (only for cases where impediments determine the need to use test data and identities) or invited familiar (from professional network of DBA pilot partners) or any companies with interest to participate in

the pilot. The objective of this strategy is the involvement of natural persons (professionals) that own (or represent) companies in real life to judge the DE4A solution from a true and realistic perspective (even in cases concerning fictitious companies). These end-users are envisaged to participate in the respective testing and running phases of the first iteration. Engagement is on a best-effort approach basis and the number of cross-border users were acknowledged from the onset to be limited due to the inherent limitations (i.e. unpredictable availability of companies from one MS actually aiming to start business in another MS within the timeframe of pilot iterations). Mitigation approaches are considered through the use of simulations, i.e. avoiding final actual registration of the company abroad. A micro-site has been published with complete information about piloting conditions for company representatives who have to previously register to participate in the pilot in order to receive additional guidance and provide feedback in interviews, in consistence with recommendations from the « legal and ethical compliance and consensus building » work package, videos and walkthroughs.

Facts and findings on Adherence to Value Principle

- Mainly related to objective A (see Figure 6: Correspondence of DBA Pilot Functional and Business Goals and Success Criteria) the pilot defined criteria and corresponding metrics to elicit from competent authorities (Data Evaluators, Data Owners and MS teams in charge of common OOTS and eIDAS infrastructure) aspects related to the quality of company and powers validation data in terms of: reliability, positive assessment of cost/effort vs benefits for integrating common components and mandate management systems and for customizing endpoints, adequacy of company evidence model and record matching mechanisms, suitability of powers validation and company data update solutions and of Explicit Request and Preview. From users, the pilot investigates appreciation of enrolment procedure considering effort and different activities involved, satisfaction with solution for proof of entitlement to represent a company and with the duration of the overall process and its different steps as well as on time and money saved.
- Easier processing of evidence received by DEs (automated and, in case of IM pattern, user-controlled evidence exchange).
- Pilot Value is set to be realized in respective use cases for companies (representatives) and competent authorities, which are aligned with corresponding « Life Events » of the SDGR for starting business abroad. These Life Events for businesses comprise, for the first iteration, the fulfilment of procedural obligations to start business in another Member State (especially the initial registration of a company / branch at an eProcedure portal). For the second iteration, DBA pilot will address updating company data for active eServices in a foreign country, triggered by a business event, e.g. company goes bankrupt, company stops its activities, company merges, etc. This will be enabled through subscriptions to notifications on selected business events (S&N pattern) or repeated requests for previously shared data (Lookup pattern).
- The pilot defined for the first iteration a Minimum Viable Product which features uninterrupted exchange of evidences through IM pattern between two MS and involves real or simulated eProcedures. This includes authentication of representatives on behalf of their companies with full powers validation using a dedicated pilot network of adapted eIDAS nodes, simple Explicit Request and Preview functionalities, with limitation to one DP per MS and one type of evidence (company registration evidence). All of which provides the context for Value realisation.

Facts and findings on Adherence to Learning (for Adoption) Principle

- Success criteria defined for Objectives C and D (see Figure 6: Correspondence of DBA Pilot Functional and Business Goals and Success Criteria) and corresponding metrics can be considered for evaluation purposes to be mainly related to generating and consolidating a body of lessons learned regarding evaluation of DE4A OOP components to support cross-border information flows, leveraging the feedback obtained from DEs, DOs and MS teams responsible for common components (e.g. Connector, eIDAS pilot nodes…).

- Learning areas also cover estimates of the costs and efforts spent by DEs and DOs to customize respective endpoints (multiple aspects) versus expected benefits. This is required for integration with DE4A common and semantic components (Connector, Information Desk, eIDAS) in the piloted interaction patterns. Member States also assess costs and benefits of deploying the DE4A Connector and SMP.
- During the actual lead to the phased launch of running combinations, the pilot has also studied organizational and technical challenges which had an impact in pilot delays, and which constitute valuable lessons learned.
- The generation of internal discussion papers (some of which have also been shared externally as input towards SDG OOTS discussions) shows a clear predisposition from pilot partners to achieve a more detailed understanding of several challenges investigated for piloting (on cross-border identity and record matching, powers validation, Explicit Request and Preview, use of BRIS outcomes and piloting in production) and to generate valuable learning. This is further coupled with specific information generated by the pilot for internal and external audiences in DE4A Wiki: https://wiki.de4a.eu/index.php/Doing_Business_Abroad_Pilot.DBA has provided there information about its goals, MS scenarios and use cases (with related details about major design decisions, technical description of interaction patterns, processes, data models, components, legal status…).

3.2.2 Consistency of Pilot Goals with Pilot Definition and general DE4A Objectives

Regarding the question of ***consistency with the pilot's definition and relation to DE4A objectives*** the pilots' main objective and the pilot technical and business goals have to be considered:

- The main objective of the pilot is defined as follows: **to lower barriers for companies starting a business or doing business cross-border**. This main objective is consistent with the pilot objective in the Description of Action to (in order to meet the needs of both company and service provider) retrieve company data from (authentic) sources (Data Providers) for Data Consumers, and to keep this data up-to-date by connecting to new or existing data subscriptions (notification services) based on business events. In this way, the data is stored once (in a national -business- register) and used many times by service providers all over Europe. This main goal can also be seen to contribute to the general DE4A objective of reinforcing **"trust in public institutions' transparency and protection of users' information and to unleash multiple qualitative and quantitative positive impacts in terms of efficiency gains and reduction of administrative burden, costs and barriers in cross-border public services through substantiation of the innovation and transformative technologies potential and the use of stakeholder expertise**" in that the pilot:
    1. Defines, designs, integrates and pilots for real stakeholders (companies representatives, business registers and other portals with public services for businesses) and under realistic conditions, use cases that effectively promote businesses mobility supported on fully online eProcedures that realize the Once-Only Principle through evidence exchange patterns. These in turn enable secure interactions reinforcing trust perception in public institutions' transparency (i.e. mechanisms like Explicit Request, record matching, or Preview) and protect users' information (authorization checks using powers validation mechanisms).
    2. With regards to Pilot Value, the goal is to verify efficiency gains and administrative burden reduction for service delivery/completion of procedures (less manual work, lower processing costs) with competent authorities. Positive perception of end-users (e.g. improved service enrolment speed), along with company data quality improvement, when delivered in electronic and harmonized electronic formats are to be verified as well.
    3. Generates valuable lessons learned towards sustainable adoption beyond the pilot itself, with hands-on experience about the efforts of pilot participants required for connecting national systems to the DE4A OOTS and the corresponding organizational, technical, legal and semantic challenges. Pilot solutions to challenges focus on specific learning aspects relevant for the pilot domain such as management of representations for authentication and authorization, Explicit

Request and Preview for business procedures context, synergies with BRIS and good strategies to overcome or at least mitigate -technical, organisational, semantic, legal- barriers and challenges for piloting in production.

The pilot is thus designed to demonstrate in practice the benefits for different stakeholders of realizing across borders the principles of Once-Only and Digital-by-Default, achieving simplification of cross-border user interaction with systems offering procedures and data for legal persons and their representatives. To do so, the pilot: (i) defines (functional) requirements for the OOP-infrastructure, different functional service patterns and semantic interoperability requirements as well as technical requirements for national services that must connect to the OOP-infrastructure ; (ii) integrates together existing and new building blocks and solutions, adhering to the Solution Architectures developed in collaboration with other technical work packages and (iii) validates DE4A outcomes in real life cases promoting the Once Only Principle within the MS towards public administrations and companies. It also aims to investigate and demonstrate feasibility of solutions for management of mandates and powers information, extending eID-based authentication beyond natural persons scenarios. Both business registers and other service providers for businesses and policy makers will be supported in understanding the implications of integrating with and using DE4A technical system for the cross-border automatic exchange of company-related evidence for different scenarios, with and without user interaction.

- Pilot-specific business and technical goals are targeted to generate benefits to public authorities (A), companies applying for a service through DE4A OOTS (B) and the project as a whole (C-D) as can be seen in list below (presented slightly reordered and refined from the initial deliverable in section 2.1 of D4.5[11]):

  For Public Authorities:
  - Improve the quality of company data within the service fulfilment processes:
    - Re-use data from authentic sources;
    - Receive notifications in case of changes to the company status or company data;
  - Reduce manual work and lower processing costs.

  For companies applying for a service:
    - Reduce manual work and lower transaction costs;
    - Improve service enrolment speed.

- Pilot technical goals contributing to project objectives:
  - Evaluate the OOP-components supporting the cross-border information flow:
    - Assess technical impact on national services already in place;
    - Test national OOP-to-EU OOP principles and connections.
  - Evaluate whether the once-only solutions designed to the DBA specific challenges have proven adequate in piloting eProcedures:
    - Usability of harmonised company evidence model;
    - Solutions to validate powers to different degrees;
    - Usability and correct implementation and use of Explicit Request and Preview;
    - Adequacy of patterns to keep company data up to date.

For technical common criteria, the pilot described, adapted to its viewpoint, the following ones. These were reported in section 2.2 of D4.5 [11], taken from the main underlying EIF Interoperability Principles as presented in EIRA v3.0.0 (p.65) [17] and they are also matching “DE4A Principles” (see Chapter 7 in DE4A D2.1 “Architecture Framework”[18]):

- **Openness** – The services should use open standards, interface definitions, schemes and protocols. The openness of the (Member State connections to the) OOP technical system should reduce efforts of public authorities to connect to the system. Furthermore, it should increase availability of data flows. On-line and real time use of data directly, without delay, from authentic sources (business registers) across borders is a major step forward in the Digital Single Market.

- **Transparency** – All pilot-related procedures should be traceable and transparent for all the stakeholders involved, leading to more companies interested in piloting (as they understand the business value of the OOP principle better), and putting more trust in the pilot services as they understand that best quality available data will be (re-)used.
- **Reusability** – focus is on the re-use of data directly from data sources. Data is more re-usable as soon as it is available online and in machine-readable format. Reusability furthermore refers to the use of existing building blocks in the OOP technical system.
- **Technological neutrality and data portability** – Technical neutrality should be a way to minimise required efforts of pilot participants to connect to the OOP technical system. In time, this should boost the number of participating Member States. In case all piloting partners agree on the use of one single technology, technological neutrality may not be pursued (technical neutrality is a means to an end).
- **User-centricity, inclusion and accessibility** – Users' needs and requirements should guide the design and development of the services, thus leading to user empowerment. The services must also offer an acceptable degree of usability and preferably comply with commonly accepted standards in that area. User-centricity will lead to more companies interested in piloting and a reduction in lead time to apply for a service. Inclusion and accessibility will not be major criteria in this pilot as it deals with professional representatives instead of citizens.
- **Security and privacy** – Availability, integrity and confidentiality of data exchanged through the common infrastructure must be guaranteed. It is important for the success of the pilot to respect the rights of the users on this aspect and ensure compliance with national and European regulations, for example GDPR. This criterion also includes "safety": the pilot is deliberately described to do only its intended scope of work and will not affect other domains, which are not in a crucial relationship to fulfil the duties.
- **Administrative simplification** – The piloted procedures should simplify administrative processes of public administrations. Administrative simplification should lead to a reduction in lead time to apply for a service and reduction in efforts of data consumers to provide services.
- **Effectiveness and efficiency** – The piloted procedures should reduce manual work, lower transaction costs and improve service enrolment speed.

3.2.3 Consistency between Pilot Objectives and KPIs and Planning of Activities for Expected Results

Lastly, considering the ***question of consistency between pilot objectives and pilot key success and performance indicators, and whether its products, activities and plans represent a pilot set up that can yield the necessary results to test DE4A evidence interoperability solutions and enable the fulfilment of pilot goals,*** it is necessary to assess how the goals are considered in the use cases and how the success criteria and metrics are established in logical relation between each other.

Success criteria were initially sketched in D4.2 [11] and the final list was consolidated and refined in D4.6 Pilot Planning [2]. It comprises the following list where it can be seen how the pilot has satisfactorily established a direct correspondence between the *15 success criteria* it defines with its *4 business and technical goals*, which will allow to assess the fulfilment of such goals (see section 4.1):

Goal A: Improve the quality of Company data within the service fulfilment process by re-using data from authentic sources, thereby reducing manual work and lowering processing costs
•A1: DE recognizes the company data is of higher quality, more reliable and easier to process when using the OOP TS to retrieve company data directly from the DO
•A2: DE recognizes powers validation method provides data of higher quality and reliability, proving that the representative is sufficiently authorized to represent the company
Goal B: Reduce manual work, lower transaction costs and improving enrolment speed for the company when using the Once Only Principle
•B1: user acknowledges the procedure for applying for a service to be effective and efficient
•B2: user acknowledges the method to proof their authorisation as effective and efficient
•B3: user acknowledges duration of completing the online eProcedure activities to apply for a service as acceptable
•B4: user saves time and/or cost when completing the eProcedure using the OOTS
Goal C: Evaluate the OOP-components supporting the cross-border information flow (technical impact on existing national registers/services, evaluate connections of national systems to DE4A OOTS)
•C1/C2: DE/DO believes the cost and effort for integrating to the DE4A Connector will eventually be outweighed by the benefits
•C3: DO believes the cost and effort for integrating to the Mandate Management System will eventually be outweighed by the benefits
•C4: participating MS believe the cost and effort for setting up and deploying the DE4A Connector in their national infrastructure will eventually be outweighed by the benefits

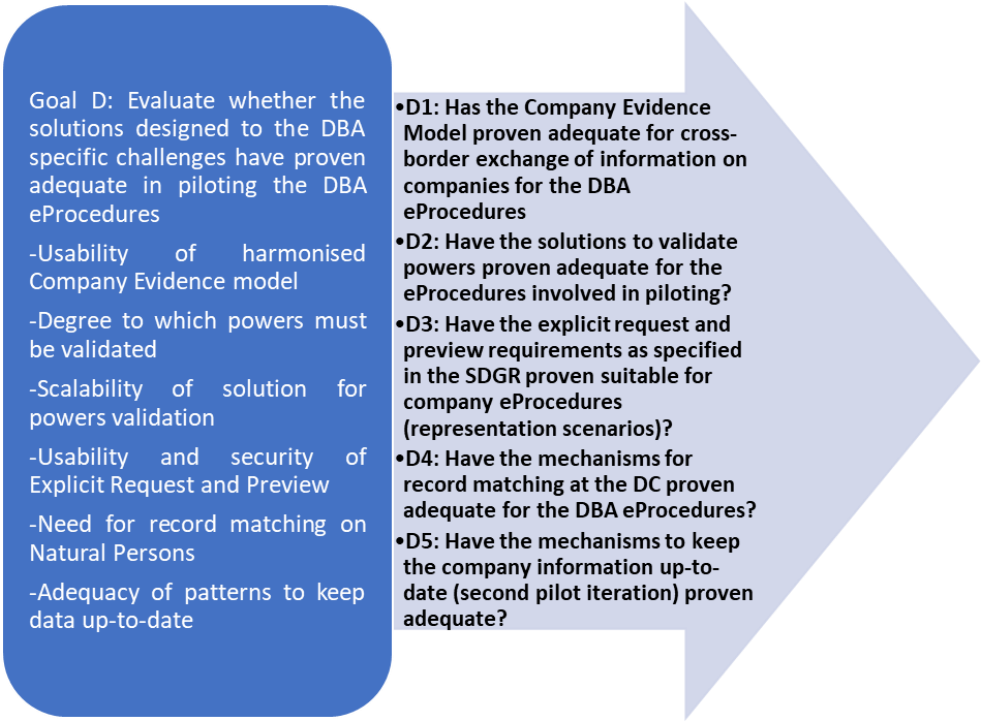

Figure 6: Correspondence of DBA Pilot Functional and Business Goals and Success Criteria

While all objectives and corresponding success criteria and metrics are directly applicable for results collection in the 2 use cases of the pilot, some of the associated criteria and metrics (D4-5) related to goal D are also focused on 2 new patterns (Lookup and Subscription & Notification) that will be piloted in the second iteration (as well as Fine-Grained Powers Validation).

All key piloting principles are addressed in a top-down manner, as the corresponding success criteria and metrics also become (for evaluation purposes) linked more directly to Use, Value and Learning: while Criteria A focuses more on Value principle, criteria B can be related to Use Principle, while criteria C and D are considered to focus mainly on Learning towards Adoption (and also serve to assess pilot technical goals). The criteria are adequately designed in order not to be restrictive limiting/controlling (qualitative) feedback from users and processes.

Derived from the *15 success criteria* above, the pilot established *23 quantitative and qualitative metrics* together with corresponding quantifiable *targets* that allow to verify objectively their fulfilment (see section 2.2 of D4.6 [2]). Some metrics are of a directly quantitative nature[10] and are often broken down to more detailed topics in order to collect fine grained results (using as units manhours / Euros spent applying for a service in baseline scenario, minutes spent on the eProcedure portal activities, effort as manhours to integrate DO data service / mandate management systems / DE data portal to the Connector -and to implement explicit request and preview where applicable- or to deploy and set up the DE4A Connector)[11]. Other metrics are qualitative and used to collect appreciations / level of satisfaction from end-users and pilot stakeholders: 5-point Likert scales [19] are used in order to allow a quantitative assessment of the answers against metric-defined targets. In order to maximise learning, DBA metrics are in most cases established as a combination of a quantitative measurement or appreciation, and a free-format observation allowing for unstructured qualitative feedback to be collected. Each metric is well connected to a pilot process step that specifies when the measurement

[10] Some are also optional e.g. in cases where data like costs is considered confidential.

[11] For some criteria consideration of the baseline (traditional situation without usage of the OOTS) is relevant so that results can be compared (and effects can be properly determined) with the use of DE4A technical system for evidence exchange. This holds true for the DE perspective and to a certain extent also for the DO perspective.

should be executed. Some metrics do not use scales nor units (especially for criteria D) but are aimed to capture different thoughts and considerations from key stakeholders regarding different pilot solutions.

Evaluation analysis of the established metrics and targets shows they are all adequately mapped to the related success criteria and can be used to elicit multiple facts and findings and to derive pilot knowledge (lessons learned), offering a broad coverage of multiple aspects of specific interest to the pilot domain. They are seemingly adequate for enabling at this stage an assessment of progress towards fulfilling the different goals (see section 4.2).

Aligned with these metrics and designed to collect results to feed them, the Pilot also produced online feedback forms for company representatives and internal questionnaires for DE eProcedure portal owners, DO data service providers and MS authorities in charge of common infrastructure components (with drafts provided in Annex 3 of D4.6 [2] and Annex A of D4.3[4][12]). The questions appear well-designed and formulated in clear and concise terms to collect the necessary feedback for subsequent analysis of fulfilment of the defined success criteria, asking in several cases about multiple aspects in detail within a given question. Care has been taken, in particular for company representatives feedback forms, to keep questions limited in number while focusing on the most important areas where end-user feedback is required.

Additional and highly valuable feedback (such as what users particularly appreciated or disliked about procedure activities and their duration, powers validation or options for preview of retrieved data) is to be collected with additional interviews given the context of direct contact with company end-users. MS and competent authorities are also enticed in questionnaires to elaborate on the appreciation or dislike of aspects they evaluate with Likert scales, which is a slightly different approach to that followed in other pilots but can equally help to understand better any gaps or weaknesses and, in particular, allow formulation of lessons learned about different challenges and complexities faced in the different pilot phases.

The substantive facts and elements presented in this section and the common tables in the first part of section 3 provide sufficient and fair evidence to conclude that the pilot has established in a sound manner the expected trail from objectives to success criteria and finally to metrics, covering all key piloting principles of Use, Value and Learning towards Adoption which, when generating corresponding results for them, will allow to traverse the path back towards fulfilment of objectives.

3.3 Moving Abroad Pilot

The Moving Abroad pilot aims to **facilitate and automate evidence (administrative documents) exchange for citizen mobility (citizens moving and/or living abroad) in 5 EU MS (Luxembourg, Portugal, Romania, Slovenia and Spain)**. This will materialise benefits such as fewer physical movements of citizens to fetch the evidence and less interventions of civil servants resulting in a faster evidence exchange. It addresses the administrative burden and often time-consuming (3-6 months are typically spent in the process of moving to a new destination abroad) and stressful procedures for citizens moving to a new country: looking up country-specific requirements for registration, obtaining often notarised/legalised copies of important documents, doing formalities in-person, etc.

Thus, the ambition of the pilot, in addressing these problems, is to make the exchange of documents across-borders (for which in some cases certified translations are required) as smooth and simple as possible for the citizen and cost-effective for a set of authorities collaborating to facilitate citizens' mobility. For this and leveraging the Once-Only and Digital-by-Default principles, the pilot identifies that having a secure value chain enabling the trustworthy exchange of necessary evidentiary data between the authentic sources of information and the European public services involved would be of

[12] "Additional questionnaire on specifications, software and procedures" which is common for the 3 pilots.

great benefit in the future i.e. enabling higher quality of the cross-border services by securely delivered, trustworthy and up-to-date information, making more efficient workflows available to authorities to interact with the information chains, less need to spend time and resources investigating the validity of the documents, etc.

As in the case of other pilots, this pilot is set to validate and explore different aspects of the DE4A environment and platform, including innovative concepts such as interrupted procedures or linking of processes across borders e.g. registration abroad of a new domicile address followed by de-registration of old domicile address.

The pilot use cases follow a pragmatic approach in real-life environments and relate to Life Events in Annex II of the SDGR[22]: "Moving – Change of Address" (UC#1 as part of broader process of registration in population register of the destination MS) and (UC#2) "Birth - Requesting proof of registration of birth" (also marriage certificates are covered in a more general case of Request of Civil Status Certificates). A third use case for requesting information and other social benefits was analysed and designed but could finally not be implemented after withdrawal from partners from 3 MS. Regarding the evidence, for use cases 1 and 2, the pilot has opted to follow the EC Regulation (EU) 2016/1191 [21], allowing to flexibly exchange harmonized canonical evidences (Domicile, Birth and Marriage as they encompass most of the evidence that is needed to register in a foreign MS), and for countries that can provide them, corresponding multi-lingual and original evidence formats can also be transferred together.

The pilot mainly focuses on realizing the USI interaction pattern, aiming to demonstrate its adequate design in terms of transparency of the exchange and to increase certainty and hence trust at the side of the DP that the data can indeed be shared cross-border. The pilot considers this pattern as particularly appropriate for contexts demanding highly human-centric and strongly GDPR compliant approach, given it features guaranteeing Preview and approval of evidence cross-border transfer at DP side, as well as redirection of the user to the DO to authenticate and assist towards unambiguous record matching. This replicates current national procedures involving civil and population registers which typically require direct citizen interaction.

Different actors (citizens executing procedures for themselves or their family members, civil servant at data providers and data consumers) will benefit from the integrated cross-border procedures and the Once-Only principle:

- Citizens will be able to complete, in a fast, secure, privacy-preserving manner, the administrative formalities to register and live abroad (a pre-requisite for requesting benefits such as pensions, unemployment benefit, etc.) from anywhere using only their electronic identities and digital credentials, provided procedure-specific conditions are also fulfilled. These formalities will be delivered to them as fully online and simplified procedures that rely on (DE4A) OOTS and allow reduced manual steps and time and costs savings, e.g. citizens will need to communicate change of address only once through the corresponding competent authority that will access evidence from authentic sources and disseminate information to all public institutions concerned.
- Both DCs and DPs will rely on secure user authentication, leveraging eIDAS network: pre-production eIDAS nodes network is used to support authentication of citizens from countries with non-notified eIDs. Thanks to USI pattern, users will be able to also authenticate in the DP side and authorize the exchange after Preview increasing trust in the cross-border exchange for the involved competent authorities and end-users themselves. Leveraging the alignment with both SDGR and public documents Regulations, DEs will benefit from evidence that is delivered from authentic sources in a form that can be interpreted and used in the requesting country to optimize public service delivery to moving citizens: reducing manual work and lowering processing costs. This will have a multiplier effect as the solution is replicated to multiple procedures once the national infrastructures are adapted to integrate with pan-European OOTS.

- Stakeholders outside the project will be able to learn from the solutions designed for Moving Abroad specific challenges to pilot eProcedures, including usability of harmonised evidence models as well as from Explicit Request and Preview, record matching on natural persons, etc. They will also learn about the technical impact on existing national services for connecting to OOP components of the technical system supporting the cross-border information flow.

3.3.1 Pilot Adherence to General Pilot Principles

When it comes to the question of ***pilot adherence to general pilot principles*** **(Use, Learn and Value),** it is verified that the pilot has demonstrated high-level of awareness of the principles with an explicit set up in its documentation from early stages of a consistent and coherent framework from technical and business goals to metrics through success criteria which focus on collecting and analysing results in real-life conditions over those general principles:

- D4.9 [12] defined the scope of the pilot, establishing the functional boundaries in terms of use cases which were described through: structured procedures descriptions (preconditions, intermediate steps and postconditions), high level business flows and business process models, functional and non-functional requirements, identification of involved actors and relevant existing infrastructures, definition of required and available data per MS for exchange, etc., all of which were used as input by the other technical work packages. This deliverable also set the pilot main objective and specific technical and business goals, presenting a preliminary identification of corresponding pilot success criteria suitable to assess them. It also provided the sectoral context of strategic EU policies (SDGR, Public Documents Regulation, Services Directive) and other relevant initiatives (e.g. EESSI). At this initial stage the pilot also identified several political, legal, technical and organizational issues.
- D4.10 [3] provided the consolidated list of success criteria (table 2 of section 2.1.2) and corresponding quantitative and qualitative metrics related to respective Use, Learn and Value principles (section 2.2).

Please note that when adherence to principles is addressed in this section, the potential shown by the pilot in its set-up and corresponding documentation is often considered. The actual realisation of this potential is addressed in section 4 based on actual results and findings from the activities leading to the running of the pilot.

Facts and findings on Adherence to Use Principle

- The pilot, through its defined and planned use cases and requirements, has potential to sufficiently demonstrate use of interoperable services based on Once-Only Principle in multiple cross-border combinations between 5 MS and involving multiple competent authorities as DC and DP, as well as MS infrastructure for authentication using eID of natural persons (eIDAS preproduction nodes) and to do so deploying DE4A semantic (« Information Desk ») and common components (« Connector » including eDelivery AS4 gateways, SMP).
- The pilot implements in realistic conditions for use by real citizens the USI evidence exchange pattern, which is aligned with OOTS Implementing Regulation and extended to support request and response of multiple evidences. It is also leveraging for domicile address de-registration scenario Lookup pattern to directly send a new address to country of origin. These solutions have been designed, in the case of USI pattern at Solution Architecture level (see Annex A of D4.10 [3]), jointly between pilot architects and architects from « Architecture Vision and Framework » work package, also aligned with the « Semantic Interoperability Solutions » and « Common Component Design & Development » work packages.
- Mainly related to Objective B (see below) the pilot is set to obtain use information and assessment from citizens regarding overall satisfaction with the eProcedures for applying for a service covering aspects like: required effort and time reduction, clarity and simplicity of procedure, number of errors and interruptions (effectiveness to complete the procedure), language, communication, duration, security and privacy protection and user control over evidence exchange. In this regard, D4.10 [3]

specifies related metrics (section 2.2) and end-user feedback forms (Annex B), made available as on-line questionnaires in the pilot microsite (https://www.de4a.eu/movingabroadpilot).

- The pilot identified in its user engagement strategy (section 4.4 of D4.10 [3]) local users for the testing phase (involved with DE4A). Even though it had determined to reach out through initiatives such European Innovation Partnership on Active and Health Ageing (https://digital-strategy.ec.europa.eu/en/policies/eip-aha) which has many members, or others (like MyData Global, JoinUp) towards technology literate external users as well as other unknown users to be reached through networks of other departments and agencies of pilot-involved entities as well as social networks (LinkedIn, Twitter), it later decided, given existing delays, not to approach any external users until the services were up and running to avoid creating unfulfilled expectations. Procedures for recruiting users are expected to become a continuous process and some MS have reached out to their embassies to support this and offer as many people as possible the opportunity to participate. In any case, given the known scarcity of cross-border users for experimental services and also given the fact that in some procedures the process will not be carried out fully, discarding evidence exchanged at the end, it is not expected that more than 10 users per country may be involved, leaving the total expected number of users actually participating in the order of tens at most. A micro-site has been established that will contain complete information about the pilot, videos and walkthroughs, feedback forms and piloting conditions (i.e. informing participants of the fact that they are involved in piloting activities, including any risks and countermeasures taken, and the lack of legal effects and consequences of participation), following recommendations from the « legal and ethical compliance and consensus building » work package.

Facts and findings on Adherence to Value Principle

- Mainly related to objective A (see below) the pilot defined criteria and corresponding metrics (see section 2.2.1 of D4.10 [3]) to elicit from competent authorities (Data Evaluators) aspects related to the quality of citizen data (used for automated and human-centric evidence exchange) in terms of its reliability, completeness, correctness, meaningfulness, availability in electronic format, effort to process the evidence, benefit of retrieving moving data that is up-to-date.
    - Value in respective use cases is also to be verified for citizens and authorities. These use cases are aligned with corresponding « Life Events » of the SDGR: change of address and request for civil status certificates with validation in combinations of two MS of: exchange of evidences (in some cases multiple types) through USI pattern and using real services that have save and resume support for interrupted procedures where available; extended functions like notification of new address for deregistration; assessment of Explicit Request and Preview for different implementations of these steps in MS; assessment of error handling and logs in OOP common components and endpoints and a theoretical analysis of scenarios of family reference person requesting evidence for family members (e.g. entire family moving abroad); assessment of record matching (national differences i.e. using eIDAS or not).

Facts and findings on Adherence to Learning (for Adoption) Principle

- Success criteria defined for Objectives C-D (see below) and corresponding metrics support generating and consolidating a body of lessons learning gathered both from end-users in their testing of offered cross border services (SDGR-like eProcedures) and authorities integrating national infrastructures and endpoints for cross-border evidence exchange.
- Learning areas cover for DEs and DOs estimates of cost and effort spent to customize respective endpoints (multiple aspects) as required for integration with DE4A patterns and common and semantic components (also eIDAS) in comparison with expected benefits (cost-benefit assessment), similarly for Member States costs and benefits of deploying the DE4A Connector and SMP. During the actual lead to the phased launch of running combinations the pilot has in addition studied organizational and technical challenges (see Section 3.3 of D4.11 [6]) which had an impact in pilot delays, and which are valuable lessons learned.

- Learning finally covers successful connection and piloting across borders of data services and eProcedures through DE4A interoperability infrastructure and proof of adequacy of canonical evidence models developed by DE4A for the respective DC authorities, of record matching as well as citizens' perception of suitability of Explicit Request and Preview steps (questions on this last criteria D2 are apparently yet to be included in the citizens' feedback form).
- The pilot also consolidates information for internal and external consideration in the DE4A Wiki (https://wiki.de4a.eu/index.php/Moving_Abroad_Pilot) covering multiple knowledge aspects: goals, use cases with details about their partners, interaction patterns, second iteration overview, legal status, etc. In the case of this pilot the documentation is less developed / complete compared to other pilots also given the delays in launching the running activities: the recommendation is to rapidly complete additional details as the pilot approaches piloting different combinations with real users.

3.3.2 Consistency of Pilot Goals with Pilot Definition and general DE4A Objectives

Regarding the question of ***consistency with the pilot's definition and relation to DE4A objectives*** the pilots' main objective and the pilot technical and business goals have to be considered:

- The main objective of the pilot is defined as follows: to **lower barriers (paper-based processes, language challenges etc.) for citizens wanting to move abroad**. This main objective is consistent with the pilot objective in the Description of Action to deliver a secure value chain enabling the trustworthy exchange of necessary evidentiary data between the authentic sources of information and the European public services involved, pursuing as main benefit the faster and more efficient message exchange between National/Population registers and the municipalities, where the "Moving abroad pilot" will speed up exchanges between national authorities, allowing them to handle individual cases more quickly and facilitate a faster relocation or access to social benefits. With its pilot orientation and its focus on MS needs, this pilot also helps to introduce the use of a common secure infrastructure for cross-border data exchange between institutions. Considering the overarching DE4A objective of reinforcing "trust in public institutions' transparency and protection of users' information and to unleash multiple qualitative and quantitative positive impacts in terms of efficiency gains and reduction of administrative burden, costs and barriers in cross-border public services through substantiation of the innovation and transformative technologies potential and the use of stakeholder expertise" it is seen that the pilot aligns by means of its contributions:
  1. It defines, designs, integrates and pilots with real users in realistic conditions use cases that effectively promote mobility of citizens supported on fully online eProcedures that realize the Once-Only Principle to optimize case handling through evidence exchange patterns that promote accurate (correct, complete) and human-centric data exchange as well as secure data handling between public authorities, reinforcing perception of trust perception in public institutions' transparency and with guarantees on the protection of users' information (i.e. mechanisms like Explicit Request, record matching, or Preview).
  2. Verifies with competent authorities the efficiency gains and administrative burden reduction achieved through the exchange of standardized documents, removing the need for document translation by promoting improved multilingual communications e.g. multilingual forms, multilingual ontology repository (pilot Value).
  3. Generates valuable lessons learned with hands-on experience on the organizational, technical, legal and semantic barriers towards sustainable adoption beyond the pilot itself, contributing hands-on knowledge regarding the re-use of existing (eIDAS, eDelivery, national infrastructures) and new building blocks (Connector, Information Desk…).

For the technical common criteria, below is the adapted definition from pilot's viewpoint for each of them. These are taken from the main underlying EIF Interoperability Principles as presented in EIRA v3.0.0 (p.65) [17] and are also matching "DE4A Principles" (see Chapter 7 in DE4A D2.1 "Architecture Framework"[18] and section 2.3 in D4.9 [12]):

- **Openness** – UC specifications are elaborated with the active contribution of the stakeholders and are based on open standards for information exchange. Open-source software technologies should be used to develop the pilot to help save development cost, avoid a lock-in effect and allow fast adaptation to specific business needs.
- **Transparency** – Standard (API) interfaces with the heterogeneous internal information systems of public administrations are available. Access to and exchange of personal data are protected respecting the applicable legal framework. The user decides who has access to the data and for what reason.
- **Reusability** – Existing EU IT frameworks and solutions will be reused. Existing EU standards and specifications will be reused.
- **Technological neutrality and data portability** – No specific technical implementations or products should be imposed to use the pilot services. Pilot services should be easily adapted to align with rapidly evolving technological environment. Pilot services should be integrated and reused in perspective of the presence of specific technologies or products. Data should be easily transferable / exchanged among different applications and systems.
- **User-centricity** – User needs and requirements should guide the design and development of public services leading as well to user empowerment. A single point of contact should be made available to users, to hide internal administrative complexity and facilitate access to public services. Under the legislation in force, users should be able to provide data once only, and administrations should be able to retrieve and share this data to serve the user, in accordance with data protection rules. Users should be asked to provide only the information that is absolutely necessary to obtain a given public service.
- **Inclusion and accessibility** - Inclusion is about enabling everyone to take full advantage of the opportunities offered by new technologies to access and make use of the piloted services, overcoming social and economic divides and exclusion. Accessibility ensures that people with disabilities, the elderly and other disadvantaged groups can use the services at service levels comparable to those provided to other citizens.
- **Security and privacy** - Before delivering the evidence, the citizen will give his consent to use it. The authenticity of the evidence must be guaranteed. The access to the DP systems is done in a secure way.
- **Administrative simplification** – The public administrations have simplified their administrative processes by improving them and/or eliminating any information that does not provide public value. The evidence that is needed to fulfil the procedure will be exchanged electronically, if possible, in structured data format that can be integrated automatically.
- **Effectiveness and efficiency** – The effectiveness and efficiency of pilot services will be measured in terms of time to deliver, cost of physical movements to obtain the evidence, cost of civil servant interventions, number of process steps and level of user satisfaction.

Pilot-specific business and technical goals are targeted to generate benefits to public authorities (A and C), students (B) and the project as a whole (C-D) as can be seen in figures further below.

3.3.3 Consistency between Pilot Objectives and KPIs and Planning of Activities for Expected Results

Finally, considering the ***question of consistency between pilot objectives and pilot key success and performance indicators, and whether its products, activities and plans represent a pilot set up that can yield the necessary results to test DE4A evidence interoperability solutions and enable the fulfilment of pilot goals,*** it is necessary to assess how the goals are considered in the use cases and how the success criteria and metrics are established in logical relation between each other.

Success criteria were initially sketched in D4.9 [12] and the final list was consolidated and refined in D4.10 Pilot Planning [3] and comprises the following list where it can be seen how the pilot has

satisfactorily established a direct correspondence between the *9 success criteria* it defines with its *4 business and technical goals*:

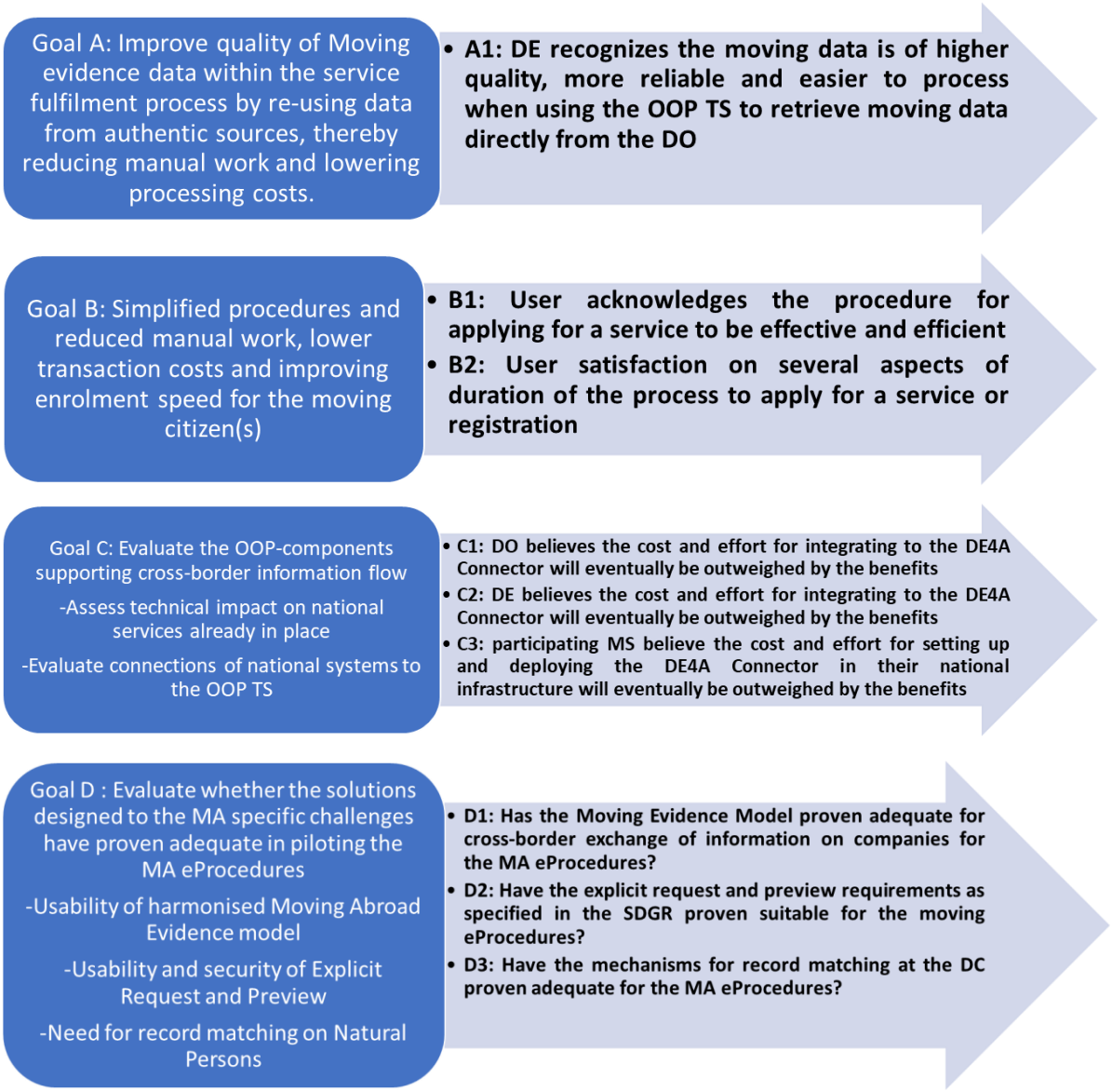

Figure 7: Correspondence of MA Pilot Functional and Business Goals and Success Criteria

All of the objectives and corresponding success criteria and metrics are directly applicable for results collection in all use cases of the pilot. While criterion A focuses more on Value principle, criteria B.x refers more to Use principle and criteria C.x and D.x focus on Learning and Adoption and serve to assess pilot technical business goals. It can thus be verified that all key piloting principles are addressed in a top-down manner as corresponding success criteria and metrics also become linked to Use, Value and Learning.

Derived from the *9 success criteria* above, the pilot established *14 quantitative and qualitative metrics* together with corresponding quantifiable targets that allow to verify objectively their fulfilment (see section 2.2 of D4.10 [3]). The pilot has established some metrics of a directly quantitative nature (efforts in person-days to deploy components or customize and integrate endpoints), while also using for qualitative metrics that collect appreciations / level of satisfaction from end-users and pilot stakeholders 5-point Likert scales [19] in order to allow a quantitative assessment of the answers

against metric-defined targets. Each metric is well connected to a pilot process step to specify when the measurement should be executed.

Analysis of the established metrics and targets shows their correct mapping to the related success criteria, with coverage of multiple topics of interest to elicit facts and findings and deriving pilot knowledge, adequate for assessing at this stage progress towards fulfilling the different goals (see section 4.3).

Aligned with these metrics and designed to collect results to feed them, the Pilot also produced online feedback forms for citizens and internal questionnaires for DE eProcedure portal owners, DO data service providers and MS authorities in charge of common infrastructure components, with drafts provided in Annex C of D4.10 [3] and Annex I of D4.11 [6]). The questions appear formulated in clear and concise terms to collect the necessary feedback for subsequent analysis of fulfilment of the defined success criteria, asking in several cases about multiple aspects in detail. While the citizens' feedback form asks about 10 different aspects in relation to satisfaction / dissatisfaction with the eProcedure, these are grouped in a single question with a free-text box to explain negative answers. The pilot should re-assess if this covers sufficiently all metrics and criteria, i.e. criterion B2-metric B2.2 would require asking about duration of different activities within the eProcedure. For non-positive answers in the different questionnaires, stakeholders are required to provide justification in order to understand better any gaps or weaknesses.

Based on the evidence gathered in this section and common tables in the first part of of section 3 about these substantive facts and elements, it is fair to conclude that the pilot methodologically established a trail from the objectives to success criteria and finally to metrics which, when generating corresponding results for them, should allow to traverse the path back towards fulfilment of objectives. A relevant finding is that, compared to other pilots the number of criteria and metrics is smaller and the recommendation would be to assess both of them carefully, also considering the final piloting scope to identify any potential gaps in results and knowledge elicitation from stakeholders which may justify extending more the success criteria, metrics and therefore questions in feedback forms. Furthermore, more questions followed with free-text boxes could be formulated trying to collect from citizens and/or internal stakeholders details that allow e.g. formulation of lessons learned about different challenges and complexities faced in pilot preparation activities, i.e. what the authority appreciated or disliked regarding different aspects of parts of eProcedures (Explicit Request, Preview…) and of pilot-specific solutions like interrupted procedures or deregistration, attributes modelled as optional or mandatory with respect to usefulness for a given eProcedure, comparison of costs vs perceived/expected benefits, etc.

4 Assessment of Fulfilment of Pilot Goals and Recommendations to improve pilot results and processes

This section addresses a question that is broad in its scope: *has the execution of the pilots so far taken place according to the defined plans?* Or, in other words, ***what is actual progress of the pilots against the planned scope in terms of outcomes achieved so far?*** It is to be noted that the focus here is on actual achievements and results generated by the pilots during their running phase and in the activities leading up to it and is not a mere assessment of fulfilment of milestones in a planned timeline. Suggestions are given for improvement with a focus on a more complete fulfilment of objectives and benefits realization in the form of common recommendations and pilot-specific ones.

During the extended duration of the first iteration of piloting, from February to July 2022, it can be observed that the different experienced organizational and technical difficulties had a relevant impact on the pace of launching the planned pilot combinations, although with different impact in each pilot:

- In the case of **Studying Abroad**, it can be observed that the number of combinations very significantly expanded from originally 2 launched for the Diploma Recognition use case to 8 launched and 3 functioning combinations (enabled for limited piloting with real students) in total, also covering the other 2 use cases and all 3 piloting MS, and with only 1 combination which had to be postponed to the second iteration. The majority of combinations were successful in their launch in the last months of piloting, also in 80% of the cases with some limitations that led to the use of test evidence although with real users. The growth in the number of combinations (expected to be further completed in the second iteration) determines an observable improvement during the running activities of the iteration notably for the Use dimension. This has allowed to positively expand and consolidate Value and Learning findings as well, towards significant fulfilment of pilot objectives in as much the Minimum Viable Product scope enables this (i.e. exchange of only one type and instance of evidence for each combination between 2 MS), also covering 2 widely different exchange patterns (User-Supported Intermediation and Verifiable Credentials).
- In the case of **Doing Business Abroad**, 8 DE/DO combinations had initially been planned with the 4 piloting MS[13], of which 2 combinations were successfully launched between 2 MS. Three more combinations with another MS were technically verified to work in test environments but could not be finally launched and had to be postponed due to technical issues complicated by sharing of internal components with other projects in that MS that resulted in lack of readiness of preproduction portal (the pilot still awaited for readiness until the end of the iteration). In the case of another MS, lack of readiness of eIDAS piloting nodes meant that 4 combinations in which that MS was involved also had to be postponed. While the piloted combinations have allowed to successfully prove in real-life conditions both the use case in scope of the first iteration and the Intermediation pattern that was implemented for it, the number of real companies involved has been impacted by the low number of combinations available between just 2 MS.
- In the case of **Moving Abroad**, the fact that only 3 Member States (LU, ES, PT) were planned to implement the corresponding endpoints and evidence exchange infrastructure, of which only one (LU) had the role of DC, determined that the serious and long-lasting combination of technical and organisational issues in this MS prevented de facto any combination from launching with only limited opportunities to test interoperability in test environments (Connectathons), also involving another MS (SI) as DP, which was a positive development not initially planned. The resulting impact is that MA Pilot has not been able to generate any metrics for Use dimension, with limited feedback only from piloting competent authorities from 3 MS in charge of common components and in some

[13] Not considering combinations with Belgium who withdrew at the start of Y2 of the project.

cases endpoints for Value and Learning results. The Pilot has thus postponed all combinations to the second (and in its case unique) iteration where all the remaining MS[14] in the pilot will participate.

For this part of the evaluation, the respective pilot reports of the initial iteration of piloting are analysed given the monitoring activities carried out in the running of the respective use cases and cross-border evidence exchange combinations, oriented to the end-user perception of usability and value, and complemented by inputs from other pilot participating authorities responsible for the integration of procedure portals, evidence sources and common infrastructure components. It must be noted here the fact that the eProcedures are generally repeated in low volumes by testing users during the pilot. Thus, the value of quantitative feedback should not be overestimated (also the feedback from authorities is limited to participating MS in each pilot) and this makes the combination with qualitative feedback even more important.

Some common **recommendations** for pilots considering the scope of this section are (see specific recommendations for every pilot in each subsection below regarding Use, Value and Learning for Adoption principles):

- **Reinforce the relation with "Sustainable impact and new governance models" work package to provide feedback useful for better understanding of requirements for future sustainability of Member States investments**. This can include those investments made for DE4A common components as well as adaptations in endpoints for integration with patterns and use cases similar to those implemented in the pilots. For instance, before pilots finish, actions can be explored to survey Member States stakeholders' intentions to maintain parts of the DE4A outcomes and building blocks as well as functioning Pilot Services, when suitable towards SDG OOTS implementation efforts but this may be an initiative undertaken from the mentioned work package;
- **Identify and leverage opportunities in collaboration with the "Stakeholder dialogue, dissemination and communication" work package for dissemination of pilots results and findings**: especially through liaisons with other similar projects and general events in the eGovernment arena, as well as sector-specific conferences in the domain of each pilot where achieving impact towards targeted audiences may yield particularly important results;
- **Reinforce and safeguard pilot knowledge as a key DE4A outcome, especially for lessons learned and Value findings, leveraging possibilities for this purpose through the DE4A Wiki**. This can include technical details of issues solved with support from the "Common Component Design & Development" work package, testing results and issues found during Connectathons with use of second iteration "Playground" components both with mock, test and piloting endpoints, advice from the "Legal and ethical compliance and consensus building" work package, etc. For pilots that produced discussion papers on specific challenges (DBA Pilot), it could be worthwhile to consider making these papers available as a publication or at least make the information available through the Wiki, revisiting information at the end of the second and final iteration when more complete knowledge exists on how well options chosen for the pilot have worked out in the context of piloting in realistic conditions.
- **Further investigation with DEs and DOs to detail better the achieved degree of administrative simplification** is also an important aspect to continue to address in the second iteration.
- After analysing the information obtained in the first iteration, another area of improvement is the **logging system used on the different endpoints and the connector** as common component (a revised common syntaxis has been agreed with the "Common Component Design & Development" and with the "Semantic Interoperability Solutions" work packages). The following analysis points can be considered as possible and useful to extract from log analysis in the second iteration (taking

[14] BE (BOSA) left the project at the beginning of 2021, while Skatteverket partner from SE participating in the pilot also left, the same as SEF partner from PT, all of which has limited the available combinations and even removed the possibility of piloting a third use case for requesting Information on Pensions and Labour Status (pensions, unemployment and working life information).

into account that significance generally increases with number of transactions but these may not be high):

- Number of transactions per pattern used
- Number of transactions per combination. Between which countries the cross-border process is being held.
- Number of errors per component and most frequent types of errors: given the users of SA pilot complained on number of errors it is relevant to know in which component(s) they happen, and the most common types observed.
- For piloting interrupted procedures, it can be extracted from DE/DO logs number of times evidence was not available yet.
- Number of evidence exchanges rejected in Preview step can extracted from DE/DO logs.

In addition, in the final iteration, a new feature will be piloted: multievidence. The logging system could potentially also be used to analyse information about the number of canonical evidences exchanged in one transaction, allowing the analysis of how many evidences were successfully transmitted and which ones.

The Studying and Doing Business Abroad pilots have reflected in section 3.3 of their Initial Running Phase reports on how Technical Common Criteria (Openness, Transparency, Technological Neutrality and Data Portability, User-centricity, Security and Privacy, Administrative Simplification, Effectiveness and Efficiency) are being addressed so far in the first iteration. Presented findings are fact-based and of a clearly positive nature, they summarized below:

- Regarding **Openness and Transparency**, the availability of open source common components (Github) and documentation as well as information on status of connections and readiness for the pilots (in the DE4A Wiki and de4a.eu website) allows to follow along the progress and study project details.
- Regarding **Reusability** both pilots highlight use of external building blocks/standards/infrastructures and frameworks like eIDAS, eDelivery and EBSI/ESSIF as well as internal building blocks (e.g. Connector, Authority Agent), also reusing existing data sources and in some cases eProcedure portals (pre-production versions in some cases) and national eIDs familiar to users; Technological neutrality comes from general reliance on technologies which are not vendor-specific and from the freedom to choose the AS4 gateway and standards and software in endpoints, which is also highlighted.
- For **User-centricity** Studying Abroad highlighted high appreciation by students of control given over evidence exchanged through features such as reauthentication and Preview at DP side (USI pattern) or the SSI features of VC pattern. DBA pilot highlighted how much and to a large degree, usability depends on standards applied in each portal as well as by eIDAS interfaces and users seem capable to cope with a certain level of challenges when switching between user interfaces. Accessibility can be improved when more languages are supported for texts presented to users (in this regard MOR functionality that will be piloted in MA pilot is helpful and can offer additional learning).
- For **Security and Privacy**, findings refer to complexities regarding obtaining of certificates and configuration of firewalls within authorities' technical domains, where several policies and administrative procedures apply. Nonetheless, the authenticity, confidentiality and integrity of exchanged data is correctly ensured thanks to common infrastructure based on secure building blocks (eIDAS, eDelivery and TLS connections). In the case of VC pattern, digital signing of Verifiable Credentials and the use of protocols like DIDComm guarantee the same properties. The pilots have followed measures to ensure data protection like (at organisational level) the signing of Memorandum of Understanding and supervision by Data Protection Officer. The Preview and Explicit Request are also highlighted on the technical level, and users have a high appreciation of privacy aspects, with no incidents happening in the running of the pilots.

- Finally, regarding **Administrative simplification, effectiveness and efficiency**, a massive reduction in effort required to process data (which is of higher quality and less prone to errors) is clearly appreciated by competent authorities and users (from weeks or days to very few minutes thanks to automation). The piloted procedures are seen as faster, simpler and secure to produce intended results for the stakeholders involved. Overall experience of users is expected to further improve in the second iteration (getting multiple evidence in just one request or with improved VC pattern flow and mobile app).

4.1 Studying Abroad Pilot

4.1.1 General considerations

The pilot was able to launch its first cross-border combinations in February 2022 for UC#3 (VC pattern), followed by more combinations using USI pattern for UC#2 and UC#1 in April and until June with the first iteration formally concluding in July 2022. This represents in total 6 months of piloting with 3 MS[15], although the duration is not the same for all combinations in the different use cases, which is also not abnormal, as all pilots were expected to manage a phased and incremental launch of their cross-border services. The pilot also adopted several strategies to mitigate and minimize, to the extent possible, the experienced delays, as explained in section 2.2 of D4.3 [4], which explains the pragmatic approaches followed. In some cases, these may be of interest for the MS teams that will be involved in the testing phase of OOTS and which may face similar challenges in some cases.

This pilot is demonstrating through real cross-border combinations (as MA pilot will demonstrate), the User-Supported Intermediation (USI) pattern: it is now the most similar pattern to the interaction proposed for the SDGR OOTS and it is piloted in multiple scenarios (2 use cases in SA and MA pilots). Especially in the case of Studying Abroad, it has been demonstrated with 7 combinations already in the first iteration and will be extended with 2 more combinations to be added in the second iteration[16]. Essentially sharing the same infrastructure (common components and semantic framework) with the IM pattern, the pilots using USI pattern have started demonstrating its suitability for Life Events having as users citizens (including students) where the user support at DP side to record matching and approval through the Preview mechanism for the exchange of evidences (while the data still resides in the sphere of the DP) increases the transparency of the exchange and serves to increase the certainty and hence trust at the part of the DP when data is to be shared across borders.

Regarding actual pilot usage and, as reported in section 2.3 of D4.3 [4]), some combinations were piloted with test eID credentials for students from two MS and in the case of one MS, their students also had to use test evidences for testing cross-border exchanges due to technical/organisational limitations (more details below). While this was not the originally intended plan, the impact regarding results and their interpretation is virtually non-existent as students were informed of the circumstances and were able to do all steps in the procedure in order to answer the multiple questions in student feedback form to assess their satisfaction and experience when using DE4A solutions. The pilot made the right decision to launch those combinations, in as much real students did the piloting, which is the key to elicit intrinsically valuable findings and substantiate learning through realistic use of implemented services and solutions.

While the question of the statistical relevance of students' feedback (given the current user base) is legitimate, the novelty of the piloted solutions, which represent pioneering efforts in the domain of

[15] Belgium withdrew from DE4A at the beginning of Y2 but impact on the pilot was mitigated through participation of additional partner from PT, INESC-ID, in UC#3 and later also as DO in UC#2.

[16] An improved USI flow with user redirection URL provided directly from the DP side and the support for exchange of multiple evidences is expected to be also piloted for which additional learning and value will be uncovered in addition to improved use through improved user engagement plans and in particular with more combinations exchanging real user evidence instances (secondary and higher education diplomas).

cross-border Once-Only implementations, has to be considered: responses from a reduced universe of real testers exposed to those solutions for the first time are highly relevant as well, to gain through their perceptions valuable understandings on the strengths and aspects to improve. Similarly, the number of competent authorities is limited to those from participating MS in different combinations, but their experience in addressing technical, semantic, organisational and governance issues is still highly relevant to other MS which must soon address similar issues in order to implement the OOTS of the SDGR and, in fact, feedback from DE4A MS has been highly influential in the SDG Coordination Group, SDG specialised work packages and the process to produce the Implementing Regulation on OOTS technical specifications.

The pilot provides (section 3.2.4 of D4.3 [4]) an accurate overview of fulfilment of each defined metric for the different success criteria. This is based on responses verified with internal stakeholders and the students as pilot users. Targets defined for metrics were all met except for two related to success criterion F that contributes more to Learning dimension):

- Metric F1.1 which is measuring if all functional tests are successful and if cross-border services were used with evidence provided in electronic format from its trustworthy sources is almost met: as commented in the results and findings for Use subsection below, one combination had to be postponed but this represents a very small fraction (1 out of 12) and a majority of students also used test evidences for piloting (see also explanation and limited impact of this below).
- Metric F4.1 which assesses adequacy of record matching mechanisms at the DOs, could not be yet fully evaluated linked to the fact that only a limited number of students used real credentials to request real data (29% used real credentials and real data, see below).

Regarding technical common criteria, section 3.3 of D4.3 [4] reflects findings so far in the first iteration and overall show a good level of satisfaction for all of them with adequate evidence and explanations given in each case. The aspects identified for improvement relate to inclusion and accessibility (clarity and simplicity of the procedures) which is to a certain extent something to be expected for a first MVP. Further investigation with DEs and DOs to detail better degree of achieved administrative simplification is also important to address in the second iteration, as well as documenting improvements to overall experience with eProcedures e.g. related to experience with multi-evidence scenarios.

4.1.2 Results and findings – Use

According to results of achieved interoperability status (section 2.3 of D4.3 [4]) it can be seen that the first iteration was quite successful for the pilot: **it covered all three use cases, demonstrating interoperability for evidence exchange with 2 different interaction patterns for the 3 participating MS**. Considering the amount of combinations officially launched for piloting with real users (8), it is seen that two thirds (66%) of combinations were officially launched with real users. Three more combinations are classified as having undergone "limited piloting", meaning that some parts of the implemented procedures were still having minor unresolved issues, e.g. display errors that prevented an official launch but allowed for supervised piloting[17] or that piloting had to be suspended at some point within the iteration due to errors caused by changes in the piloting environment. If these combinations are also considered, then almost 92% of combinations could be piloted to a good degree and involving real users. The only cases where endpoints were not ready are explained i.e. lack of resources in the same competent authority to have a DE ready for UC#1 and an Issuer for UC#3, whereas cases of limited piloting are related to changes in the piloting environment that required suspending and postponing one combination in UC#1.

Some limitations existed for the use of real data in some combinations, however this did not prevent piloting with real students: (i) for combinations in all 3 Use Cases involving Portuguese students, test

[17] Real users were informed of these difficulties prior to the piloting sessions.

data and test credentials were used as 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. (ii) Students from Spain used test credentials and real academic data, but anonymized and bound to the personal data of a test credential[18]. However, despite test credentials being used, the gathered data is still production-relevant: for example in the case of Spanish DO, test identities were bound to anonymised real data (academic data from real users but with all personal information erased and substituted by the info of the test identity) and the test evidences, which had also been used for Connectathons, allow to technically exchange evidence just the same as for real evidences, with no or minimum impact on user experience (Portuguese and Spanish students were informed of the circumstance so they expected to e.g. see test values in Preview step). In the second iteration, as long as the Portuguese Connector is deployed in pre-production and eIDAS preproduction node accepts real eIDs, Portuguese students will be allowed to authenticate with their real eIDs and retrieve their own real academic evidence.

The pilot had **limitations with the number of students engaged** due to different objective challenges known beforehand: students had to belong to one of the 3 academic institutions and have 1st level Bologna degree diploma, some of the later combinations became ready for piloting in a period where students in some cases were harder to find and universities had to conduct tests beyond the real application periods, which (e.g. at Spanish University Jaume I) required to exceptionally enable the application to some programmes and instructing the personnel to consider it a test situation despite being on a production service (see other relevant details on user engagement in each MS in section 4.2 of D4.3 [4]). This and the delayed start of the pilot determined that only local users for the testing phase and focus group users for services that went live could be targeted (unknown but reachable users and unknown users will be invited in the final running phase to extend user base). 52 students from the 3 MS piloted the different combinations in the 3 different use cases. Considering the distribution of students 50% were Spanish, 29% Slovenian and 21% Portuguese. Considering distribution of tests in the 3 use cases, 35% piloted combinations of UC#1, 35% combinations of UC#2 and 30% UC#3. Therefore 70% of results from students relate to USI pattern and 30% to VC pattern.

Regarding **analysis of students' feedback** (Criteria and metrics C.x) **on satisfaction with completed eProcedures** with focus on 10 different aspects, the pilot has reflected accurately in table and figures of section 3.2.1 of D4.3 [4] the average of answers using 5-point Likert scales, divided between the 3 use cases. Overall, the most appreciated aspects are: control in managing own credentials, security and privacy protection, and duration of the procedure, with appreciation of Explicit Request and Preview also being over 70%. Students were less satisfied with the number of errors and interruptions (due to use of Verifiable Credentials and the Digital Wallet and instability of eIDAS preproduction environment) and clarity of the procedures (due to their apparent complexity as students referred to having to use guidelines in order not to get lost although it is not known which parts of the procedure were less clear). This indicates areas to improve and actually the pilot is already going to pilot an improved flow for VC pattern and an improved mobile digital wallet. Regarding internationalisation, over 60% of students were satisfied with the fact that services are provided in the language of the service provider and in English with less than 10% complaining of lack of translations to other languages or about language switches[19]. Targets for all C.x metrics are verified to have been reached.

Some interesting findings when comparing UC#1/UC#2 (USI pattern) with UC#3 (VC pattern) is that satisfaction is slightly higher with VC regarding control of own credentials (as could be expected) as well as for security and privacy protection, duration of the procedure, overall experience,

[18] 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 whitelisted before the service use.

[19] The SDGR acknowledges issues with language barriers and makes some recommendations e.g. recitals 19 and 35 and some budget will be available for MS to do translations to English in OOTS implementation context.

communication, simplicity, clarity of the procedure and required effort. For communication and language differences are very small and lastly for number of errors and interruptions values are similar between UC#1 and UC#3 whereas UC#2 shows higher satisfaction (since the pattern is the same in UC#1 and UC#2 it should be investigated further if this has to do with differences with the eProcedures themselves).

When it comes to log analysis, only partial results for average duration of procedures from 2 DEs were available due to issues with logs record keeping at 2 DEs; furthermore, it was not possible to distinguish logs generated for testing in Connectathons from those generated by real users. There is a difference in averages and median values between UC#1 and UC#2 which can refer to the fact that procedures have different complexity and also because UC#2 indicates total duration while values for UC#1 focus only on pure DE4A interaction for evidence retrieval (i.e. excluding eIDAS authentication). The median value can be considered more reliable considering the impact of outliers in calculating average value. Since number of logs considered is relatively high, the duration values can be considered relevant (around 44 seconds of median for pure DE4A interaction and 92 seconds considering total duration with other parts like eIDAS authentication).

Overall, the pilot has clearly demonstrated the use of interoperable services based on Once-Only Principle in multiple (11) cross-border combinations between 3 MS and involving multiple competent authorities as DC and DP, as well as MS infrastructure for authentication using eID of natural persons (eIDAS preproduction nodes) while relying on semantic and common components from DE4A to realize 2 different evidence exchange patterns (USI and VC).

Recommendations:

1. The pilot should reinforce further students' participation to the extent possible from the Slovenian and Portuguese Higher Education institutions participating in the pilot.
2. The number of students testing UC#3 should also be reinforced if possible, also given the increased relevance of this approach in the context of foreseeable and announced increased synergistic interplay between the OOTS of the SDGR and eIDAS European Digital Identity Framework.
3. The pilot should aim to maximize number of students using real data and real credentials (in the first iteration only Slovenian students -29%- used real data while Spanish students -50%- used real academic data but anonymised and bound to test credentials and the remaining 21% of Portuguese students used test data and test credentials). This may be still limited by the need of students to be in possession of a valid eID with non-expired certificates that they can use (i.e. know PIN) and by other issues (acceptance of non-notified eIDs in eIDAS preproduction nodes). The rationale of this recommendation is that can provide additional learning on important aspects like issues experienced for record (and identity) matching.
4. In the final iteration satisfaction with additional aspects regarding new functionalities (multi-evidence scenarios) should be explored but it is relevant to measure again satisfaction levels with same or similar aspects in order to have more solid grounds for conclusions. Some additional fine-grained questions would also be relevant to consider to rate experience with improved mobile digital wallet (aiming to make explicit with which aspects students are more or else less satisfied with) and also to determine which aspects of procedures are less clear or if issues for different satisfaction levels relate to different degree of complexity between procedures of different Use Cases. More detailed feedback through free text or interviews should be obtained as well, e.g. to understand better where any errors/interruptions could be happening and whether the number of redirections (eIDAS, redirection to DP) or other factors create understandability difficulties to students or not positive overall perception of clarity/simplicity of the procedure. Enticing feedback about neutral and even positively rated aspects may also lead to discovery of additional valuable knowledge.

5. More complete log analysis should be aimed for by obtaining logs from more DEs/DOs (possibly also Connectors) and extending analysis to extract not only duration of procedures but identifying unsuccessful transactions and prevalent causes of errors[20]. This can help trying to determine in which components or logical steps of the flow they happen. Tracking dates and times of tests is also recommended to distinguish real usage from technical testing as well. Logs may also allow to assess better aspects like record matching at DOs (or at Issuers and Verifiers in case of UC#3), for example it could enable to count how many times record matching failed. This analysis of logs can allow to aggregate data and produce statistics like number of transactions per pattern used, per cross-border combination, errors per component, number of evidences rejected in Preview functionality, etc.

4.1.3 Results and findings – Value

The Value of the Studying Abroad pilot can be understood as focusing on specific benefits realised and verified with real students during cross-border piloting as well as with staff of universities and Ministries of Education (related especially to different administrative burden reductions for both types of stakeholders).

While all A.x and B metrics targets were surpassed, not all competent authorities from DOs / DEs filled in the questionnaires provided (e.g. answers were missing for 2 of the 5 DOs, for 1 of the 4 DEs and 1 of the 2 verifiers), see recommendation below.

For DEs/Verifiers that provided feedback, all rated aspects regarding quality of student data are rated "high" or "very high" with neutral values for availability of data in structured format. When it comes to processing of student data, values are "high" as well except for interpretation of data and solving of errors, missing data and exceptions, which are "neutral" for USI pattern. Additional feedback is also very relevant, e.g. on continued need for official translations of academic evidence and manual examination to check if knowledge acquired for an academic Degree matches the programme the student applies for. It is also relevant that, in cases when not all data required in a specific enrolment procedure is available in electronic format (e.g. average grade), the effort reduction for processing the evidence is affected.

For DOs/Issuers that provided feedback, they are satisfied or very satisfied with (lower) effort required for processing evidence request, as well as with lower communication costs and risks of errors and that these benefits outweigh the costs and efforts of customization and integration. Relevant feedback is provided on record matching details e.g. in Spain with relevant finding that students are often registered under passport or foreigners' identity number so eIDAS identifier will often not match and binding process(es) will be necessary. More complete assessment of this important aspect needs to be addressed in the second iteration (several students used test credentials for authentication and retrieved test data in the first iteration so there were limitations to research better this aspect).

Regarding **assessment of usefulness of DE4A patterns and components** (Solution Architecture, evidence exchange model, canonical data model, Connector, mocked DE and DO, central SMP, SSI agents, Kafka server for non-persisted errors) based on 6 answered questionnaires, shows generally high scores for the different aspects rated with the highest values found for suitability of the components for the purposes of the pilot. Technical teams seem almost highly satisfied with quality of support including over Slack by common components work package support team during integration and testing. Somewhat less but still positive appreciation of quality of technical documentation and testing methodology / Connectathons.

[20] This may entail additional complexity as most errors may be logged by Connectors rather than at DEs and DOs.

Recommendations:

1. It has been observed that not all DE and DO partners filled in the respective questionnaires and only one MS provided answers to the questionnaire for assessment of efforts of different aspects of deployment and configuration of Connectors and SMPs (although it is the MS that leads the common components work package, so the feedback is to be considered of good quality). The pilot should discuss with those partners the reasons for this and ensure as much as possible that all of them answer the questionnaires in the final iteration in order to have more information on which to make analysis and conclusions.
2. It needs to also be confirmed how piloting with real students and real data for more time affects (consolidates or changes) the results assessed regarding quality of data and its processing. Metrics and questionnaires should be revised considering the extended scope of the second iteration, removing where necessary metrics and corresponding questions that could no longer be relevant while adding new ones to assess this new scope and to elicit other details e.g. with sub-questions and free-text inputs and interviews.
3. For some neutral answers of DEs (availability of data in structured format in both patterns and interpretation of data or solving issues with the data in USI pattern) it can be relevant to obtain more details from all the DEs/Issuers. For positive answers regarding amount of work to process student data it would be very relevant to elicit from DEs what is the average duration in processing student data in current procedures for UC#1 and UC#2 and if workload in terms of staff/effort is currently also high and have them assess how much (orders of magnitude) reduction of time/effort can be expected thanks to the new system of evidence exchange. In the case of one university in Spain they refer to inclusion of average grade for Higher Education academic evidence for second iteration to be able to estimate time reduction as this attribute is needed (not all MS are able to provide it, though).
4. Regarding DOs answers, for "Effort for processing requests of evidence" it should be estimated how long processing requests would have taken for DOs without the DE4A system, considering in the baseline system, what methods are available to obtain the academic evidence (diploma), which may differ per country. This will allow to precisely confirm the benefits at this level of DE4A i.e. avoiding paper certificates and even non-machine-readable PDFs. Also, in the second iteration and with higher use of real eIDs for record matching to retrieve real evidence data, it should be possible to analyse in more detail issues with record matching (i.e. absence of unique persistent identifiers in some MS, although this may not be the case for MS in the pilot).
5. Regarding assessment of usefulness aspects of DE4A components, it will be relevant to reassess again these aspects in the second iteration as there are newer versions of the DE4A Connector and every MS will use an SMP, also asking in the questionnaire for further explanations of provided scores. In addition, focus on intentions to consider each of them towards sustainability beyond the project, as well as for the piloted services (eProcedures and data services)[21] would be relevant. Request for further semantic analysis of data models and technical analysis of Solution Architecture or Connector with support from other technical work packages (authentication of requests/responses and their integrity, protocol design, security model, as well as higher education canonical data model are mentioned as examples) should be internally discussed as it is linked to assessment of likelihood for adoption. Impact of issues with eIDAS preproduction environments used to support eIDs not notified by a MS (although expected to be less frequent with production nodes) should continue to be monitored as it can be relevant for more MS towards OOTS implementation.
6. Considering feedback received in the first iteration, it would be advisable to reassess with subcontractors during the second iteration if understanding of technical documentation has

[21] Such decisions can be expected to be decisively influenced by implementation choices at the SDG OOTS level and the degree in which DE4A building blocks and approaches become part of it.

improved (structure, transparency), and if background knowledge is more easily available thanks to the extended and detailed technical information now available in public Wiki.

7. For the second iteration bilateral discussions and exchanges in technical Slack channels can be considered as a source of technical learning (specially where it is thought this may help OOTS implementers), i.e. to identify which technical problems were the most common or hardest to solve. It was also seen in Connectathons that the sharing of information about up-to-date key technical configurations (identifiers, redirection URLs…) is of paramount importance as end-to-end connectivity depends completely on having these configurations correctly implemented: it should be assessed how the availability of these details in the Wiki has a positive impact for testing in the second iteration.
8. For the final iteration the pilot should explain, referring to concrete examples, how it is contributing to expected DE4A benefits as a project and any impacts in relation to external communities: domain specific (EHEA, EUNIS…) and SDG stakeholders i.e. feedback from pilot partners to SDG semantic working group.

4.1.4 Results and findings - Learning

The pilot has documented in table format several lessons learned, including suggestions relevant for adoption for each of them. It did so both for activities during the analysis and design phase and those related to the customization, integration and testing phase. These lessons learned cover different types of challenges and the pilot has concentrated more in those aspects which can be of relevance for adoption by similar stakeholders beyond the project end e.g. competent authorities integrating eProcedures or data services with SDG OOTS. The pilot documents the knowledge building and documenting process (phases, actors, sources) with clarity in section 3.2.3 of D4.3 [4]. Interactions for this purpose are not only project-internal, but include interactions with external communities with convergent lines of work i.e. EBSI and SDG Work Package on “Data semantics, formats and quality” or new sub-group on “standardisation of data models”.

On **estimation of efforts for the various tasks involved to customize endpoints** and to integrate common components, these were delivered for USI and VC patterns but only by one of the three MS (which is also leading work in the common components work package so estimates would be highly relevant). A conscious decision was made so that these estimations are not considering delays in the project and are corrected to allow future adopters to estimate the real efforts, showing a total of 34 days of effort for DEs and 19 days for DOs. The difference between both may correspond to the fact that that DO is mostly pre-built software with 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 harder. For setting up of the Connector, estimations exclude time of preparation of different environments (testing, preproduction, production), obtaining production certificates and additional security assessments, which had a severe impact in delaying readiness of combinations for piloting. An important finding is that as DE4A Connector already integrates Phase4 AS4 gateway, this makes setting up AS4 gateway very easy (less than 2 days, compared with set up of an external AS/4 gateway using Domibus which took almost 9 times more).

Time spent for endpoints adaptations and deployment and set-up of components in case of VC pattern seems substantially lower but as only one respondent provided feedback this needs reassessment in the second iteration. There is also noticeable difference in effort for customizations and integrations between DE and DO endpoints being considerably higher with DEs: the hypothesis, that should be further confirmed in the second iteration, is that complexity is inherently higher on DE side as explained above.

Pilot partners had interactions with SDG Work Package on “Data semantics, formats and quality” providing highly appreciated feedback covering various points: needs for data to be semantically portable, so the evaluator can, not only trust it, but present it to human agents in a localised way

(official translation of fields, normalised ranged values, etc.). Also, data availability: if some data is optional, that means the eProcedure cannot expect it, as usually it won't be provided so it was proposed to define different incremental levels of "mandatoriness" using syntactically compatible variants of an evidence e.g. including average grades, lists of courses.

The pilot also explains **lessons learned in the process of participating in EBSI's Early Adopters Programme and the integration with that common blockchain infrastructure through ESSIF APIs**, explaining the scope of this integration and its importance, e.g. to increase trust through signed Verifiable Credentials and validation of Verifiable Presentations and their Issuers. Aspects which are on-going work at EBSI and are thus not yet available were also described, e.g. API-based registration of Issuers or VC schema-related activities.

Aspects regarding the need for clear specifications and integration guidelines were highlighted: the work during the project was fluid and interactive across WPs, but future integrators will need more written down guidance. In this regard, the technical documentation in the DE4A public Wiki acquires higher importance. Aspects related to record matching mentioned in previous subsection considering interoperability/binding of different identifiers and issues with non-persistent identifiers in eIDAS are also relevant for the wider community of adopters. Another category on effort devoted to any changes to extend the national processes considering matching based on eIDAS identity information may also be interesting to consider.

Overall the lessons learned so far (based on experience with the MVP of the first iteration) cover in a pragmatic way a significantly wide variety of topics: from expertise required in eIDAS and OOTS, to evidence content variability and canonical model schemes harmonization, centralised Preview and unique request of multiple evidences to potentially different DPs and cases of multiple country scenarios, to clarity and simplicity of procedures or finding solutions for countries that have not yet notified eID schemes (which is very important to avoid negative impacts/discrimination on SDG users from those MS).

Other lessons learned relate to: relevance of adequate and coordinated organisation of tasks with multiple teams within each MS, explanation of OOTS specifications to public authorities involved, easy to access, clear and detailed documentation, early addressing of complexities for trust infrastructure including lifecycle of certificates for eDelivery components, use of national central services (« Connector ») to ease connection of multiple DEs and DOs, availability of reference implementations to facilitate integrations and practical understanding of specifications and of technical channels that facilitate swift collaboration between MS technical experts.

Several lessons focus on what the pilot has learned in relation to i**ntegration of national components**, which is also largely related to the delays suffered to be able to launch the first iteration. These have to do with availability of resources and prioritisation of national projects, complexity of internal IT department procedures and security (e.g. audits) requirements within MS. This comes on top of the inherent high complexity of integrations and adaptations, requiring collaboration between multiple technical teams and where varying paces of progress in developments and integrations may have a bigger effect between many MS. Approaches in DE4A like Connectathons and use of mocked and reference components in a common testing environment (called 'Playground' in the project) have also proven extremely valuable to address the technical complexity and to foster swift and intense collaboration (e.g. exchange of configuration details and test credentials) between MS teams, providing extra confidence prior to moving into operational/production environments.

Recommendations:

1. In order to complete learning about some aspects, all competent authorities (DEs, DOs, MS authorities in charge of common components) should provide requested feedback to assess on a quantitative and qualitative manner respectively the efforts and pain points (different types of challenges and barriers) for customizing existing systems and for deploying and integrating

components from the project. This time focus needs to be on the new version of the Connector, national SMPs (with production certificates from EC eDelivery team) and further adaptations in DEs, DOs (new USI implementation, multievidence management, new evidence types…).

2. Identity and record matching can be a highly-relevant point on which to extend learning towards adoption given the intrinsically diverse nature of national solutions and the impact of current challenges: the lack of unique persistent identifiers in all MS that can be used from eIDAS, the limited number of mandatory attributes that can be used for comparison of their values or the absence of processes to link local identifiers used in data sources with eIDAS identifiers retrieved in cross-border cases. In order to do this, students will need to use more their real eIDs for authentication and real evidences should be retrieved matching those identities.
3. As explained in previous recommendations, updates in questionnaires to elicit more detailed but important aspects and the conduction of interviews are seen as relevant in order to extend the lessons learned with value for adoption and to clarify aspects that may otherwise result ambiguous or insufficiently detailed.
4. Key findings and conclusions and major results can also be considered to be reflected in the pilots' Wiki pages, in addition to the pilots' public deliverables reporting results for each of the running phases. In order to avoid effort duplication, the information may be selected and copied from these deliverables or specific sections mentioned and links provided to them.
5. Regardless of the medium used to document pilot learning, the recommendation is to structure knowledge to make it easier to find and manage i.e. considering the nature of challenges and solutions which can be technical, semantic, legal and organisational/political. Findings which are common between pilots can also be distinguished from those that are pilot-specific.

4.2 Doing Business Abroad Pilot

4.2.1 General considerations

Regarding the four goals this pilot proposed to achieve, generally speaking, the outcome is positive as success criteria are dependent on metrics which have all been fulfilled in terms of achieving defined targets. However, it is also true that the pilot was run with a reduced number of participants, only 6 SME from 2 MS and 2 Data evaluators and 2 Data Owners were piloting the procedures implemented in this first iteration. Indeed, lack of readiness in 2 Member States (Austria and Sweden[22]) determined fewer combinations which had an impact on the engagement strategy. This can be a matter of concern and further reflection on this point can be found in the next subsection.

The pilot also adopted several strategies to mitigate and minimize to the extent possible the experienced delays, explained in section 2.2 of D4.7 [5], which represent pragmatic approaches, which in some cases may be of interest for the MS teams that will be involved in the testing phase of SDG OOTS, and that may face similar challenges in some cases.

The pilot has successfully piloted in the available combinations the Intermediation (IM) pattern: largely similar to the interaction described in TOOP project [16] and which was the starting point for the OOTS. It has proven suitable for procedures where evidence exchanged does not contain personal data and where record matching can be performed without additional control, through the user leveraging unique identifiers at European level (e.g. for companies as used in BRIS and also for vehicles used by EUCARIS) and which may serve to bridge existing sectoral exchange systems such as business registers networks and to realize back-office exchanges without (further or any) user interaction when the legal basis exists to skip the Explicit Request and Preview requirements. IM pattern will continue to be

[22] Belgium withdrew at the beginning of Y2 of the project but impact on the pilot was considered minor given the possible cross-border combinations among the remaining 4 MS.

piloted in DBA by one more MS for the same use case of the first iteration (full powers validation) while other MS will address extended use case of fine-grained powers validation as well as Lookup and Subscription & Notification patterns which move in the direction of proving direct back-office exchanges that don't require user interaction in order to respectively enable repetitive requests and automatically propagate information (evidence) updates to other authorities.

On the improvement of the quality company data by re-using data, DE4A offers faster and easier data processing and avoids typing errors compared with the situation when the information has to be introduced manually. There is no doubt among the participants that the implementation of DE4A solution very largely reduces the time needed for carrying the eProcedures by company representatives and enables a high degree of administrative simplification for competent authorities. On the other hand, the Data Evaluators and Public Authorities had their doubts about benefits of the system for portals where the number of eProcedures using it can be very low or is limited to eProcedures with low usage/reduced audience. Nevertheless, pilots are a good exercise to solve "first-time" problems for future implementation of the SDG OOTS. As a recommendation for the 2nd iteration of DBA pilot, it could be interesting to check the soundness of this perception when more companies participate in the procedures and, if possible, for companies from different MS where the eProcedures are slightly different, reducing the subjective aspect that few companies from same MS could share.

On the evaluation of features for the specific DBA solution, the participants believe there is a huge benefit on the flexibility of the company data model for any additional data. They also consider well-suited to use national eID for eIDAS authentication as users are familiar with it (this seems to assume wide availability of national eIDs notified through eIDAS Cooperation Network, which is not necessarily the case yet for all MS). In this regard, consideration of upcoming Digital Identity Wallets proposed in the context of revision of eIDAS regulation becomes relevant.

A need of harmonization of mandate models in the Member States is noticed: there is still a long way to achieve this given the substantial differences in powers and mandates definition and use across Europe and differences in national legislation. This belongs to a long-standing process of discussion with implications beyond the SDGR and more in the domain of eIDAS revision of the European Digital Identity Framework.

Regarding the Explicit Request and Preview, generally required by SDGR, the participants found very little interest on checking their content in detail: this could be improved with offered guidance by the legal work package on making these screens even more light-weight (following a layered approach), as well as by raising awareness on the privacy protection these mechanisms offer as foreseen in the Regulation.

4.2.2 Results and findings – Use

There is a **lack of awareness of cross-border authentication concepts among different stakeholders** e.g. levels of assurance and to a certain extent the concept of representation (representation structures and mandates). This could represent a possible bigger problem for wide adoption if eProcedure portals are not ready to support with simplicity the required mechanisms to allow company representatives authentication and associated checks. Such mechanisms normally require integration with other systems (i.e. Mandate Management Systems) as well as considering extensions to eIDAS for mandates and powers information and assessment of potential for greater harmonization of such data. The latter harmonization can be seen as a hard challenge given the existing heterogeneity regarding this between MS, including legal landscapes.

Although obtained feedback is only from a small number of users (6 companies, 3 DEs for D.x metrics), via questionnaires and direct communication, D4.7[5] explains the **challenges found in involving companies** are related to the fact that companies that wanted to start doing business across border exactly during the time when the pilot is running are few, added to the fact that 2 DE/DO combinations were piloted, making even lower the number of companies. Nonetheless, the user perception seems

highly positive with regards to ease of navigation of the portal and for procedure efficiency and reliability. Also, 100% of respondents confirmed lower costs when applying for a service and less time spent on eProcedure portal activities when compared to the baseline of doing these formalities without such a system (metrics B4.1, B4.2).

Regarding an **overview of usage of the DE4A system**, participants considered the piloting in general as a very positive experience considering the ease of use, with all of them confirming very little effort required to carry out the enrolment procedure with the system (metric B1.1). This positive feedback extends to the satisfaction with more particular aspects like: adequacy of the method used for providing proof of being entitled to represent a company and the duration to complete all aspects of the process (92%, metrics B2.1, B3.1).

Sometimes the high speed of the process adds to the representatives' hastiness to not read the complete screens, perhaps losing valuable information. This contrasts with the fact that, on the contrary, there are some pre-requisites to access the eProcedure (mandate registration in national portals) that could discourage the user to actually start to use the eProcedure: while this is not strictly part of the OOTS, it is a relevant finding towards SDG actual use. This is also valid for the integration with eIDAS with screens where the user is redirected during the authentication prior to the eProcedure. It is worth noting for this that the complaints of non-optimal user experience with user redirection in eIDAS node interfaces for authentication, are well known for years and not under the scope of DE4A/SDG functionalities. The new paradigm of EUDI wallets will surely change the game as well.

One aspect mentioned by few representatives, is the **lack control over the data source selection** as in the first iteration the source is automatically selected as there is only one possible Data Provider per MS. DE4A Information Desk supports this kind of Data Provider selection even if the opportunity to pilot it may not arise.

It was learned during the user engagement, that some companies of the DE4A participants countries, despite the clear explanations provided and available in the piloting micro-site, were reluctant to participate due to privacy concerns with possible use of company data that is part of the evidence exchanged. To overcome this reluctance, after first iteration, positive outcomes and impressions from participants could be shared with potential participants invited for the second iteration, solving any doubt about privacy topics and data management.

Overall, the pilot has demonstrated the use of interoperable services based on Once-Only Principle in two cross-border combinations between 2 MS and involving competent authorities as DC and DP as well as MS infrastructure for authentication of company representatives (eIDAS piloting nodes, full powers) while relying on semantic and common components from DE4A to realize IM evidence exchange pattern. The effort involved from many parties for achieving this has been substantial and deserves recognition.

Recommendations:

1. Considering that Fine-Grained Powers Validation is to be piloted in the second iteration, the pilot should consider inviting large companies for this use case, as these large companies are more natural users for FGPV compared to SMEs of the first iteration.
2. It is recommended, as the pilot broadens its scope with more use cases and more countries and combinations, to further substantiate findings on positive perception with regards to ease of navigation in the portal and procedure efficiency and reliability based on a wider results basis.
3. Further investigation and confirmation of parts of eProcedures which generate less satisfaction to users should be undertaken in the second iteration, with same or new companies in order to have more solid grounds for conclusions. New and maybe fine-grained questions for new functionalities to be piloted in the second iteration (Lookup, Subscription & Notification patterns) involving in this case the competent authorities, should be added to revised questionnaires.

4. The pilot encountered objective difficulties to engage more companies in the first iteration (also considering the limited number of combinations that could be launched). Additional effort should be made to analyse the root causes behind these difficulties and result in a revised user engagement plan for the second iteration (differences of scope will also impact this plan). All possibilities need to be explored and leveraged to reach out to familiar companies through professional networks of pilot participants but also unknown companies through chambers of commerce / Eurochambers, business registers, embassies, etc.
5. More complete log analysis should be aimed for by obtaining logs from more DEs/DOs or possibly also Connectors and extending analysis to extract not only duration of procedures but identifying unsuccessful transactions and prevalent causes of errors. This can help trying to determine in which components or logical steps of the flow they happen. Tracking dates and times of tests to distinguish real usage from technical testing is important as well. Logs will also allow to assess better aspects like Preview acceptance or issues with identity/record matching. This analysis of logs can allow to produce some relevant statistics like number of transactions per pattern used, per cross-border combination, errors per component, number of evidences rejected in Preview functionality.

4.2.3 Results and findings – Value

The main benefit the piloted eProcedure brings to the company users is the **reduction of time**, decreasing the completion of procedures for businesses in orders of magnitude from weeks up to a duration of 2 minutes. In the same light, they highlighted the simplicity of all steps needed, and less manual work for processing requests that this solution brings to the table, particularly when compared to current processes to start business abroad. An external factor mentioned by these users that decreases somehow their experience, refers to mandate management and configuration in each Member State which is in any case outside the scope of the project.

The feedback received from competent authorities shows clear benefits in the fields of **reduction of administrative burden, avoidance of handling errors, integrity of the information, well-designed canonical company evidence that suits direct needs of DEs for piloted procedure** and, last but not least, the **optimization of the processes** conducing to an enhanced return on investment to pilot participants (it is estimated up to hundreds of hours per year can be saved by DEs on processing and correcting data).

In more detail, results in Annex I of D4.7 for A.x metrics are positive or very positive as reported from 3 DEs (some metrics were only answered by the 2 DEs that actually launched cross-border combinations) when it comes to assessing reliability of company data in electronic structured format as being more complete correct and meaningful (100%, metric A1.1), the effort required for its processing as being considerably less (67%,metric A1.2) and considerably high benefit of having company data always up-to-date (A1.3). Regarding reliability of the powers validation method (providing more reliable proof that the representative is entitled to represent the company), 83% of the answers confirmed this (metric A2.1) and 50% of answers also appreciated considerably less effort in verifying the powers of the company representative.

Data evaluators feedback includes the observation that the majority of benefits accrue after coping with a learning curve. It is also worth noting a comment from Data Evaluator perspective expressing doubts on whether benefits outweigh costs in the case that the integration were only done for a single procedure. This doubt may have arisen from the fact that in the first iteration only one procedure was piloted per Data Consumer Member State but in the full-fledged OOTS deployments, it can be expected several procedures for businesses will benefit from it.

While value is more clearly perceived by DEs than DOs (e.g. Business Registers), the latter see there will be less manual work for processing evidence requests and handling errors due to the automatic evidence exchange, although minimisation of record matching errors depends on the specific design

of national procedures that will address the matching based on eIDAS identity attributes provided with the request.

As a general point, the experience of the pilot with validated structured data, the value of the eIDAS/Powers Validation and the integration of OOTS, already points to the future development and interest in adoption of such robust technical and organizational solution in the area of cross-border interoperability of services for business and eID management for the benefit of multiple stakeholders.

Recommendations:

1. It is recommended to assess administrative simplification achieved in the case of the two new patterns and associated procedures in the second iteration (Subscription & Notification, Lookup) and to identify a strategy to disseminate the rest of findings related to these patterns as they may be very interesting for certain adopters e.g. based upon facts like how much money can be saved thanks to automation of company data updates.
2. It is recommended to elicit more details from users of which steps were perceived as particularly easy and fast to do, compared to standard manual procedures.
3. An interesting proposal for the second iteration could be to discuss with DE partners how many procedures (available online for national DE portal users) and which exist in participating DEs, could meet requirements in SDGR requiring them to be offered for cross-border use, in order to have assurance that it will not be one but many procedures that will have to be offered across borders according to the SDGR.
4. For the second iteration bilateral discussions and exchanges in technical Slack channels can be considered as a source of technical learning (especially, where it is thought this may help OOTS implementers). For example it can help to identify which technical problems were the most common or hardest to solve. It was also seen in Connectathons that the sharing of information about up-to-date key technical configurations (identifiers, redirection URLs…) is of paramount importance as end-to-end connectivity depends completely on having these configurations correctly implemented: it should be assessed how the availability of these details in the Wiki has a positive impact for testing in the second iteration.
5. For the final iteration, the pilot should explain, referring to concrete examples, how it is contributing to expected DE4A benefits as a project and any impacts in relation to external communities: domain specific (BRIS, Eurochambers…) and SDG stakeholders i.e. feedback from pilot partners to SDG OOTS team / Functionality - Authentication working group or new SDG OOTS sub-groups.

4.2.4 Results and findings - Learning

Regarding the lessons learned towards future adoption of the solution, the responses were obtained through different channels, offline (emails and questionnaires) and online meetings. The pilot is further consolidating knowledge (in a joint effort with other DE4A work packages) in the public Wiki and is also sharing it externally in dissemination events (EEMA Annual Conference) and in a joint pilot between NL and Germany.

Values observed in Annex I of D4.7 for C.x metrics are positive or very positive as reported from the 3 DEs and 2 DOs involved when it comes to assessing different aspects of benefits[23] exceeding costs to integrate with DE4A OOTS. Regarding costs in manhours to customize and integrate DE portals the average is 700h (with important variations depending on the type of portal) while average effort to customize and integrate DO data services is 500h. Effort to integrate Mandate Management Systems with eIDAS nodes was on average 350 hours while the cost to set up the eIDAS piloting node for the pilot is about 1250 manhours. For metrics C3.1 and C4.1 no responses were collected yet on benefits

[23] Less manual effort, lower communication cost, lower risk for error, shorter duration of processing and more complete, consistent, trustworthy and up-to-data data.

of online powers validation (versus cost of integrating Mandate Management Systems) as the complete assessment on this will happen in the second iteration and similarly for benefits over costs for deploying DE4A connectors as considerably more MS will be doing this in the final iteration.

For D.x metrics, 81% of DEs (3) confirmed high level of satisfaction with Company Evidence model (metric D1.1) considering their needs for information on the company for aspects like legal entity identification, attributes such as address, activities, etc. 44% (of 3 DEs) appreciated applicability of full powers validation method to their services as satisfactory or very satisfactory with the metric (D2.1) averaging to 'sufficient'. Metric D3.1 shows that 83% of the 6 companies prefer that Explicit Request and Preview are requested and shown only the very first time when using the eProcedure portal (enrolling to the procedure). While metric D5 regarding adequacy and effectiveness to keep company data up-to-date is reserved for the second iteration, some DEs expressed themselves positively on this topic and expect benefits on data quality. A research topic that will continue to be investigated refers to the need, adequacy and effectiveness to perform record matching on legal persons and/or natural persons (representatives): the finding was that some eProcedures were meant for one-time use and not expecting recurring customers while for eProcedures where recurring customers were expected, matching on Legal Person identification sufficed. On one occasion, matching on (also) Natural Person identification would be necessary.

Many aspects were evaluated in the DBA pilot with regards to technical (analysis, design) and organizational (planning and management) activities executed prior and during the pilot.

Important lessons learned for pilot design topics are:

- Deep knowledge of both eIDAS and OOTS is needed to be brought together in MS for saving time during design.
- MS and EC should move forward step-by-step with focus on most frequently used scenarios with focus on core functionalities (e.g. full powers to begin with) and strict scoping with incremental addressing of improvements and additions (e.g. fine-grained powers which requires more advanced solutions); this stems from practical experience in the pilot which addressed many complex issues in this way. However, scenarios involving more than 2 MS[24] are particularly complex and would benefit from making an early start with their analysis.
- Findings about different ways of using eIDAS representative attributes and issues of backward incompatibility between certain eIDAS versions leads to the recommendation that the EC clarifies in advance the eIDAS specification version to use for the SDGR.
- Pilot participants agreed there would be no significant benefit to perform record matching of the natural person in the data owner (it is not the case with the piloted Intermediation pattern) and recommended using the national companies' eIDs and eIDASLegalIdentifiers for extending the pilot to SDG-wide implementation. In the case of services for cross-border (fine-grained) powers validation and company event types, the pilot recommends organising a harmonisation process.
- Explicit Request (legally required) seems to be a step quickly done by users in all cases and perceived as a legal formality. On the other hand, (GDPR) consent for retrieval of attributes is advised to be combined in a single step with the Explicit Request as one joint question to the users (when applicable at the same time). Provision by the EC of wireframes and animations (as addressed in DE4A) to facilitate similar implementation by all MS has been recommended as this would lead to more consistent user experience and lower learning curve.
- In the adoption of SDG, notification of eIDs to eIDAS Cooperation Network is a strong prerequisite that a participant in the pilot has not yet done (Romania, but it is planned). An agreed temporary solution for using non-notified eIDs in SDG procedures should be discussed although there are

[24] An example is when a natural person (representative) from MS A is representing a legal person (represented) from Member State B, which applies for a service from a Service Provider in Member State C and having to hand over evidence that is available in Member State D.

doubts on acceptance of such eIDs for large-scale SDG implementation. Identities in EUDI wallets can become an interesting option for users.

- Integration with existing systems (BRIS) was not possible due mainly to difference in targets of solution implemented and legal framework, as was explained in Pilot Planning deliverable D4.6 [2]. BRIS data models were also considered when designing the canonical evidence for the pilot making some semantic alignment and re-use possible.
- Implementation of same logic of user interaction in the participants´ specific portals is recommended to the extent possible. In order to avoid big differences among them, DBA worked with guideline documents and wireframes (agreed in collaboration with Common Components Work Package) for homogeneity in the user interfaces (e.g. Explicit Request and Preview).

Regarding the implementation, the following aspects must be remarked:

- The priority on DBA tasks among the participants MS should be raised, as the collaboration between all involved teams implies a lot of time and an extra effort on the coordination of pilot leader and pilots and project coordinator. The speed of development was not the same in all participants and this had a big impact on the readiness for cross-border testing, the lesson learned here is to allow for flexible planning and phased roll-outs, also with clear readiness for parties to participate in interoperability testing sessions (e.g. setup and test national eIDAS infrastructure thoroughly prior to OOTS testing). Successful interoperability testing required tests credentials shared between participants and critical settings configured correctly in the systems. Despite the effort of Pilots Work Package and Common Components Work Package leaders to coordinate all these aspects, several configuration/setup issues had to be solved during the testing sessions. For these reasons the pilot recommends that a coordination team is established in each MS tasked with keeping activities prioritized and making sure heterogeneous issues (legal, technical, organisational) are resolved in a timely manner. A multi-month phase for establishing alignment, responsibilities, financial means, etc. among organizations involved seems necessary as well.
    - In the case of the pilot in DE4A, a high percentage of these unwanted situations can be avoided for the second iteration (and less troublesome testing achieved as well) by fulfilling the checklist published on DE4A wiki page including tasks that should be done prior to a Connectathon session. In addition, a complete guideline of steps to be taken by each partner to deploy DE4A infrastructure exists and must be followed in the second iteration.
- DE4A followed the methodology of transferring knowledge from Solution Architecture to Pilots Work Package and Common Components Work Package in order to have a comprehensive common documentation and understanding of all the design details prior to the implementation phase. The pilot has recommended that efforts to explain the working of OOTS components (as well as designs and specifications) to all authorities involved are undertaken to ensure a common comprehensive understanding of such design details prior to testing phases. Similarly, investment in proper and clear documentation or a team of technical experts providing support to MS (similar to what has been done on small scale in DE4A) is also advised to solve doubts on ways to deploy and configure common components, for example. Open channels of direct messages (i.e. Slack) are strongly recommended to be used more frequently during the implementation of the second iteration to speed up the problems solving. This is a valuable lesson learned towards the future integration of the OOTS as many different technical teams will also be involved (even within each Member State).
- The acquisition of certificates process should be considered in the planning as it was a time-consuming procedure. As already seen in eIDAS, the management of certificates is a very complex and critical aspect to ensure the availability of services and interoperability between the systems involved. The EC and MS should consider how this process could be simplified and kept running smoothly to guarantee OOTS connectivity e.g. in case of updates of certificates or even changes of root CAs/sub-CAs. Similarly, the EC should coordinate the exchange of test credentials to enable proper interoperability and avoiding complex bilateral exchanges.

- Starting recruitment of participants for piloting with a long anticipation and with effort to keep them involved is an important finding as getting actual commitment from users takes a long time.
- The pilot finds that quantitative evaluation is less useful when limited number of DEs, DOs and companies participate as the results may be less meaningful, recommending instead to maximize qualitative feedback for learning through interviews and observations.

Recommendations:

1. In the second iteration, it is recommended to focus more directly on the learning aspects relevant for sustainability (in collaboration with Sustainable impact and new governance models work package) of the pilot and, where possible, in dialogue with EC (BRIS, DG CONNECT, etc.) including pilot-specific areas where expertise is strong (power and mandates validation, representation, record matching, etc.). Examples of such areas can relate to powers validation (metric D2.1), which requires further investigation with participation of more DEs and when fine grained powers are piloted or regarding mechanisms to keep data up-to-date (subscription to and notification of events), metric D5.
2. Open channels of direct messages (i.e. Slack) are strongly recommended to be used frequently during the implementation of the second iteration to speed up the problems solving. This is a valuable recommendation as well towards the future integration of the OOTS as many different technical teams will also be involved (even within each Member State).
3. As a future recommendation, and since it is considered that steps towards harmonization of powers information to be exchanged by trusted data providers could have a positive impact on the adoption, the pilot may give an assessment of challenges in this regard and which steps could be necessary to address to generate progress with this important topic. Similarly, regarding challenges of representation (authentication on behalf of legal persons).
4. The pilot may consider wider dissemination of aspects explored so far in internal discussion papers (on cross-border identity and record matching, powers validation, explicit request and preview, use of BRIS outcomes and piloting in production), in particular assessing how well pragmatic choices and decisions made for piloting have worked in the context of piloting.
5. Key findings and conclusions and major results can also be considered to be reflected in the pilots' Wiki pages, in addition to the pilots' public deliverables reporting results for each of the running phases. In order to avoid effort duplication, the information may be selected and copied from these deliverables or specific sections mentioned and links provided to them.
6. Regardless of the medium used to document pilot learning, the recommendation is to structure knowledge to make it easy to find and manage i.e. considering the nature of challenges and solutions which can be technical, semantic, legal and organisational/political. Findings which are common between pilots can also be distinguished from those that are pilot-specific.

4.3 Moving Abroad Pilot

4.3.1 General considerations

In the first iteration 3 MS (Luxembourg, Spain and Portugal) were planned to implement the corresponding endpoints and evidence exchange infrastructure with only one of them (LU) had the role of DC. Given that different issues have prevented to integrate the eProcedure portal in that MS with the common components, no combination was possible to launch and testing only happened with test environments (Connectathons). This determined that the pilot prepared only a partially complete report regard the initial phase, D4.11[6]For this reason it does not contain analysis of Value metrics and criteria and only partial results for Use and Learning, limited to internal stakeholders feedback, coming only from the 3 MS that had been working towards the first iteration and which is understandably of a qualitative nature in the case of Use principle. Because of the lack of results from running activities of the pilot, it is only possible to make a very preliminary and necessarily incomplete

evaluation, having to postpone for the final evaluation report a more complete assessment of results and findings, based also on feedback from more internal stakeholders (i.e. 2 more MS).

It is worthwhile to indicate that the pilot has suffered several changes in its configuration, directly corresponding to changes in the composition of participating MS and partners: withdrawal from the project of Belgium (also Denmark) and of Sweden from the pilot at beginning of Y2 determined the replacement of pilot leader by Stockholm University and the reinforcement of the pilot with another partner from PT that finally also withdrew in Y3, together with the technical partner with Sweden, which determined impossibility to pilot the third use case of the pilot in the final iteration as only one MS remained in that use case. Slovenia due to national constraints could not take on the role of DE and will pilot only as DO. Therefore, although 5 MS remain in the pilot, only 2 use cases can be piloted, and the number of combinations is reduced as well with respect to the initial scope.

The pilot adopted several strategies to mitigate and minimize to the extent possible the experienced delays and scope reconfigurations, explained in section 2.2 of D4.11 [6], which represent pragmatic approaches which in some cases may be of interest for the MS teams that will be involved in the testing phase of SDG OOTS, and which may face similar challenges in some cases.

4.3.1 Results and findings - Use

While there is no actual use reported from end-users (citizens), pilot DE and DO partners as well as MS teams (in all cases from 3 MS) responsible for common components deployment and configuration reported on the **usefulness of components and fundamental DE4A outcomes** (Solution Architecture, Information Exchange Model, Canonical Data Models, Connector, Mocked DO and DE, Central SMP and Kafka Server), considering for each of them the following aspects: perceived quality of specs/ software, ease of integration, potential to include in sustainability plan, adequacy for pilot purpose and overall assessment. All values reported were “high” or “very high” except for ease of integration of Connector in PT (“low”), potential to include Mocked DE and DO in sustainability plan in the case of one MS (“neutral”), and for another MS also “medium/neutral” values to include in sustainability plan solution architecture, information exchange model, canonical data model, DE4A Connector and “low” for Information Desk.

Some comments on these outcomes of DE4A were also collected. In relation to the Solution Architecture, feedback is provided confirming how **multiple coexistence of patterns (in particular of both USI and IM patterns) allows for a flexible approach useful for different situations in the context of eProcedures for the SDGR,** including linking of procedures by means of mechanisms that may trigger cross-border updates such as in the deregistration scenario, with appreciation of the Preview as authorization system which can be bundled as an easy to integrate component for portals. The pilot also confirms usefulness of canonical data models and the need for further standardisation especially when some evidences are relevant between different Life Events and consideration of advanced schema validation against business rules in some cases combined with syntax checks and easier management for attributes and code lists that are more prone to change. Mocked DE and DO are confirmed as very useful to enable testing and debugging of problems, including application of more complex validations if these are needed and implemented in the future. Information Desk is also very useful for dynamic lookup of DOs and can be further extended to use additional parameters for selecting more fine-grained administrative levels.

There are still no results metrics related to success criteria B1 and B2 (see section 3.3.3) as they are focused on end-user feedback, and these are expected to be available once combinations can be launched in parallel to the second iteration of the other two pilots.

Recommendations:

1. Reasons for some values on usefulness of components, specifications and technical documentation provided by authorities in the 3 MS are not clear and should be further investigated

with the 3 MS, also collecting answers from the 2 MS that will pilot more combinations in the final iteration in order to have a more reliable set of findings and results.

2. Preliminary findings of usefulness of DE4A components and solutions require further validation in the running phase of the pilot and collecting feedback from the other 2 MS that will participate in it.
3. As for other pilots, MA Pilot is recommended to put special effort in implementing the end user engagement strategy which is described in D4.11[11], taking lessons from other pilots piloting in the first iteration.
4. Additional aspects regarding new functionalities (e.g. multi-evidence scenarios, interrupted procedures, deregistration) should be explored with end-users while it is relevant to also gauge in detail (through fine-grained questions and interviews) satisfaction levels with different aspects of eProcedures and duration of different part of the flows to derive sufficiently detailed usage conclusions.
5. A sufficiently detailed log analysis should be addressed to confirm not only duration of successful cross-border exchanges but to identify causes (most frequent types) of errors for unsuccessful transactions and some statistics like number of transactions per pattern used, per cross-border combination, errors per component, number of evidences rejected in Preview functionality and, for interrupted procedures, number of times evidence was not available yet.

4.3.2 Results and findings – Learning

Similar to SA Pilot, several lessons learned (including suggestions relevant for adoption for each of them) both for activities during the analysis and design phase and those related to the customization, integration and testing phase have been documented in table format (see section 3.3 of D4.11 [6]). Lessons learned cover different types of challenges and the pilot has concentrated more in those aspects which can be of relevance for adoption by similar stakeholders (e.g. competent authorities integrating eProcedures or data services with SDG OOTS) beyond the project. Overall, the body of lessons learned so far is significant and is expected to be consolidated and further extended once metrics, especially for success criteria for goal D (see section 3.3.3), can be obtained through running pilot activities.

Overall the lessons learned so far (based on experience with the MVP foreseen for the first iteration) cover in a pragmatic way a significantly wide variety of topics: from expertise required in eIDAS and OOTS, to focus on most frequently used scenarios and core research questions with strict scoping (e.g. 2 MS) and pragmatic choice-making, to bundle GDPR consent within SDGR Explicit Request function, to consider up-front essential requirements like authentication of citizens from MS that have non-notified eIDs (2 MS in the pilot), to be aware as well the complexities of alignment with sectoral initiatives like EESSI (see more details below), to use mechanisms like wireframes for user interaction design to help user experience in terms of consistency and understandability.

Other lessons relate to the relevance of adequate and coordinated organisation of tasks with multiple teams within each MS, explanation of design details (Solution Architectures) to implementation teams involved, easy to access, clear and detailed documentation (e.g. use of artifacts for deployments, settings for different configuration items), early addressing of complexities for trust infrastructure including lifecycle of certificates for eDelivery components which can be complex administratively and time-consuming, consider impact in existing systems (DE/DO) of integrating them in cross-border infrastructure including issues that may only be discovered in such new use context, availability of technical channels that facilitate swift collaboration between MS technical experts, mechanisms to cope with varying speeds of development between MS such as phased testing and launching of services also establishing clear readiness criteria and organising well exchange of test credentials, importance of eIDAS nodes continued availability and stability, among others.

Important lessons learned also relate in the case of MA pilot to USI pattern, which has many of its specification and standards used in common with IM pattern allowing a good level of re-use of

common building blocks). The pilot advises to use this pattern in the context of evidence exchange for online procedures and data services holding citizens data, considering a number of important MS requirements and guarantees that are satisfied thanks to user interactions at DP side including reduced errors in record matching, increased user control and transparency of the process having Preview at DP side. This actually represented very important feedback from project MS to the SDG discussions leading to the implementing regulation of the OOTS and which have also had a positive influence for its technical specifications. Furthermore, the experience of building on existing sectoral Regulations -such as the Public Documents Regulation (EU) 2016/1191- in order to leverage existing solutions that are beneficial in cross-border contexts combined with the flexibility of DE4A's Information Exchange Model to exchange structured evidence (canonical) as well as original evidence and multilingual forms is proving a good approach to be considered by future adopters in the domain of citizen-oriented public services.

Some lessons also cover technical, semantic, legal and communication aspects, for example to show OOP benefits to adopters through animations and videos, to address up-front legal challenges using mock-ups that can clarify the meaning of different concepts and to aim for simplifying bureaucratic steps (e.g. powers of attorney). Lessons on the technical side recommend considering advanced identity linking mechanisms in the future, to address the problem of lack of persistence of some unique identifiers in eIDs.

Regarding governance and sustainable impact, initial lessons learned span from the need to establish minimum level of common agreed security measures, to the sharing of plans and approaches with adjustments to cope with different levels of progress in deployments, simplification and harmonisation of these deployments and facilitation of quicker decision-making at MS based e.g. on exchange clear cost and effort estimates.

Several lessons focus on what the pilot has learned in relation to integration of national components which is also largely related to the delays suffered results in inability to be able to launch the planned combinations of the first iteration and which have to do with availability of resources and especially the organisational complexity e.g. internal IT department procedures and security (e.g. audits) requirements within 2 MS, added to the high complexity of integrations and adaptations which require collaboration between multiple technical teams and where varying paces of progress in developments and integrations may have a bigger effect between MS. Approaches in DE4A like Connectathons and use of mocked and reference components in a common testing environment (called 'Playground' in the project) have proved very valuable to address the technical complexity and to foster swift and intense collaboration (e.g. exchange of configuration details and test credentials) between MS teams, at the level of Connectathons involving test environments.

On estimation of efforts for the various tasks involved to customize endpoints and integrate common components, these were delivered for USI pattern and shown as average values in person days from the 3 involved MS. The estimates are not considering delays in the project and are corrected to allow future adopters to estimate the real efforts, showing a total of 11-15 days both for DE and DO customizations and integration with common components. For setting up of connector, estimations exclude time of preparation of different environments (testing, preproduction, production), obtaining production certificates and additional security assessments, which had a severe impact in delaying readiness of combinations for piloting. An important finding is that as DE4A Connector already integrates Phase4 AS4 gateway, which makes setting up AS4 gateway very easy (4-5 days).

At the beginning of Y3, the pilot had various interactions, together with the "Semantic interoperability solutions" work package with experts from EESSI in order to gain good understanding of the common data model, code lists used and messages employed for business use cases and messages exchanges across borders considering common scenarios like requesting pension information or social benefits the third use case of the pilot (which had to be suspended when partners in that use case from two of

the three participating MS left the pilot). Nonetheless, the interactions served to further assess potential synergies considering future collaboration between SDG and sectoral systems like EESSI.

Recommendations:

1. While the pilot scope has been affected by changes in MS and partners participating in it during Y2 and Y3, it is recommended to preserve knowledge as lessons learned from internal discussions and interaction with external stakeholders e.g. the third use case on pensions information, unemployment and other social benefits designed canonical models between 3 MS and the "Semantic interoperability solutions" and had useful exchanges as described above with EESSI. Another area that can be documented, even if not piloted in practice, is related to scenarios of representation between natural persons (e.g. reference person of a family requesting multiple evidences for family members).
2. In order to complete learning about some aspects, all competent authorities (DEs, DOs, MS authorities in charge of common components), including the 2 MS working on further combinations, need to provide feedback to assess on a quantitative and qualitative manner respectively the efforts and pain points (different types of challenges and barriers) for customizing existing systems and for deploying and integrating components from the project. This needs to cover as well the new version of the Connector, national SMPs (with production certificates from EC eDelivery team) and further adaptations in DEs, DOs (new USI implementation, multievidence management, new evidence types…).
3. Identity and record matching, as well as experience with non-notified eIDs for authentication, is an important learning area, given the intrinsically diverse nature of national solutions and the impact of current lack of unique persistent identifiers in all MS that can be used from eIDAS (or limited number of mandatory attributes that can be used for comparison of their values).
4. It is recommended to consider updates in questionnaires and conduction of interviews to elicit more detailed but important aspects in order to extend the lessons learned with value for adoption and to clarify aspects that may otherwise result ambiguous/high-level.
5. Key findings and conclusions and major results can also be considered to be reflected in the pilots' Wiki pages in addition to the pilots' public deliverables reporting results for each of the running phases. In order to avoid effort duplication, the information may be selected and copied from these deliverables or specific sections mentioned and links provided to them.
6. Regardless of the medium used to document pilot learning, the recommendation is to structure knowledge to make it easy to find and manage i.e. considering the nature of challenges and solutions which can be technical, semantic, legal and organisational/political. Findings which are common between pilots can also be distinguished from those that are pilot-specific.

5 Conclusions

A Mid-term Evaluation has been conducted over the three DE4A pilots, comprising analysis of consistency of pilots design and plans to realize goals including correct set-up of success criteria and metrics to assess progress towards their fulfilment and actual assessment of results and findings for Use, Value and Learn dimensions as evaluation criteria. In addition to the assessment, the Evalution provided the pilots with general and pilot-specific recommendations for improvement towards maximization of benefits and impact.

All pilots have established well the respective scopes (i.e. with detailed use cases and sensible design choices for "Minimum Viable Product" in the first iteration) with proper risks identification and management of multiple challenges chiefly at organisational and technical levels. Noteworthy is the intense collaboration with other technical work packages with tangible outcomes: Solution Architectures for each exchange pattern to be piloted iteratively developed in a joint task force with architects of the pilots and "Architecture Vision and Framework" work package, canonical evidence models suitable for eProcedure needs based on available data from the DOs and designed in conjunction with semantic experts from "Semantic Interoperability Solutions" work package, requirements and feedback guiding the work to produce components like DE4A connector of the "Common Component Design & Development" work package. In this regard the pilots have also integrated effectively the DE4A components and approaches and are validating them already with real users and real-life cross-border exchanges in the case of SA and DBA pilots. Furthermore, pilots have externally demonstrated their capacity to generate positive impacts for interested stakeholders, through interactions with initiatives relevant to their work (EBSI/ESSIF, BRISS, EESSI) and with the SDG CEF OOTS team and technical work groups with valuable bi-directional exchanges on multiple aspects, from architecture discussions to semantic interoperability findings or inputs on record matching and powers validation and which have had positive influence e.g. towards the SDG OOTS Implementing Regulation.

All pilots demonstrate high levels of awareness and adherence to piloting principles through the definition of consistent specific criteria to gauge success for different key aspects (also with consideration to common technical criteria) and setting-up quantitative and qualitative metrics with reasonable and balanced targets. Furthermore, Pilot goals are sufficiently reflected in use cases and directly related to success criteria which focus (through the underlying metrics) on verifying aspects of end-user satisfaction with several aspects for the eProcedures they use and for specific functionalities (e.g. powers validation), of competent authorities with canonical models and the administrative burdens reduction and collecting lessons and cost-benefit feedback from such authorities for deployment of common and semantic components and for customizing DE and DO endpoints to integrate with them. All this allows to make the overall conclusion 3that the pilots have been adequately set up as true pilots (with their scopes, benefits logic elements and plans well documented) and are capable to generate both verifiable benefits and valuable learning that can be re-used beyond the scope of the project by stakeholders that will face similar challenges to overcome interoperability barriers in the context of the SDG. While pilots planning deliverables show a detailed and consistent planning approach in particular for all customization, integration, testing and user involvement activities undertaken by all pilot participants in order to launch the pilots, including prerequisites and dependencies for performing the activities, in reality there were significant deviations in the planning, motivated by multiple factors, which are well analysed in the Initial Phase Reports by each pilot.

Regarding actual realisation of progress, 4 in the case of MA pilot the assessment is not complete, since for reasons also explained in subsection 4.3.1, the cross-border combinations couldn't yet be launched for that pilot and therefore there are no results available yet from end-users to be able to assess Use-related metrics and criteria. Nevertheless, information has also been collected to the extent possible from authorities involved in the pilot on lessons being learned in the activities for integrating common

DE4A components and adapting DEs and DOs.In this regard, it is highly relevant for other MS that both SA and DBA pilots provide similar effort estimates for customization and integration with common components of DE portals (29-34 person days) and DO data services (19-21 days) for USI and IM patterns with less effort required for endpoints in VC pattern (10 days for Issuers and 8 days for Verifiers). Effort to deploy and configure common components (Connector, SMP/Information Desk) seems to depend to a large extent on previous technical skills varying from 5-9 days in MS of SA and MA pilots and 4-27 days in DBA pilot.

With the combinations piloted in practice already in SA (11 for patterns USI and VC) and DBA pilots (2 for IM pattern), highly significant fact-based and practical knowledge is being generated regarding value unlocked for end-users and competent authorities in the context of procedures modernisation with automation of evidence exchange: for instance in SA and DBA pilots time reductions thanks to DE4A linking eProcedures with data services for Once-Only go from days (sometimes weeks) to around 2 minutes or less. Thus, the three pilots so far also confirm the suitability of DE4A's multi-pattern architecture approach and the project finding that "different underlying public service processes, national regulatory frameworks, different criticality of personal information exchanges, different national baseline infrastructures and different data quality in registries represent a diversity that impairs a "one pattern fits all"-approach"[14].

A highly valuable body of learning is being built regarding challenges for implementation and operation of cross-border public services relying on eIDAS, OOTS and other frameworks to realize Once-Only benefits in the context of the SDG: in particular all three pilots offer recommendations relevant for other MS explaining how to cope with inherent complexity of OOTS and the different paces of implementation and integration with multiple teams involved with different expertise and with issues of scarce specialised resources and changes in priorities during project lifetime. In this regard the pilots also coped well with unexpected challenges, a good example being SA pilot that managed to pilot a few combinations that suffered some technical limitations with real students to obtain results, also piloting using test eIDs and or test data when it became necessary in some cases.

While the question of relevance of collected feedback when numbers of cross-border users in the pilots are not high can be understood to be a possible concern, this needs to be put in the context of being the first time such feedback is obtained for these types of services but using a well defined framework of questions and interviews covering multiple areas of high interest, all of which re-inforce the relevance of feedback obtained. In the case of authorities from MS numbers are also not high and this does not mean the feedback is less significant for other MS. Satisfaction levels of end users are overall high and positive as is the satisfaction with value-related metrics for competent authorities (for administrative simplification achieved, quality of data, but also usefulness of DE4A patterns and components) all of which is indicative of significant success for MVP implementations.

Approaches extensively applied in DE4A like Connectathons and use of mocked and reference components in a common testing environment (called 'Playground' in the project) have also proven extremely valuable to address the technical complexity and to foster swift and intense collaboration (e.g. exchange of configuration details and test credentials) between MS teams, providing extra confidence prior to moving into operational/production environments.

Regarding major recommendations from the Mid-term Evaluation to the pilots we can highlight the following:

1. Pilots should consider how to detail better the degree of administrative simplification and burden reductions that are observed both from viewpoint of authorities in charge of eProcedures and (where relevant) data services, and from user experience (including new scenarios where multiple evidences can be exchanged at once or aimed at keeping data up-to-date).
2. Given that in the second iteration all MS will pilot in DBA and MA pilots, (i) efforts for DE/DO customizations and integrations, (ii) efforts for common components deployments and

configurations (new version of Connector, AA and SMPs per MS) and (iii) evaluation on usefulness of components, specifications should be collected in a more complete manner ensuring that every relevant authority provides estimates and feedback (also in SA pilot): this will make initial results in this regard more reliable for other MS to consider.

3. User participation needs to be reinforced, in some cases taking advantage of more MS and new combinations (DBA pilot), critically revisiting engagement plans and considering experience to identify aspects to improve for user recruitment (e.g. causes of difficulties to engage companies), and reinforcing in some cases participation from specific MS, categories of end-users or use cases (see SA pilot). Pilot learning about important aspects for the SDG OOTS like record matching can be further increased if more users use their real eIDs and real evidence data.
4. Pilots should carefully re-assess metrics and questionnaires in order to obtain more detailed feedback in some cases, especially considering extended scope of second iteration with new functionalities (multi-evidence, de-registration), new or improved flows (e.g. USI, VC, S&N, Lookup) and components (e.g. mobile wallet) but also to understand better reasons for lower user satisfaction with specific parts of eProcedures/flows. Use of log data has been somewhat scarce, but they have been improved and are recommended to be used more to extract additional usage details and for error analysis.
5. Reinforce collaboation with “Sustainable impact and new governance models” work package to better understand and contribute on factors for sustaining components and services relevant for MS (interplay with SDG implementation activities, critical mass of procedures that could use DE4A outcomes, etc.).
6. To continue to maximize learning, it is recommended additional inclusion of pilot knowledge in DE4A wiki (i.e. key findings and conclusions) and making available discussion papers on specific aspects (powers harmonization, increased automation with innovative patterns like S&N, representation of natural persons, etc.) which can also serve as guidance for future OOTS adopters, as well as on on findings that can influence sustainability and adoption, including how to make benefits’ perception clearer. Possibilities to preserve technical knowledge exchanged (Slack) can also be considered. Structuring this knowledge to make it easy to find and understand is equally important. Leveraging dissemination opportunities (papers, conferences…) to showcase pilot success stories to SDG stakeholders and domain-specific communities is also important for wider positive impact.

As overall conclusion DE4A pilots have been found as per the Mid-term Evaluation to have a pragmatic orientation and to be generating tangible benefits for the project as a whole, which is addressing real needs from MS in relation to SDG and administrative modernisation, according to their definition and goals and having followed adequately the agreed methodology to collect, analyse and substantiate findings regarding Use, Value generation and Learning consolidation aimed at fostering adoption of project outcomes. The pilots take to the reality of proving in reality interoperability multiple research concepts where by re-using existing building blocks and developing new ones and by facilitating collaboration between multiple experts and teams from different MS, working solutions are found to address the challenges that inevitably arise in such complex endeavours as the ones addressed by DE4A. The proposed recommendations are realistic and achievable and will help improve the results from the pilots and the overall impact of the project in the final phase of the project. The evaluation of the final iteration will be reported in deliverable “D4.14 Pilots Final Evaluation Report” at the end of the project.

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