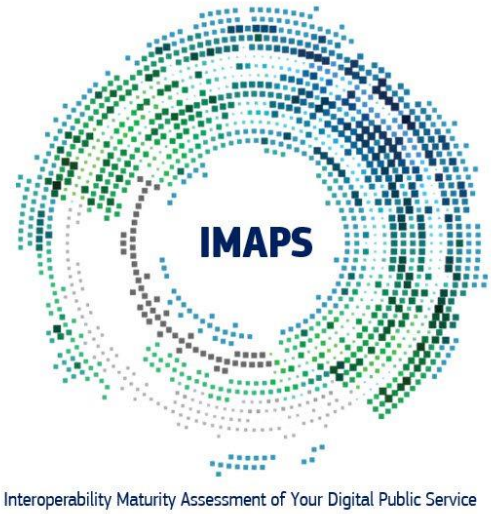
SIMAPS v1.1.0

Semantic Interoperability Maturity Assessment of a Public Service

User guide



LIMAPS Legal Interoperability

OIMAPS Organisational Interoperability

SIMAPS Semantic Interoperability

TIMAPS Technical Interoperability

Disclaimer

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Table of Abbreviations

Acronym	Description
ABB	Architectural Building Block
CAMSS	Common Assessment Method for Standards and Specifications
CarTool	Cartography Tool
DIGIT	Directorate-General for Informatics
EC	European Commission
EIF	European Interoperability Framework
EIRA© (EIRA)	European Interoperability Reference Architecture
ELAP	EIRA Library of Architecture Principles (ELAP)
ELIS	EIRA Library of Interoperability Specifications
EU	European Union
HL SAT	High Level Solution Architecture Template
IQAT	Interoperability Quick Assessment Toolkit
ISA	Interoperability Services for Public Administrations
IMAPS	Interoperability Maturity Assessment of a Public Service
MS	Member State
PA	Public Administration
SIMAPS	Semantic Interoperability Maturity Assessment of a Public Service
SIQAT	Structural Interoperability Quick Assessment Toolkit

Glossary of terms

Term	Description
Attribute	Structural part of each SIMAPS component. Each attribute includes questions (items) that assess a specific aspect of the digital public service. Each of the SIMAPS survey components has questions (items) that are organised under the following attributes: the semantic interoperability specifications of data, information and knowledge delivered by the digital public service to its end users and/or other services, the semantic interoperability enablers and the semantic interoperability manifestations.
Component	Fundamental structural part of the SIMAPS model that reflects how the respective questions (items) in the questionnaire (survey) are organised. Each component refers to a different pillar of the digital public service lifecycle. SIMAPS has two components: Service Delivery and Service Consumption, which means that the respective questions refer to these two specific categories.
Item	Structural part of each SIMAPS attribute. Items are the questions of the SIMAPS questionnaire (survey)
Option	Options are the possible replies to one SIMAPS item
Principles	Rules applied on digital public service to enable and ensure semantic interoperability
(*Overall*) Weight	Weight refers to the absolute numerical factor that each component/attribute/item contributes into the structural part it belongs. Overall weight refers to the overall numerical factor that each component/attribute/item contributes to the whole SIMAPS survey

EXECUTIVE SUMMARY

This document provides the guidelines and definitions for using the **Semantic Interoperability Maturity Assessment of a Public Service (SIMAPS)** tool in order to assess and improve the semantic behavioral interoperability maturity of a digital public service. It also includes the questions and the options of the SIMAPS questionnaire as well as the respective recommendations. SIMAPS is the **semantic specialisation** of IMAPS survey that assesses the behavioral aspects of a digital public service from the semantic interoperability viewpoint.

In the following chapters, we provide an introduction to the most important chapters in the context of SIMAPS and we present the objectives of SIMAPS, the defined maturity levels and the approach and attributes of semantic interoperability that are the subject of observation and assessment.

In addition, we provide an explanation of the structure of the SIMAPS questionnaire, the methodology used to determine the maturity levels of semantic behavioral interoperability of a digital public service and the questions and options of the questionnaire.

Finally, we conclude with the recommendations that the end-user receives for each question. After filling in the online questionnaire, the respondent receives a PDF with advice on how to improve the semantic behavioral interoperability of his digital public service.

1 INTRODUCTION

1.1 Document Objectives

The main objective of the **Semantic Interoperability Maturity Assessment of a Public Services (SIMAPS)** is to provide insight into how digital public services can improve their semantic behavioral interoperability maturity. SIMAPS is the **semantic specialisation** of IMAPS survey that assesses the behavioral aspects of a digital public service from the semantic interoperability viewpoint. This document is based on the updates of SIMAPS to version 1.1.0 by implementing the feedback collected during SIMAPS v1.0.0deployment and review, as this has been recorded in the respective JIRA tickets as well as during the sessions with the experts. These updates include the description of SIMAPS version 1.1.0, its purpose and scope in relation to IMAPS, as well as its design and deployment on the EU Survey portal. The objectives of the present deliverable are the following:

- the description of the **key concepts** to understand the SIMAPS;
- the presentation of **model objectives**;
- the description of the SIMAPS **maturity levels**, as well as the **behavioral interoperability aspects** that it covers;
- the description of the SIMAPS **structure** including its **attributes and components**;
- the description of how the SIMAPS **questionnaire** is structured, its questions and their options;
- the description of how the SIMAPS recommendations are generated including the recommendations per question.

1.2 Document Structure

The document is organised in the following chapters:

- **Executive summary**, which provides an overview of the deliverable objectives, activities and conclusions;
- **Chapter 1:** Serves as introduction to the document;
- **Chapter 2**: Includes the description of the key concepts used in SIMAPS and their link to IMAPS;
- **Chapter 3**: Includes the maturity levels of SIMAPS;
- **Chapter 4:** Presents SIMAPS structure, in components, attributes and items, demonstrating how their design ensures alignment with IMAPS, EIF and EIRA;
- **Chapter 5**: Presents the SIMAPS questionnaire and how it is structured**;**
- **Chapter 6:** Presents the SIMAPS recommendations and how they are generated

2 SIMAPS KEY CONCEPTS

The following concepts are key to understand the SIMAPS:

- *Digital public service* – the digital delivery of a public service via channels such as interactive digital collaborations (chat, messaging functionality), mobile application, web portal / website, email and machine-to-machine interface.
- *Interoperability* – the ability of disparate and diverse organisations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organisations, through the business processes they support, by means of the exchange of data between their respective IT systems.
- *Semantic Interoperability* - Semantic interoperability enables organisations to process information from external sources in a meaningful manner and ensures that the precise meaning of exchanged information is understood and preserved throughout exchanges between different parties. In the context of the European Interoperability Framework (EIF), semantic interoperability also encompasses the syntactic interoperability in the sense of describing the exact format of the information to be exchanged in terms of grammar, format and schemas.

2.1 Digital public service

The Semantic Interoperability Maturity Assessment of Public Services (SIMAPS) assesses the semantic behavioral interoperability of a digital public service. The following four design rules apply when defining a digital public service:

1. The digital public service has a **single outcome / public decision**. When multiple service outcomes are recognised, then multiple digital public services will need to be defined and assessed, each one through a separate SIMAPS assessment;
2. The digital public service has a **single service owner** i.e. the public administration responsible for the service. When the ownership of a service is distributed amongst multiple public administrations (e.g. multiple local administrations providing birth certificates), then each service owner needs to conduct a separate assessment for his respective service;
3. The digital public service has a **single primary end user group**. Public services can be delivered towards three of end users: citizens, businesses and other public administrations. In case the same digital public service is delivered to different types of end users, then these services should be assessed separately from one another through the SIMAPS;
4. The digital public service has a **virtual end user interface**. SIMAPS at the outset has been designed to evaluate services, which are delivered to end users. This is a corollary to the previous design rule.

Examples of digital public services that conform to the aforementioned design rules are the following:

- Citizens (3) are offered the service to issue an e-administrative fee (1) via the GSIS portal (4) provided by the Ministry of Digital Government (2);

- The national electronic public procurement platform (4) delivers semantically aligned electronic notices (1) to the TED eNotices platform of EU (3).
- Citizens (3) are offered the national electronic service of citizens' identities (eID) (1) via the eID portal (4) provided by the Ministry of Interior (2). The eID portal (4) also delivers semantically aligned data to national business registers (3).

2.2 Interoperability and IMAPS

Interoperability in a digital public service is an attribution defined as "the extent it enables peer-to-peer collaboration with public services towards mutually beneficial goals, involving the sharing of data, information and knowledge between them regardless their legal, organisational, semantic and technical environment". Figure 2 illustrates the digital public service in the context of interoperability.

Interoperability is of multidimensional nature involving structural interoperability, behavioral interoperability and governance interoperability:

1. The **structural interoperability** is "the extent its structure has been developed reusing and/or sharing components in support of a peer-to-peer collaboration"
2. The **behavioral interoperability** is "the extent its manifested behavior exchanges data, information or knowledge with its environment in support of a peer-to-peer collaboration"
3. The **governance interoperability** is "the extent its agreed choreography rules support a peer-to-peer collaboration"

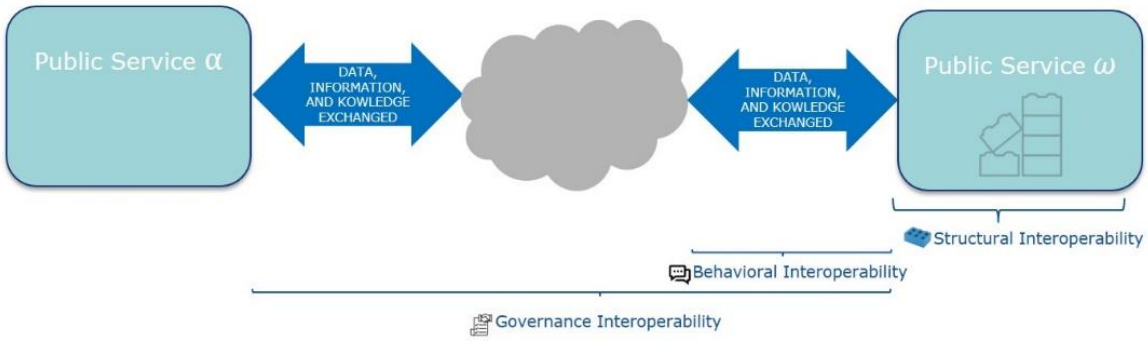


Figure 1: Interoperability dimensions

In addition, all relationships that interconnect the digital public service with the outside environment are considered relevant for assessing interoperability and thus, they are taken into account in the IMAPS. Interoperability and IMAPS are concerned with how the relationship between internal and external domains is defined and implemented.

In particular, IMAPS measures how well a public administration interacts with **external** entities to organise the efficient provisioning of its public services to other public administrations, businesses and citizens. IMAPS uses the term “behavioral” to refer to the fact that it assesses aspects that have to do with how the public services “behave” while interacting with each other or with their end users (citizens, business or other Public Administrations).

2.3 Semantic Interoperability and SIMAPS

SIMAPS assesses the behavioral aspects of a digital public service, via an approach similar to this of IMAPS, but from the **semantic behavioral interoperability viewpoint**.

Semantic interoperability enables organisations process information from external sources in a meaningful manner and ensures that the precise meaning of exchanged information is understood and preserved throughout exchanges between different parties such as different Public Administrations. In the context of the **European Interoperability Framework** (EIF), semantic interoperability also encompasses the syntactic interoperability in the sense of describing the exact format of the information to be exchanged in terms of grammar, format and schemas. **Semantic interoperability** provides also a common understanding of the data, by using common nomenclatures and data formats. It is crucial to agree on the use of common semantic standards, promote transparent and well-documented metadata policies and increase the visibility and reuse of existing semantic interoperability solutions.

In particular, SIMAPS assesses the behavioral aspects of a digital public service by limiting its focus on:

- the semantic behavioral interoperability **specifications** of data, information and knowledge delivered and consumed by the public service and its end-users or other client services;
- the semantic behavioral interoperability **capabilities** that **enable** either the delivery and consumption of data, information and knowledge by the digital public service and its end users or other client services or ii) the discoverability of the public service or other client services;
- the semantic behavioral interoperability **manifestations** of the public service delivering and consuming data, information and knowledge (manifestations can be performance, results, user experience).

SIMAPS Objectives

SIMAPS delivers insights into two important aspects of semantic interoperability maturity:

- Provide insight into the **current semantic interoperability maturity** of a digital public service based on a set of defined interoperability attributes and maturity stages;
- Provide guidelines for how the digital public service can **improve its semantic interoperability maturity.**

Improving interoperability and in particular, semantic interoperability is a continuous activity. Organisations are therefore encouraged to use the model and its improvement recommendations regularly.

2.4 IMAPS and SIMAPS User Journey

The figure below illustrates a typical user journey for the IMAPS end user and shows how IMAPS recommendations can trigger the need for an assessment with SIMAPS survey.

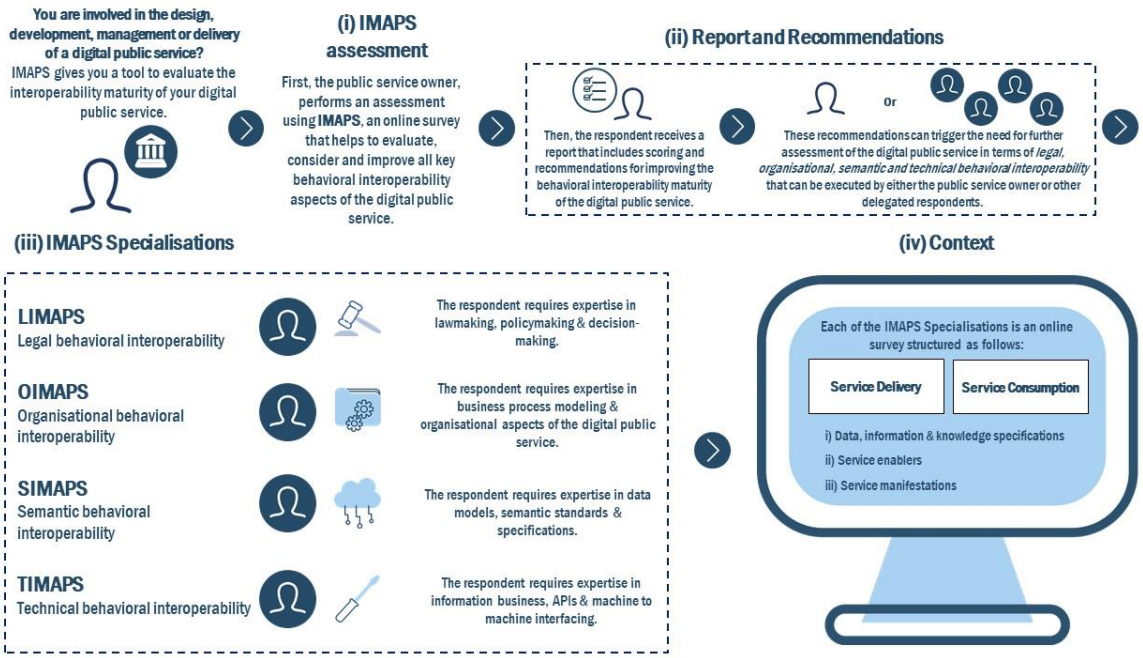


Figure 2: IMAPS to SIMAPS user journey

2.5 SIMAPS Target users

SIMAPS can be used by the following end-users:

- Data experts : to provide information on existing and reusable data sets, data models and core vocabularies on their use;
- Public service owners: to improve the overall semantic interoperability and conformance of their digital public services;
- Business Architects: to help analyse and document the processes and data flows for the smooth data exchange among services.

3 SIMAPS MATURITY LEVELS

SIMAPS uses a ***five-stage model*** to indicate the semantic interoperability maturity of the digital public service. Using maturity levels allows to:

- Measure the semantic interoperability maturity of the digital public service as a whole as well as underlying aspects;
- Indicate which capabilities and next steps are required to reach higher levels, and thus improve semantic interoperability maturity.

A five-stage approach is often seen in proven maturity models and is considered best practice for assessing and improving maturity. The five maturity levels for SIMAPS are summarised in the table below.

Table 1: Five maturity levels of SIMAPS

Maturity Level	Maturity Stage	Interpretation
1	**Ad Hoc**	Poor interoperability – the digital public service cannot be considered interoperable
2	**Opportunistic**	Fair interoperability – the digital public service implements some elements of interoperability best practices
3	**Essential**	Essential interoperability – the digital public service implements the essential best practices for interoperability
4	**Sustainable**	Good interoperability – all relevant interoperability best practices are implemented by the digital public service
5	**Seamless**	Interoperability leading practice – the digital public service is a leading interoperability practice example for others

The desired interoperability level for a digital public service is at least level 4: “Sustainable”. At this level, the digital public service is considered to have implemented all relevant best practices.

4 SIMAPS STRUCTURE

4.1 Approach

IMAPS uses the term “behavioral” to refer to the fact that it assesses aspects that have to do with how the public services “behave” while interacting with each other or with their end users (citizens, business or other Public Administrations). **SIMAPS** assesses the behavioral aspects of a digital public service, via an approach similar to this of IMAPS, but from the **semantic behavioral interoperability viewpoint**.

SIMAPS conceptual model describes all possible instances where **interoperability with the outside world may occur from the digital public service viewpoint**. It distinguishes between the **internal domain** (the internal service management) and the **external domain** (the digital public service uses/consumes existing services and exposes the produced service to thirds).

4.2 SIMAPS Components

Component	Fundamental structural part of the SIMAPS model that reflects how the respective questions (items) in the questionnaire (survey) are organised. Each component refers to a different pillar of the digital public service lifecycle. SIMAPS has two components: Service Delivery and Service Consumption, which means that the respective questions refer to these two specific categories.

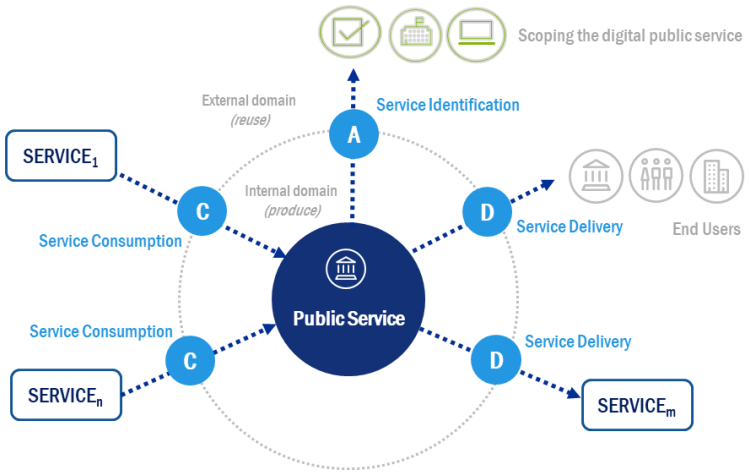


Figure 3: SIMAPS behavioral interoperability viewpoint

The behavioral interoperability aspects are described below:

- **Service Consumption (C)** – Consumption of reusable machine-to-machine services from other public administrations and businesses. This can include the consumption of functionalities, base registry information and security services;
- **Service Delivery (D)** – Delivery of the digital public service to its end users and/or other public administrations

The aspects (hereafter referred to as Behavioral Interoperability Aspects) indicated in the figure above, are the object of measurement in SIMAPS, specifying where semantic behavioral interoperability plays a role from a service delivery and a service consumption viewpoint.

4.2.1 Service Delivery (D)

The public administration delivers the digital public service towards end users i.e. citizens, businesses or other administrations. We call this **Service Delivery**. The service that is being delivered represents the focal point of the SIMAPS in terms of correctly scoping and delimiting the digital public service under evaluation. If service delivery is scoped correctly, the scoping of the other areas becomes more straightforward. The Service Delivery area focuses on the delivery of the digital public service to its end users or other services.

4.2.2 Service Consumption (C)

For delivering the digital public service towards the end user, the digital public service may be required to consume services of other public administrations or businesses. This area is called **Service Consumption** and it focuses on the consumption of reusable machine-to-machine (client) services from other public administrations and businesses. This can, indicatively, include the consumption of functionalities, base registry information and security services.

Digital public services that consume (reuse) existing services where possible are considered more interoperable than organisations that produce (develop) their own proprietary services without reusing existing functionalities.

4.3 SIMAPS Attributes

Attribute	Structural part of each SIMAPS component. Each attribute includes questions (items) that assess a specific aspect of the digital public service. Each of the SIMAPS survey components has questions (items) that are organised under the following attributes: the semantic interoperability specifications of data, information and knowledge delivered by the digital public service to its end users and/or other services, the semantic interoperability enablers and the semantic interoperability manifestations.

It is reminded, as per the glossary in the introduction of this document, that SIMAPS questionnaire is structured into two components: Service Delivery and Service consumption. The attributes that compose these SIMAPS components, are presented in the table below.

Table 2: Service delivery and service consumption attributes

Service Delivery	
Attribute	**Rationale**
Data, Information, Knowledge Delivered	Assesses the semantic behavioral interoperability **specifications** of data, information and knowledge delivered by the public service to its end users and/or other client services.
Service Delivery Enablers	Assesses the semantic behavioral interoperability **capabilities** that enable either i) the delivery of data, information and knowledge by the digital public service to its end users **and/or other** client **services** or ii) the discoverability of the public service.
Service Delivery Manifestations	Assesses the semantic behavioral interoperability **manifestations** of the public service delivering data, information and knowledge (manifestations can be performance, results, user experience).

Service Consumption	
Attribute	**Rationale**
Data, Information, Knowledge Consumed	Assesses the semantic behavioral interoperability **specifications** of data, information and knowledge **consumed** by the public service **from** other server services
Service Consumption Enablers	Assesses the semantic behavioral interoperability **capabilities that enable the** public service **to either i) discover other server services and/or ii) consume their** data, information and knowledge
Service Consumption Manifestations	Assesses the semantic behavioral interoperability manifestations of the public service **consuming** data, information and knowledge (manifestations can be performance, results, user experience).

It is briefly noted that there is a symmetry in the way the Service Delivery and Service Consumption attributes have been defined, from the delivery viewpoint to the consumption viewpoint. This means that there is no attribute in Service Delivery that is not also examined in the Service Consumption component from the service consumption viewpoint and vice versa.

4.4 Sources of Input

Various related programmes and initiatives inside and outside ISA[2] have been leveraged to build the current set of SIMAPS Attributes. The most important ones are:

- ***European Interoperability Framework (EIF)*** [1] – The European Interoperability Framework (EIF) serves as an important framework for organisations to promote and improve interoperability and therefore is considered as a paramount starting point for defining SIMAPS attributes. The respective items per attribute have been specifically formed to assess the level of conformance with the elements of EIF structure (principles/layers/conceptual model). The basis to define SIMAPS items have been the EIF recommendations;
- ***European Interoperability Reference Architecture (EIRA)*** [2] – EIRA compliance is ensured at the level of SIMAPS attributes. In this context, the respective items per attribute have been specifically formed to assess the level of conformance with the EIRA Architecture Building Blocks (ABBs). The basis to define SIMAPS items has been the context of each one of the EIRA ABBs.
- ***Digital Single Market*** - the Digital Single Market strategy aims to open up digital opportunities for people and business and enhance Europe's position as a world leader in the digital economy. Select attributes were defined to align with this ambition; the terminology of SIMAPS overall embraces the key concepts of "digitalisation" in its various aspects;
- ***Structural* Interoperability *Quick Assessment Toolkit (SIQAT©)***[3] – SIQAT© has been developed in the context of Action 2016.36 Assessment of trans-European systems supporting EU policies of the Interoperability solutions and common frameworks for European public administrations, businesses and citizens. The objective of the SIQAT© is to allows public service owners to evaluate the structural interoperability maturity level of their digital public service.

[1] https://ec.europa.eu/isa2/eif_en
[2] https://joinup.ec.europa.eu/collection/european-interoperability-reference-architecture-eira/solution/eira
[3] https://joinup.ec.europa.eu/collection/european-interoperability-reference-architecture-eira/solution/siqat/release/v100

- ***Semantic interoperability experts*** – The IMAPS project team conducted some rounds of interviews with identified experts from the semantic interoperability domain to improve the SIMAPS questionnaire.
- ***A multi-dimensional framework to evaluate the innovation potential of digital public services***[4] – This report presents the main findings of a study conducted as part of the "Innovative Public Services" (IPS) Action of the ISA² Programme. The main outcome of the research is an original multi-dimensional framework for evaluating the interoperability readiness of digital public services. The framework was conceptualised and tested in the context of desk and field research on available evidence to support European Public Administrations willing to embrace new digital technologies and deliver innovative public services according to the four layers of the European Interoperability Framework (EIF) and in alignment with the user centricity principles defined in the Tallinn Declaration (2017).
- ***Common Assessment Method for Standards and Specifications (CAMSS)*** [5] - CAMSS is the European guide for assessing and selecting standards and specifications for an eGovernment project, a reference when building an architecture and an enabler for justifying the choice of standards and specifications in terms of interoperability needs and requirements. It is fully aligned with the European Standardisation Regulation 1025/2012.
- ***EIRA Library of Interoperability Specifications (ELIS)*** [6] - The EIRA Library of Interoperability Specifications is a library containing the standards and specifications defining the interoperability requirements of the architectural building blocks (ABBs) contained in the European Interoperability Reference Architecture (EIRA). The aim of this library is supporting solutions architects when modelling using EIRA.
- ***EIRA Library of Architecture Principles (ELAP)*** [7] - The EIRA library of architecture principles (ELAP) is intended to direct government organizations in initiating changes and implementing IT projects. Particularly when designing new or modified services, it is necessary to make visible how the principles are implemented and which considerations are made in this regard. The apply-or-explain principle applies here, whereby deviations are permitted provided that they are substantiated and recorded with good arguments so that they can be revisited at a later stage. This prevents important matters from being overlooked. The principles are described in relation to relevant policy frameworks, established standards, building blocks and examples that are already available, so that they are as recognisable as possible in practice. In the context of SIMAPS, the CAMSS terminology, ELIS requirements and ELAP principles have been used as basis and guidance to design the items and options of the questionnaire, as well as the respective interoperability aspects, linked to each item. These interoperability aspects will serve as the basis to design the High Level Solution Architecture Template (HL SAT) of SIMAPS, a specification that extends EIRA and provides high level requirements on how to design a semantically interoperable digital public service.

[4] https://publications.jrc.ec.europa.eu/repository/handle/JRC121672
[5] https://joinup.ec.europa.eu/collection/common-assessment-method-standards-and-specifications-camss/about
[6] https://joinup.ec.europa.eu/collection/common-assessment-method-standards-and-specifications-camss/solution/elis/release/v110
[7] https://joinup.ec.europa.eu/collection/common-assessment-method-standards-and-specifications-camss/solution/elap/release/v100

5 SIMAPS QUESTIONNAIRE

SIMAPS uses a questionnaire structure for assessing the semantic behavioral interoperability maturity of a digital public service. This section details the questionnaire type, question types and assessment structure in more detail.

SIMAPS questionnaire is a compact and highly user-friendly tool available online. Designed as a self-assessment tool, SIMAPS assessment criteria have been condensed into targeted question sets in order to evaluate key semantic behavioral interoperability aspects of a digital public service. Such insight results in personalised, confidential feedback and recommendations on how a service can improve.

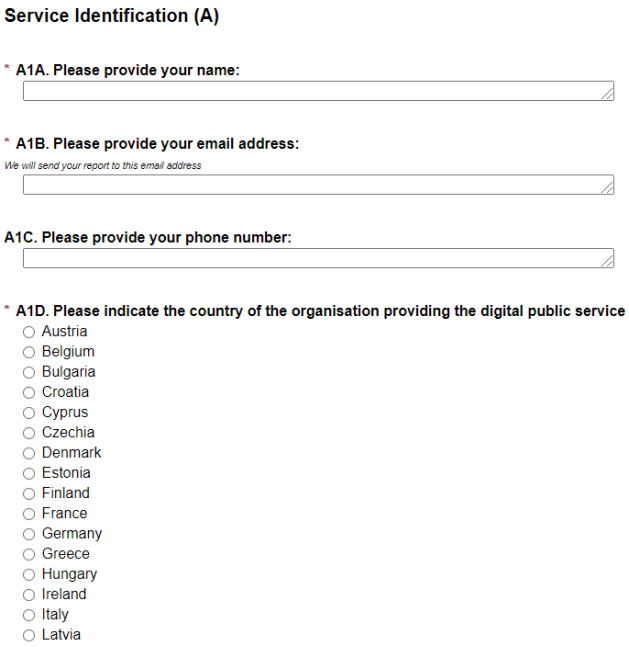
SIMAPS Questionnaire is designed to take approximately 20 minutes to complete. Once the questionnaire is completed, a report is generated with the semantic behavioral interoperability scores plus recommendations on how to further improve the digital public service's semantic behavioral interoperability.

5.1 Questionnaire Structure

This section outlines the structure of the questionnaire. The four main sections of the questionnaire are in line with the earlier presented overview of behavioral interoperability aspects (section 2.4):

- Service Identifications (A): This section assesses the scope of the digital public service (the object of measurement, i.e. the digital public service to examine), service landscaping, the digital public service's outcome, the service owner, the administrative level, etc.;
- Service Delivery (D): The section assesses how the digital public service delivers its service;
- Service Consumption (C): This section assesses if and how services are consumed from other administrations and businesses.

The following figures illustrate the sections A, D and C of SIMAPS questionnaire as described above.



Service Identification (A)

* A1A. Please provide your name:

* A1B. Please provide your email address:

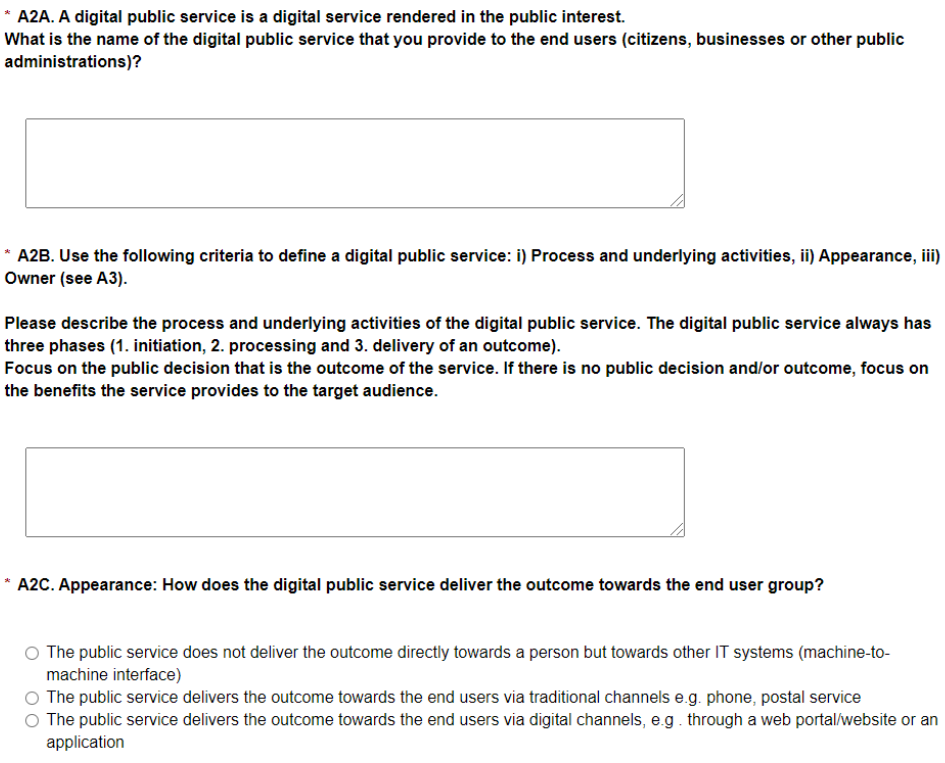
We will send your report to this email address

A1C. Please provide your phone number:

* A1D. Please indicate the country of the organisation providing the digital public service

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czechia
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia

Figure 4: SIMAPS questionnaire Section A



* A2A. A digital public service is a digital service rendered in the public interest.
What is the name of the digital public service that you provide to the end users (citizens, businesses or other public administrations)?

* A2B. Use the following criteria to define a digital public service: i) Process and underlying activities, ii) Appearance, iii) Owner (see A3).

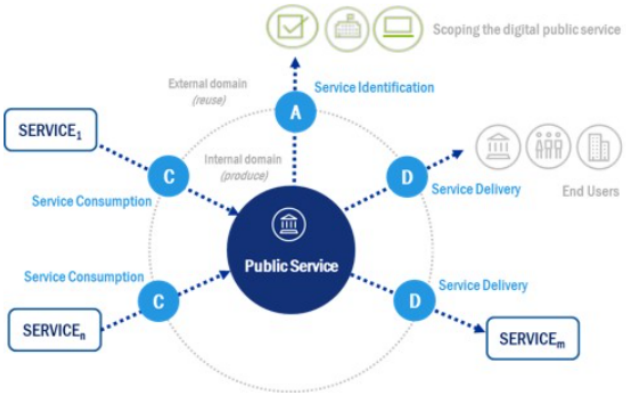
Please describe the process and underlying activities of the digital public service. The digital public service always has three phases (1. initiation, 2. processing and 3. delivery of an outcome).
Focus on the public decision that is the outcome of the service. If there is no public decision and/or outcome, focus on the benefits the service provides to the target audience.

* A2C. Appearance: How does the digital public service deliver the outcome towards the end user group?

- The public service does not deliver the outcome directly towards a person but towards other IT systems (machine-to-machine interface)
- The public service delivers the outcome towards the end users via traditional channels e.g. phone, postal service
- The public service delivers the outcome towards the end users via digital channels, e.g . through a web portal/website or an application

Figure 5: SIMAPS questionnaire Section A

Service Delivery (D)



The public administration delivers the digital public service data towards other end users like administrations, businesses and citizens. We call this the **Public Service Delivery.**

The service being delivered represents the focal point of the SIMAPS in terms of correctly scoping and delimiting the digital public service data under evaluation.

The Service Delivery area focuses on the data, information and knowledge delivered by the digital public service, the Service Delivery Enablers and the Service Delivery Manifestations.
Please answer the following questions regarding how your digital public service is delivered to its end users and/or other public services.

Figure 6: SIMAPS questionnaire Section D

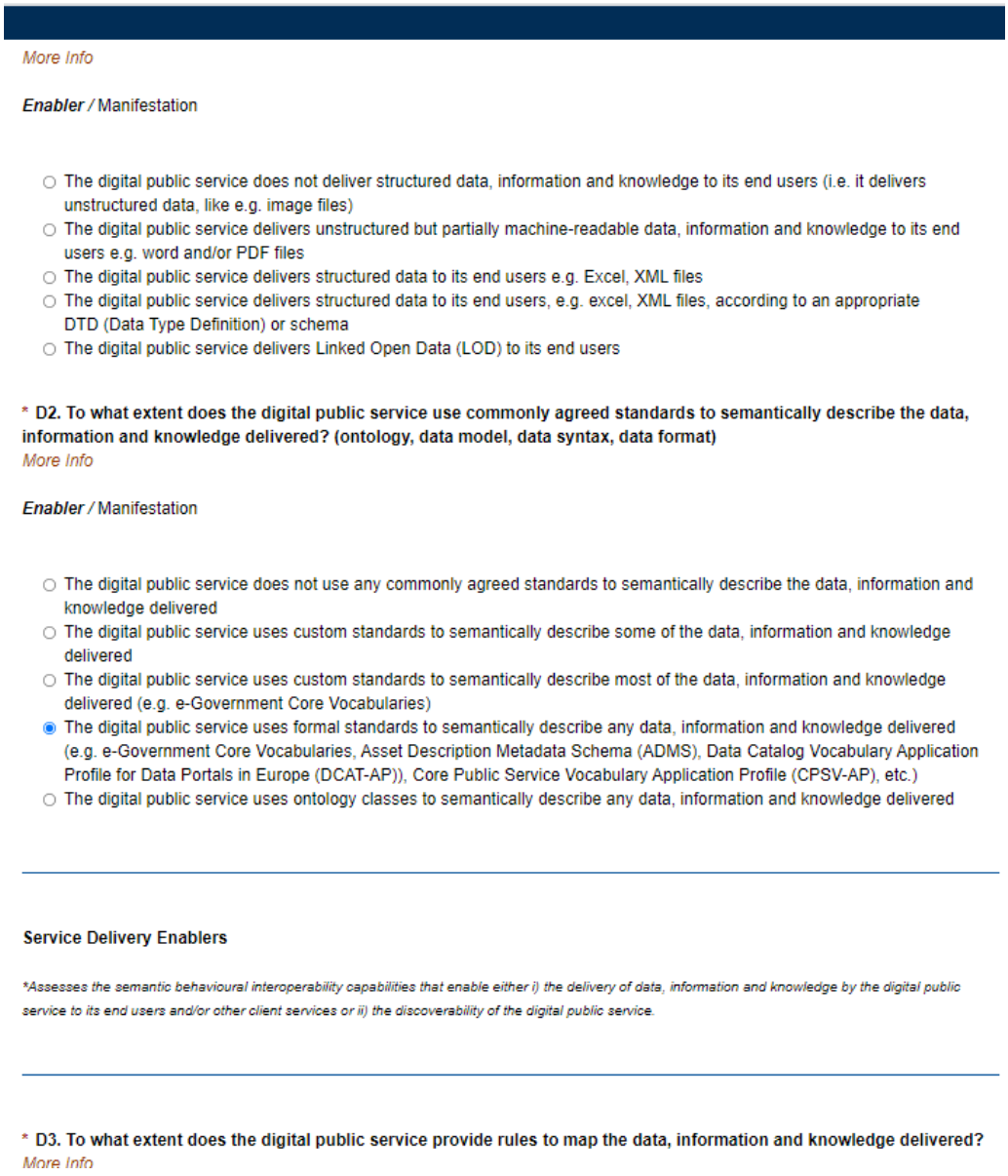
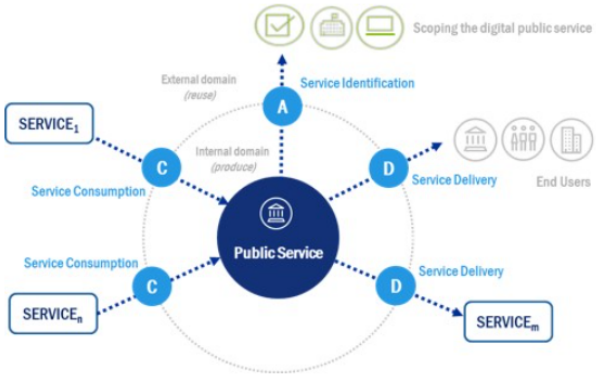


Figure 7: SIMAPS questionnaire Section D

Service Consumption (C)



For delivering the digital public service data towards other administrations, businesses and citizens, the digital public service may be required to consume service of other public administrations or businesses. This area is called **Service Consumption.**

This section comprises the "Data, information and knowledge consumed", the "Service Consumption Enablers" and the "Service Consumption Manifestations".

Please answer the following questions regarding the service consumption of your digital public service.

Figure 8: SIMAPS questionnaire Section C

Service Consumption Enablers

**Assesses the semantic behavioural interoperability capabilities that enable the digital public service to either i) discover other server services and/or ii) consume their data, information and knowledge*

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* **C3. To what extent does the digital public service apply specific rules to map the data, information and knowledge it consumes from other services?**
More Info

*Enabler / **Manifestation***

- ○ The digital public service does not apply any rules to map the data, information and knowledge consumed
- ○ The digital public service applies data mapping rules to map some of the data, information and knowledge consumed
- ○ The digital public service applies data mapping rules to map any of the data, information and knowledge consumed
- ○ The digital public service applies common semantic tools to map any data, information and knowledge consumed (e.g. mapping.semic.eu)
- ○ The digital public service applies rules, in open data format, to map any data, information and knowledge delivered

* **C4. To what extent does the digital public service consume machine-readable documentation about the data, information and knowledge consumed?**
More Info

Enabler / ***Manifestation***

Figure 9: SIMAPS questionnaire Section C

5.2 SIMAPS Questionnaire

5.2.1 Service Identification (A) - Questions

A1A.	
Name	Contact details
Question type	Free text
Rationale	Gather contact information for eventual follow-up.
Question	Please provide your name.
Question logic	Next question

A2A.	
Name	Contact details
Question type	Free text
Rationale	Gather contact information for eventual follow-up.
Question	Please provide your email address.
Question logic	Next question

A1C.	
Name	Contact details
Question type	Free text - format check on phone number
Rationale	Gather contact information for eventual follow-up.
Question	Please provide your phone number.
Question logic	Next question

A1D.	
Name	Contact details
Question type	Multiple choice (1 answer possible)
Rationale	Gather contact information for eventual follow-up.
Question	Please indicate the country of the organisation providing the digital public service.
Question logic	Next question

A2A.	
Name	Digital public service description
Question type	Open
Rationale	Gain insight into the digital public service the administration provides.
Question	A digital public service is a digital service rendered in the public interest. What is the name of the digital public service that you provide to the end users (citizens, businesses or other public administrations)?
Examples	Submission of yearly income tax declaration for citizens (administration-to-citizen); change of residence of a citizen (administration-to-citizen); online information provisioning on relevant jobs to citizens (administration-to-citizen);
Question logic	Next question

A2B.	
Name	Digital public service description
Question type	Open
Rationale	Gain insight into the digital public service the administration provides.
Question	Use the following criteria to define a digital public service: i) Process and underlying activities, ii) Appearance, iii) Owner (see A3). Please describe the process and underlying activities of the digital public service. The digital public service always has three phases (1. initiation, 2. processing and 3. delivery of an outcome). Focus on the public decision that is the outcome of the service. If there is no public decision and/or outcome, focus on the benefits the service provides to the target audience.
Examples	Providing classification services towards other administrations for ensuring international standardisation of patent data via a machine-to-machine interface (administration-to-administration).
Question logic	Next question

A2C.	
Name	Digital public service description
Question type	Multiple choice (1 answer possible)
Rationale	Gain insight into the digital public service the administration provides.
Question	Appearance: How does the digital public service deliver the outcome towards the end user group? • The public service does not deliver the outcome directly towards a person but towards other IT systems (machine-to-machine interface) • The public service delivers the outcome towards the end users via traditional channels e.g. phone, postal service • The public service delivers the outcome towards the end users via digital channels, e.g. through a web portal/website or an application
Question logic	Next question

A3.	
Name	Service owner
Question type	Multiple choice (1 answer possible)
Rationale	This question determines the scope / boundaries of the public administration providing the digital public service.
Question	Owner: Which public administration is primarily responsible for providing the digital public service? • Ministry e.g. Ministry of Public Administration, Ministry of Justice • Public Administration e.g. Tax Administration • Directorate-General of the European Commission e.g. DG COMM, DG JUST, DGIT • Government institution/agency/office e.g. National Agency for Information Society, National Centre for Public Administration and Local Government (EKDDA) • EU inistitution/agency/office e.g. EU Publications Office • Other Legal Entity
Question logic	Next question

A4.	
Name	Sector of the service
Question type	Multiple choice (1 answer possible)
Rationale	This question determines the scope / boundaries of the public administration providing the digital public service.
Question	Please indicate in which sector is the digital public service provided. • Education • Public Health • Public Safety • Environmental Protection • Justice • Transportation • Infrastructure • Social Services • Economy/Financial • Other
Question logic	Next question

A5.	
Name	End user group(s) to which the service is delivered
Question type	Multiple choice (>1 possible answer)
Rationale	Determine the end user group(s) to which the digital public service is delivered.
Question	What is the end user group to whom the digital public service is delivered? • Public Administrations (A2A) • Citizens (A2C) • Businesses (A2B)
Examples	A specific group of businesses; A specific group of citizens; A specific group of public administrations.
Question logic	Next question

A6.	
Name	Administrative level
Question type	Multiple choice (>1 possible answer)
Rationale	Gain insight into the government providing the digital public service.
Question	At what administrative level is the digital public service provided (multiple answers are possible)? • Local (e.g. city, municipality) • Regional • National • European • International
Question logic	Next question

Maturity scoring: This section is not scored.

5.2.2 Service Delivery (D) - Questions

D1.	
Name	Structure of the data delivered
Category	Enabler
Weight	50%
Question type	Multiple choice (1 answer possible)
Rationale	This item assesses whether and to what extent the digital public service delivers structured data, information and knowledge to its end users. Structured data is highly-organized and formatted in a way so it's easily searchable in relational databases. Unstructured data has no pre-defined format or organization, making it much more difficult to collect, process, and analyse. This item examines the semantic behavioural interoperability specifications of the data, information and knowledge delivered by the digital public service to its end users and/or other services. This item is compliant with the EIRA ABB Representation.
Question	To what extent does the digital public service deliver structured data, information and knowledge to its end users? • The digital public service does not deliver structured data, information and knowledge to its end users (i.e. it delivers unstructured data, like e.g. image files) • The digital public service delivers unstructured but partially machine-readable data, information and knowledge to its end users e.g. word and/or PDF files • The digital public service delivers structured data to its end users e.g. Excel, XML files • The digital public service delivers structured data to its end users, e.g. excel, XML files, according to an appropriate DTD (Data Type Definition) or schema • The digital public service delivers Linked Open Data (LOD) to its end users
Examples	• The digital public service uses structured format e.g. XML, JSON, csv or ustructured format e.g. blob/text to exchange data with other services • The digital public service uses widely-used formats such as MS Excel (.xls/.xlsx), MS Access (.mdb/.accdb), dBase (.dbf) and OpenDocument Spreadsheet (.ods) to exchange data with other services • The digital public service uses XML marked-up text (.xml) according to an appropriate DTD or schema, e.g. XHMTL 1.0 to exchange data with other services
Question logic	Next question

D2.	
Name	Commonly agreed standards for the semantic description of data delivery
Category	Enabler
Weight	50%
Question type	Multiple choice (1 answer possible)
Rationale	This item examines whether and to what extent the digital public service uses or extends commonly agreed standards for the delivered data, information and knowledge. This item examines the semantic behavioural interoperability specifications of the data, information and knowledge delivered by the digital public service to its end users and/or other services. This item is compliant with the EIRA ABB Semantic Interoperability Specification.
Question	To what extent does the digital public service use commonly agreed standards to semantically describe the data, information and knowledge delivered? (ontology, data model, data syntax, data format) • The digital public service does not use any commonly agreed standards to semantically describe the data, information and knowledge delivered • The digital public service uses custom standards to semantically describe some of the data, information and knowledge delivered • The digital public service uses custom standards to semantically describe most of the data, information and knowledge delivered (e.g. e-Government Core Vocabularies) • The digital public service uses formal standards to semantically describe any data, information and knowledge delivered (e.g. e-Government Core Vocabularies, Asset Description Metadata Schema (ADMS), Data Catalog Vocabulary Application Profile for Data Portals in Europe (DCAT-AP)), Core Public Service Vocabulary Application Profile (CPSV-AP), etc.) • The digital public service uses ontology classes to semantically describe any data, information and knowledge delivered
Examples	• The digital public service uses the DCAT Application Profile for Data Portals in Europe (DCAT-AP)) to capture the data exchanged • The digital public service uses the standard CPSV-AP to semantically describe the data exchanged and it has extended this standard using national data models.
Question logic	Next question

D3.	
Name	Data mapping
Category	Enabler
Weight	20%
Question type	Multiple choice (1 answer possible)
Rationale	This item examines whether there are rules for the data mapping between the digital public service and other services. In view of different data models (across different public services), this item seeks semantic alignments between the digital public service under assessment and its external environment. Semantic alignment lies in the use of a custom reference data model to translate/map the information from one data format (digital public service 1) to another data format (digital public service 2). It is a semantic agreement that takes place between two organisations / owners of the respective digital public services. This item is compliant with the EIRA v4.0.0 ABB 'Data mapping' which is an equivalence relationship between two data items with ontological value. This item examines a semantic behavioural interoperability capability that enables and facilitates the digital public service to deliver data information and knowledge towards its end users.
Question	To what extent does the digital public service provide rules to map the data, information and knowledge delivered? • The digital public service does not provide any rules to map the data, information and knowledge delivered • The digital public service provides data mapping rules to map some of the data, information and knowledge delivered • The digital public service provides data mapping rules to map any of the data, information and knowledge delivered • The digital public service provides common semantic tools to map any data, information and knowledge delivered (e.g. mapping.semic.eu) • The digital public service provides in open data format the rules to map any data, information and knowledge delivered
Examples	• The digital public service of the national police delivers data to the digital public service of electronic identities using common agreed data mapping specifications
Question logic	Next question

D4.	
Name	Documentation for the data delivery
Category	Enabler
Weight	20%
Question type	Multiple choice (1 answer possible)
Rationale	This item examines the documentation provided by the digital public service as a means to facilitate the end users in understanding and efficiently (re)using the digital outcome of the digital public service. This item examines a semantic behavioural interoperability capability that enables and facilitates the digital public service to deliver data information and knowledge towards its end users. This item is compliant with the EIRA ABB Semantic Interoperability Specification
Question	To what extent does the digital public service provide documentation about the data, information and knowledge delivered? • The digital public service does not provide any documentation about the delivered data, information and knowledge • The digital public service provides documentation about the delivered data, information and knowledge on an ad-hoc basis (upon request) • The digital public service provides documentation about the delivered data, information and knowledge via a custom channel (e.g. website) • The digital public service provides documentation about the delivered data, information and knowledge via multiple channels (e.g. open data portals/catalogues, website, etc.) • The digital public service provides documentation about the delivered data, information and knowledge via multiple channels (e.g. data portals/catalogues, website, etc.) and it offers a subscription service (e.g. for updates, support, etc.)
Examples	• Data formats and types of the digital public service are described in its functional specifications • Data and metadata formats and types of the digital public service are described in multiple documentations
Question logic	Next question

D5.	
Name	Multilingualism of the data delivered
Category	Enabler
Weight	20%
Question type	Multiple choice (1 answer possible)
Rationale	This item examines the availability of the digital public service documentation in more than one languages as a means to facilitate international and/or multilingual end users in understanding and efficiently (re)using the digital outcome of the digital public service in their language. This item examines a semantic behavioural interoperability capability that enables and facilitates the digital public service to deliver data information and knowledge towards its end users. This item is compliant with the EIRA ABB Semantic Interoperability Specification
Question	To what extent does the digital public service provide multilingual documentation about the data, information and knowledge delivered? • The digital public service does not provide any multilingual documentation about the data, information and knowledge delivered. • The digital public service provides documentation about the data, information and knowledge delivered in some of the officially recognised languages by the public administration delivering the digital public service. • The digital public service provides documentation about the data, information and knowledge delivered in all officially recognised languages by the public administration delivering the digital public service. • The digital public service provides documentation about the data, information and knowledge delivered in all officially recognised national languages, as well as in English and French • The digital public service provides documentation about the data, information and knowledge delivered in all EU officially recognised languages
Examples	• Data and metadata formats and types of the digital public service are described in multiple documentations and are available also in English
Question logic	Next question

D6.	
Name	Machine-readable documentation for the data delivered
Category	Manifestation
Weight	20%
Question type	Multiple choice (1 answer possible)
Rationale	This item examines the availability of the digital public service documentation in machine-readable format as a means to facilitate automatic-processing and efficient (re)use of the digital outcome (and respective metadata) of the digital public service. Machine readable documentation allows its automatic update, following the latest updates of the digital public service, in real-time, while it allows sharing the respective digital public service and/or its APIs automatically and in just seconds. This item examines a semantic behavioural interoperability capability that enables and facilitates the digital public service to deliver data information and knowledge towards its end users. This item is compliant with the EIRA ABB Semantic Interoperability Specification
Question	To what extent does the digital public service provide machine-readable documentation about the data, information and knowledge delivered? • The digital public service does not provide any documentation about the data, information and knowledge delivered. • The digital public service provides human-readable documentation about the data, information and knowledge delivered. • The digital public service provides ad-hoc machine-readable documentation about the data, information and knowledge delivered (e.g. provides an unformatted introduction and explanation of the data, information and knowledge delivered) • The digital public service provides formatted machine-readable documentation about the data, information and knowledge delivered (e.g. written in JSON). • The digital public service provides a standard formatted machine-readable documentation about the data, information and knowledge delivered (e.g. following an API schema).
Examples	• Agencies should list private, internal, and public-facing web APIs as part of their Enterprise Data Inventory and Public Data Listing data.json files. APIs can have machine readable documentation (like Swagger, RAML, API Blueprint, HAL, Hydra, etc). (https://resources.data.gov/)
Question logic	Next question

D7.	
Name	Use of metadata
Category	Enabler
Weight	20%
Question type	Multiple choice (1 answer possible)
Rationale	This item examimines whether metadata documentation is availble to give guidelines on how to reuse the data, information and knowledge delivered by the digital public service to its end users. Metadata documentation involves also policies and processes that ensure information can be integrated, accessed, shared, linked, analyzed and maintained to best effect across the organization. This item examines a semantic behavioural interoperability capability that enables and facilitates the digital public service to deliver data information and knowledge towards its end users. This item is compliant with the EIRA ABB Semantic Interoperability Specification
Question	• To what extent does the digital public service provide metadata documentation about the data, information and knowledge delivered? • The digital public service does not provide any metadata documentation about the data, information and knowledge delivered. • The digital public service provides ad-hoc metadata documentation about the data, information and knowledge delivered (e.g. high-level description). • The digital public service provides non-standardised metadata documentation about the data, information and knowledge delivered (e.g. information about the data elements, descriptions, etc. in an unformatted way) • The digital public service provides standardised metadata documentation about the data, information and knowledge delivered (e.g. in JSON format). • The digital public service provides standardised, semantically formatted metadata documentation about the data, information and knowledge delivered, published as a Metadata Application Profile (MAP) or in a metadata repository (e.g. in the form of codelists/taxonomies).
Examples	• ETL vendors offer metadata management applications for cataloging and managing ETL metadata, as well as metadata associated with source and target applications • The Eurovoc thesaurus and the European skills, competence and occupations (ESCO) taxonomy is a metadata taxonomy/code list • The Dublinked portal is DCAT-compliant, meaning that all its metadata is available in a standardised, semantic format. •
Question logic	Next question

D8.	
Name	Master data repository
Category	Manifestation
Weight	100%
Question type	Multiple choice (1 answer possible)
Rationale	This item assesses the level of reuse of existing, published data for the purpose of other digital public services. The greater the level of data reuse by other public services and by other public administrations, the better, as it ensures semantic interoperability among them. This item examines a semantic behavioural interoperability manifestation of the digital public service delivering data, information and knowledge towards its end users (in terms of user experience). This item is compliant with the EIRA ABB Shared Knowledge Base
Question	To what extent does the digital public service deliver data, information and knowledge that is input for a Master data repository? • The digital public service does not deliver data, information and knowledge to any Master data repository • The digital public service delivers basic data, information and knowledge to limited Master data repositories • The digital public service delivers data, information and knowledge to specific Master Data repositories • The digital public service delivers delivers data, information and knowledge to a national Master Data repository (e.g. business registry) • The digital public service delivers data, information and knowledge to a trans-European Master Data repository (e.g. reference data or base registry across borders)
Examples	• An example of market master data is the Universal Product Code ("UPC") found on consumer products • An example of master data source is the eID since EU citizens can use the eID means they use at national level also to access public services across borders in other Member States. • An example of master data source at national level is the online service of the Belgian government that generates the national registration number, which is is a unique identification number of natural persons who are registered in Belgium.
Question logic	Next question

Maturity scoring: The overall weight of this area in the total maturity score is 70%. For more information, please see section 7.3.

5.2.3 Service Consumption (C) - Questions

C1.	
Name	Structure of the data consumed
Category	Manifestation
Weight	50%
Question type	Multiple choice (1 answer possible)
Rationale	This item aims to assess the semantic behavioral interoperability specifications of the data, information and knowledge consumed by the digital public service, by examining the structure of the data consumed. We start from the structure (or lack of) of the data that the digital public service consumes from other services. It's the first specification to examine for the data/information/knowledge consumed from the digital public service under assessment. Structured data is highly-organized and formatted in a way so it's easily searchable in relational databases. Unstructured data has no pre-defined format or organization, making it much more difficult to collect, process, and analyze. This item examines the semantic behavioural interoperability specifications of data, information and knowledge consumed by the digital public service from other services. This item is compliant with the EIRA ABB Representation
Question	To what extent does the digital public service consume structured data, information and knowledge from other services or end users? • The digital public service consumes unstructured data, information and knowledge (e.g. image files) • The digital public service consumes unstructured but partially machine-readable data, information and knowledge (e.g. word files, PDFs, etc.) • The digital public service consumes structured data e.g. Excel, XML files • The digital public service consumes structured data, e.g. excel, XML files, according to an appropriate DTD (Data Type Definition) or schema • The digital public service consumes Linked Open Data (LOD)
Examples	• The digital public service consumes structured format e.g. XML, JSON, csv or ustructured format e.g. blob/text to exchange data with other services • The digital public service consumes widely-used formats such as MS Excel (.xls/.xlsx), MS Access (.mdb/.accdb), dBase (.dbf) and OpenDocument Spreadsheet (.ods) to exchange data with other services • The digital public service consumes XML marked-up text (.xml) according to an appropriate DTD or schema, e.g. XHMTL 1.0 to exchange data with other services
Question logic	Next question

C2.	
Name	Commonly agreed standards for the semantic description of data consumption
Category	Enabler
Weight	50%
Question type	Multiple choice (1 answer possible)
Rationale	This item examines whether and to what extent the digital public service uses or extends commonly agreed standards for to consume data, information and knowledge. This item examines the semantic behavioural interoperability specifications of data, information and knowledge consumed by the digital public service from other services. This item is compliant with the EIRA ABB Semantic Interoperability Specification
Question	To what extent does the digital public service use commonly agreed standards to semantically align the data, information and knowledge consumed? (ontology, data model, data syntax, data format) • The digital public service does not use any commonly agreed standards to semantically align the data, information and knowledge consumed • The digital public service uses custom standards to semantically align some of the data, information and knowledge consumed • The digital public service uses formal standards to semantically align most of the data, information and knowledge consumed (e.g. e-Government Core Vocabularies) • The digital public service uses formal standards to semantically align any data, information and knowledge consumed (e.g. e-Government Core Vocabularies, Asset Description Metadata Schema (ADMS) or DCAT Application Profile for Data Portals in Europe (DCAT-AP)), CPSV-AP, etc.) • The digital public service uses ontology classes to semantically describe any data, information and knowledge consumed
Examples	• National banks consumes data from the electronic administrative fee under a semantic alignment using custom data models • The digital public service of electronic identities consumes data from other services using ftp server FileZilla
Question logic	Next question

C3.	
Name	Data mapping in consumption
Category	Manifestation
Weight	50%
Question type	Multiple choice (1 answer possible)
Rationale	This item assesses the semantic behavioral interoperability specifications of the data, information and knowledge consumed by the digital public service, by examining whether there are any rules for the data mapping between the digital public service and other services. In view of different data models (across different public services), we ask about semantic alignments between the digital public service that we examine and its external environment (i.e. from where it consumes). Semantic alignment lies in the use of a custom reference data model to translate/map the information from one data format (digital public service 1) to another data format (digital public service 2). It is a semantic agreement that takes place between two organisations / owners of the respective digital public services. This item examines a semantic behavioural interoperability capability that enables the digital public service to consume data, information and knowledge that are already reusable, preferably in an automated manner. This item is compliant with the EIRA ABB Data Mapping.
Question	To what extent does the digital public service apply specific rules to map the data, information and knowledge it consumes from other services? • The digital public service does not apply any rules to map the data, information and knowledge consumed • The digital public service applies data mapping rules to map some of the data, information and knowledge consumed • The digital public service applies data mapping rules to map any of the data, information and knowledge consumed • The digital public service applies common semantic tools to map any data, information and knowledge consumed (e.g. mapping.semic.eu) • The digital public service applies rules, in open data format, to map any data, information and knowledge delivered
Examples	• The digital public service of the national police delivers data to the digital public service of electronic identities using common agreed data mapping specifications
Question logic	Next question

C4.	
Name	Machine-readable documentation for the data consumed
Category	Manifestation
Weight	50%
Question type	Multiple choice (1 answer possible)
Rationale	This item assesses the semantic behavioral interoperability capabilities that enable the digital public service consumption from other services by examimining how the digital public service processes the metadata consumed from other services. Management of the metadata involves establishing policies and processes that ensure information can be integrated, accessed, shared, linked, analyzed and maintained to best effect across the organization. This item examines a semantic behavioural interoperability capability that enables the digital public service to consume data, information and knowledge that are already reusable, preferably in an automated manner. This item is compliant with the EIRA ABB Semantic Interoperability Specification
Question	To what extent does the digital public service consume machine-readable documentation about the data, information and knowledge consumed? • The digital public service does not consume any documentation about the data, information and knowledge consumed. • The digital public service consumes human-readable documentation about the data, information and knowledge consumed. • The digital public service consumes ad-hoc machine-readable documentation about the data, information and knowledge consumed (e.g. provides an unformatted introduction and explanation of the data, information and knowledge consumed). • The digital public service consumes formatted machine-readable documentation about the data, information and knowledge consumed (e.g. written in JSON). • The digital public service consumes a standard formatted machine-readable documentation about the data, information and knowledge consumed (e.g. following an API schema).
Examples	• ETL vendors offer metadata management applications for cataloging and managing ETL metadata, as well as metadata associated with source and target applications • The Eurovoc thesaurus and the European skills, competence and occupations (ESCO) taxonomy is a metadata taxonomy/code list • The Dublinked portal is DCAT-compliant, meaning that all its metadata is available in a standardised, semantic format.
Question logic	Next question

C5.	
Name	Master data repository in consumption
Category	Manifestation
Weight	100%
Question type	Multiple choice (1 answer possible)
Rationale	This item aims to assess how the digital public service manifests its semantic behavioral interoperability performance towards its end users. This item examines whether the digital public service consumes data from Master data sources. The greater the level of data reuse by other public services and by other public administrations, the better, as it ensures semantic interoperability among them. This item examines a semantic behavioural interoperability manifestation of the digital public service consuming data, information and knowledge (in terms of performance). This item is compliant with the EIRA ABB Shared Knowledge Base
Question	To what extent does the digital public service consume data, information and knowledge from a Master data repository? • The digital public service does not consume data, information and knowledge from any Master data repository • The digital public service consumes basic data, information and knowledge from limited Master data repositories • The digital public service consumes data, information and knowledge from specific Master Data repositories • The digital public service consumes delivers data, information and knowledge from a national Master Data repository (e.g. business registry) • The digital public service consumes data, information and knowledge from a trans-European Master Data repository (e.g. reference data or base registry across borders)
Examples	• An example of master data source is the eID since EU citizens can use the eID means they use at national level also to access public services across borders in other Member States. • An example of master data source at national level is the online service of the Belgian government that generates the national registration number, which is a unique identification number of natural persons who are registered in Belgium.
Question logic	Next question

Maturity scoring: The overall weight of this area in the total maturity score is 30%. For more information, please see section 7.3.

6 SIMAPS RECOMMENDATIONS

The main objective of the **Semantic Interoperability Maturity Assessment of Public Services (SIMAPS)** is to provide insight into how digital public services can improve their semantic behavioral interoperability maturity. After filling in the online questionnaire, the respondent receives a PDF with advice on how to improve the semantic behavioral interoperability of his digital public service. This section presents how these recommendations are generated.

6.1 Principles

The following five principles are applied to generate recommendations:

- **Principle 1:** Each semantic interoperability attribute differentiates between at least two maturity levels;
- **Principle 2:** The improvement tables provide recommendations on how to improve maturity gradually for a specific semantic interoperability attribute;
- **Principle 3:** When a digital public service does not yet reach the maximum level for a specific semantic interoperability attribute, a recommendation is given to make the step towards the next semantic interoperability level;
- **Principle 4:** When a digital public service successfully attains the maximum maturity level for a semantic interoperability attribute, no recommendation is given[8];
- **Principle 5**: When the maturity improvement is not based on specific semantic interoperability characteristics per level, a sliding scale (e.g. from less to more) is used. In this scenario, a generic recommendation (not maturity level specific) is given to improve the maturity further along the sliding scale.

6.2 Recommendations overview

For each improvement step, the recommendation tables in the following chapters show:

- The question the recommendation relates to;
- The assessed maturity level;
- The next maturity level to be reached through improvement[9];
- The recommendation as to how to reach the next maturity level.

[8] The reason for this is that in this case- according to the model- the service is already implementing a semantic interoperability attribute in a way that it corresponds to best practice. There are no direct recommendations to improve further

[9] With the exception when this is considered a sliding scale

6.3 Recommendations

6.3.1 Service Delivery (D) – Scoring table

Table 3: Service Delivery scoring model

Item	Ad hoc (1)	Opportunistic (2)	Essential (3)	Sustainable (4)	Seamless (5)
D1	The digital public service does not deliver structured data, information and knowledge to its end users (i.e. it delivers unstructured data, like e.g. **image files)**	The digital public service delivers unstructured but partially machine-readable data, information and knowledge to its end users e.g. **word and/or PDF files**	The digital public service delivers structured data to its end users e.g. **Excel, XML files**	The digital public service delivers structured data to its end users, e.g. excel, XML files, **according to an appropriate DTD (Data Type Definition) or schema**	The digital public service delivers **Linked Open Data (LOD)** to its end users
D2	The digital public service **does not use any** commonly agreed standards to semantically describe the data, information and knowledge delivered	The digital public service uses **custom** standards to semantically describe **some of the** data, information and knowledge delivered	The digital public service uses **custom** standards to semantically describe **most of the** data, information and knowledge delivered (e.g. e-Government Core Vocabularies)	The digital public service **uses formal standards** to semantically describe **any** data, information and knowledge delivered (e.g. e-Government Core Vocabularies, Asset Description Metadata Schema (ADMS), Data Catalog Vocabulary Application Profile for Data Portals in Europe (DCAT-AP)), Core Public Service Vocabulary Application Profile (CPSV-AP), etc.)	The digital public service **uses formal standards** to semantically describe **any** data, information and knowledge delivered (e.g. e-Government Core Vocabularies, Asset Description Metadata Schema (ADMS), Data Catalog Vocabulary Application Profile for Data Portals in Europe (DCAT-AP)), Core Public Service Vocabulary Application Profile (CPSV-AP), etc.)

D3	The digital public service **does not provide any** rules to map the data, information and knowledge delivered	The digital public service provides **data mapping** rules to map **some of** the data, information and knowledge delivered	The digital public service **provides** data mapping rules to map **any** of the data, information and knowledge delivered	The digital public service **provides common semantic tools** to map **any** data, information and knowledge delivered (e.g. mapping.semic.eu)	The digital public service **provides** in open data format the rules to map **any** data, information and knowledge delivered
D4	The **digital public service does not provide** any documentation about the delivered data, information and knowledge	The **digital public service provides documentation** about **the** delivered data, information and knowledge **on an ad-hoc basis (upon request)**	The **digital public service provides documentation** about the delivered data, information and knowledge **via a custom channel (e.g. website)**	The **digital public service provides documentation** about the delivered data, information and knowledge **via multiple channels (e.g. open data portals/catalogues, website, etc.)**	The **digital public service provides documentation** about the delivered data, information and knowledge **via multiple channels** (e.g. data portals/catalogues, website, etc.) and it offers **a subscription service** (e.g. for updates, support, etc.)
D5	The digital public service **does not provide any multilingual documentation** about the data, information and knowledge delivered.	The digital public service **provides documentation about the data**, information and knowledge delivered **in some of the officially recognised languages** by the public administration delivering the digital public service.	The digital public service provides documentation about the data, information and knowledge delivered in **all officially recognised languages** by the public administration delivering the digital public service.	The digital public service provides documentation about the data, information and knowledge delivered in all officially recognised national languages, as well as in English and French	The digital public service provides documentation about the data, information and knowledge delivered in **all EU officially** recognised languages

D6	The digital public service **does not provide any documentation** about the data, information and knowledge delivered.	The digital public service **provides human-readable documentation about the data**, information and knowledge delivered.	The digital public service provides **ad-hoc machine-readable documentation about** the data, information and knowledge delivered (e.g. provides an unformatted introduction and explanation of the data, information and knowledge delivered)	The digital public service provides **formatted machine-readable documentation about** the data, information and knowledge delivered (e.g. written in JSON).	The digital public service provides **a standard formatted machine-readable documentation** about the data, information and knowledge delivered (e.g. following an API schema).
D7	The digital public service d**oes not provide any metadata documentation** about the data, information and knowledge delivered.	The digital public service provides **ad-hoc metadata documentation** about the data, information and knowledge delivered (e.g. high-level description).	The digital public service provides **non-standardised metadata documentation** about the data, information and knowledge delivered (e.g. information about the data elements, descriptions, etc. in an unformatted way)	The digital public service provides **standardised metadata** documentation about the data, information and knowledge delivered (e.g. in JSON format).	The digital public service provides **standardised, semantically formatted metadata documentation** about the data, information and knowledge delivered, published as a **Metadata Application Profile (MAP)** or in a **metadata repository** (e.g. in the form of codelists/taxonomies).
D8	The digital public service **does not deliver** data, information and knowledge **to any** Master data repository	The digital public service delivers **basic** data, information and knowledge to **limited** Master data repositories	The digital public service delivers data, information and knowledge to **specific** Master Data repositories	The digital public service delivers delivers data, information and knowledge **to a national** Master Data repository (e.g. business registry)	The digital public service delivers data, information and knowledge **to a trans-European Master Data repository** (e.g. reference data or base registry across borders)

6.3.2 Service Delivery (D) – Recommendations

The table below presents the respective recommendation to each option in SIMAPS questionnaire. As mentioned above, the purpose of the recommendations is to propose the needed actions to be taken by the digital public service owners in order to **achieve a higher level of semantic interoperability maturity**.

In case the selected option is associated to "Seamless level (5)", then no action is required from the public service owners and the recommendation is by default "Congratulations, you are at the Seamless level".

Table 4: Service Delivery Recommendations

Question	Addressed Level	Next Level	Recommendation
D1.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service delivers unstructured data, information and knowledge to its end users. Although they might be human-readable, they are not machine-readable. Consider performing the necessary actions so as to enable the digital public service to deliver data, information and knowledge in a machine-readable and processable format (e.g. PDF, word files, etc.).
	Opportunistic (2)	Essential (3)	Currently, the digital public service delivers machine-readable but unstructured data, information and knowledge to its end users. Consider performing the necessary actions so as to enable the digital public service to deliver machine-readable and structured data, information and knowledge to its end users (e.g. excel, XML files, etc.).
	Essential (3)	Sustainable (4)	Currently, the digital public service delivers machine-readable and structured data, information and knowledge to its end users. Consider performing the necessary actions so as to enable the digital public service to follow a commonly agreed DTD (Data Type Definition) or schema (e.g. XSD - SML schema)) to deliver structured, machine-readable data, information and knowledge to its end users.
	Sustainable (4)	Seamless (5)	Currently, the digital public service delivers machine-readable and structured data, information and knowledge to its end users, following a commonly agreed DTD (Data Type Definition) or schema (e.g. XSD - SML schema). Consider performing the necessary actions so as to enable the digital public service to have connected and enriched metadata so that different representations of the same content can be found, and links made between related resources.
D2.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not use any commonly agreed standards to semantically describe the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to use custom standards to semantically describe some of the data, information and knowledge delivered.

	Opportunistic (2)	Essential (3)	Currently, the digital public service uses custom standards to semantically describe some of the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to use standards such as e-Government Core Vocabularies to semantically describe most of the data, information and knowledge delivered.
	Essential (3)	Sustainable (4)	Currently, the digital public service uses standards such as e-Government Core Vocabularies to semantically describe most of the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to use formal standards to semantically describe any data, information and knowledge delivered (e.g. ADMS, DCAT-AP, CPSV-AP, etc.).
	Sustainable (4)	Seamless (5)	Currently, the digital public service uses formal standards to semantically describe any data, information and knowledge delivered (e.g. ADMS, DCAT-AP, CPSV-AP, etc.). Consider performing the necessary actions so as to enable the digital public service to use ontology classes to semantically describe any data, information and knowledge delivered.
D3.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not provide any rules to map the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to provide data mapping rules to map some of the data, information and knowledge delivered. This refinement, will enable limited semantic behavioral interoperability with some of its end users.
	Opportunistic (2)	Essential (3)	Currently, the digital public service provides data mapping rules to map some of the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to provide data mapping rules to map any of the data, information and knowledge delivered.
	Essential (3)	Sustainable (4)	Currently, the digital public service provides data mapping rules to map any of the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to provide common semantic tools to map any data, information and knowledge delivered (e.g. mapping.semic.eu).

	Sustainable (4)	Seamless (5)	Currently, the digital public service provides common semantic tools to map any data, information and knowledge delivered (e.g. mapping.semic.eu). Consider performing the necessary actions so as to enable the digital public service to provide in open data format the rules to map any data, information and knowledge delivered.
D4.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not provide any documentation on the delivered data, information and knowledge. Consider performing the necessary actions so as to enable the digital public service to provide documentation about the delivered data, information and knowledge on an ad-hoc basis (upon request).
	Opportunistic (2)	Essential (3)	Currently, the digital public service provides documentation about the delivered data, information and knowledge on an ad-hoc basis (upon request). Consider performing the necessary actions so as to enable the digital public service to provide documentation about the delivered data, information and knowledge via a custom channel (e.g. website).
	Essential (3)	Sustainable (4)	Currently, the digital public service provides documentation about the delivered data, information and knowledge via a custom channel (e.g. website). Consider performing the necessary actions so as to provide documentation about the delivered data, information and knowledge via multiple channels (e.g. open data portals/catalogues, website, etc.)
	Sustainable (4)	Seamless (5)	Currently, the digital public service provides documentation about the delivered data, information and knowledge via multiple channels (e.g. data portals/catalogues, website, etc.). Consider performing the necessary actions so as to enable the digital public service to provide documentation about the delivered data, information and knowledge via multiple channels (e.g. data portals/catalogues, website, etc.) also offering a subscription service (e.g. for updates, support, etc.)
D5.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not provide any multilingual documentation on the delivered data, information and knowledge. Consider performing the necessary actions so as to enable the digital public service to provide documentation about the data, information and knowledge delivered in some of the officially recognised languages by the public administration delivering the digital public service.

	Opportunistic (2)	Essential (3)	Currently, the digital public service provides documentation about the data, information and knowledge delivered in some of the officially recognised languages by the public administration delivering the digital public service. Consider performing the necessary actions so as to enable the digital public service to provide documentation about the data, information and knowledge delivered in all officially recognised languages by the public administration delivering the digital public service.
	Essential (3)	Sustainable (4)	Currently, the digital public service provides documentation about the data, information and knowledge delivered in all officially recognised languages by the public administration delivering the digital public service. Consider performing the necessary actions so as to enable the digital public service to provide documentation about the data, information and knowledge delivered in all officially recognised national languages, as well as in English and French.
	Sustainable (4)	Seamless (5)	Currently, the digital public service provides documentation about the data, information and knowledge delivered in all officially recognised national languages, as well as in English and French. Consider performing the necessary actions so as to enable the digital public service to provide documentation about the data, information and knowledge delivered in all EU officially recognised languages.
D6.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not provide any documentation about the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to provide, at least, human-readable documentation about the data, information and knowledge delivered.
	Opportunistic (2)	Essential (3)	Currently, the digital public service provides human-readable documentation about the data, information and knowledge delivered.. Consider performing the necessary actions so as to enable the digital public service to provide, at least, ad-hoc machine-readable documentation about the data, information and knowledge delivered (e.g. provides an unformatted introduction and explanation of the data, information and knowledge delivered)

	Essential (3)	Sustainable (4)	Currently, the digital public service provides ad-hoc machine-readable documentation about the data, information and knowledge delivered (e.g. provides an unformatted introduction and explanation of the data, information and knowledge delivered). Consider performing the necessary actions so as to enable the digital public service to provide formatted machine-readable documentation about the data, information and knowledge (e.g. written in JSON).
	Sustainable (4)	Seamless (5)	Currently, the digital public service provides formatted machine-readable documentation about the data, information and knowledge delivered (e.g. written in JSON). Consider performing the necessary actions so as to enable the digital public service to provide a standard formatted machine-readable documentation about the data, information and knowledge delivered (e.g. following an API schema).
D7.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not provide any metadata documentation about the data, information and knowledge delivered. Consider performing the necessary actions so as to enable the digital public service to provide, at least, ad-hoc metadata documentation about the data, information and knowledge delivered (e.g. high-level description).
	Opportunistic (2)	Essential (3)	Currently, the digital public service provides ad-hoc metadata documentation about the data, information and knowledge delivered (e.g. high-level description). Consider performing the necessary actions so as to enable the digital public service to provide, at least, non-standardised metadata documentation about the data, information and knowledge delivered (e.g. information about the data elements, descriptions, etc. in an unformatted way).
	Essential (3)	Sustainable (4)	Currently, the digital public service provides non-standardised metadata documentation about the data, information and knowledge delivered (e.g. information about the data elements, descriptions, etc. in an unformatted way). Consider performing the necessary actions so as to enable the digital public service to provide standardised metadata documentation about the data, information and knowledge delivered (e.g. in JSON format).

	Sustainable (4)	Seamless (5)	Currently, the digital public service provides standardised metadata documentation about the data, information and knowledge delivered (e.g. in JSON format). Consider performing the necessary actions so as to enable the digital public service to provide standardised, semantically formatted metadata documentation about the data, information and knowledge delivered, published as a Metadata Application Profile (MAP) or in a metadata repository (e.g. in the form of codelists/taxonomies).
D8.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not deliver data, information and knowledge to any Master data repository. Consider performing the necessary actions so as to enable the digital public service to deliver basic data, information and knowledge to limited Master data repositories.
	Opportunistic (2)	Essential (3)	Currently, the digital public service delivers basic data, information and knowledge to limited Master data repositories. Consider performing the necessary actions so as to enable the digital public service to deliver data, information and knowledge to specific Master Data repositories.
	Essential (3)	Sustainable (4)	Currently, the digital public service delivers data, information and knowledge to specific Master Data repositories. Consider performing the necessary actions so as to enable the digital public service to deliver data, information and knowledge to a national Master Data repository (e.g. business registry).
	Sustainable (4)	Seamless (5)	Currently, the digital public service delivers delivers data, information and knowledge to a national Master Data repository (e.g. business registry). Consider performing the necessary actions so as to enable the digital public service to deliver data, information and knowledge to a trans-European Master Data repository (e.g. reference data or base registry across borders).

6.3.3 Service Consumption (C) – Scoring table

Table 5: Service Consumption scoring model

Item	Ad hoc (1)	Opportunistic (2)	Essential (3)	Sustainable (4)	Seamless (5)
C1	The digital public service consumes unstructured data, information and knowledge (e.g. image files)	The digital public service consumes unstructured but partially machine-readable data, information and knowledge (e.g. word files, PDFs, etc.)	The digital public service consumes structured data e.g. Excel, XML files	The digital public service consumes structured data, e.g. excel, XML files, according to an appropriate DTD (Data Type Definition) or schema	The digital public service consumes Linked Open Data (LOD)
C2	The digital public service does not use any commonly agreed standards to semantically align the data, information and knowledge consumed	The digital public service uses custom standards to semantically align some of the data, information and knowledge consumed	The digital public service uses formal standards to semantically align most of the data, information and knowledge consumed (e.g. e-Government Core Vocabularies)	The digital public service uses formal standards to semantically align any data, information and knowledge consumed (e.g. e-Government Core Vocabularies, Asset Description Metadata Schema (ADMS) or DCAT Application Profile for Data Portals in Europe (DCAT-AP)), CPSV-AP, etc.)	The digital public service uses ontology classes to semantically describe any data, information and knowledge consumed
C3	The digital public service does not apply any rules to map the data, information and knowledge consumed	The digital public service applies data mapping rules to map some of the data, information and knowledge consumed	The digital public service applies data mapping rules to map any of the data, information and knowledge consumed	The digital public service applies common semantic tools to map any data, information and knowledge consumed (e.g. mapping.semic.eu)	The digital public service applies rules, in open data format, to map any data, information and knowledge delivered

C4	The digital public service does not consume any documentation about the data, information and knowledge consumed.	The digital public service consumes human-readable documentation about the data, information and knowledge consumed.	The digital public service consumes ad-hoc machine-readable documentation about the data, information and knowledge consumed (e.g. provides an unformatted introduction and explanation of the data, information and knowledge consumed).	The digital public service consumes formatted machine-readable documentation about the data, information and knowledge consumed (e.g. written in JSON).	The digital public service consumes a standard formatted machine-readable documentation about the data, information and knowledge consumed (e.g. following an API schema).
C5	The digital public service does not consume data, information and knowledge from any Master data repository	The digital public service consumes basic data, information and knowledge from limited Master data repositories	The digital public service consumes data, information and knowledge from specific Master Data repositories	The digital public service consumes delivers data, information and knowledge from a national Master Data repository (e.g. business registry)	The digital public service consumes data, information and knowledge from a trans-European Master Data repository (e.g. reference data or base registry across borders)

6.3.4 Service Consumption (C) – Recommendations

Table 6: Service Consumption Recommendations

Question	Addressed Level	Next Level	Recommendation
C1.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service consumes unstructured data, information and knowledge. Although they might be human-readable, they are not machine-readable. Consider performing the necessary actions so as to enable the digital public service to consume data, information and knowledge in a machine-readable and processable format (e.g. PDF, word files, etc.).
	Opportunistic (2)	Essential (3)	Currently, the digital public service consumes machine-readable but unstructured data, information and knowledge to its end users. Consider performing the necessary actions so as to enable the digital public service to consume machine-readable and structured data, information and knowledge from client services (e.g. excel, XML files, etc.).
	Essential (3)	Sustainable (4)	Currently, the digital public service consumes machine-readable and structured data, information and knowledge to its end users. Consider performing the necessary actions so as to enable the digital public service to follow a commonly agreed DTD (Data Type Definition) or schema (e.g. XSD - SML schema)) to consume structured, machine-readable data, information and knowledge from client services.
	Sustainable (4)	Seamless (5)	Currently, the digital public consumes machine-readable and structured data, information and knowledge, following a commonly agreed DTD (Data Type Definition) or schema (e.g. XSD - SML schema)). Consider performing the necessary actions so as to enable the digital public service to consume connected and enriched metadata so that different representations of the same content can be found, and links made between related resources.
C2.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not use any commonly agreed standards to semantically align the data, information and knowledge consumed. Consider performing the necessary actions so as to enable the digital public service to use custom standards to semantically align some of the data, information and knowledge consumed.
	Opportunistic (2)	Essential (3)	Currently, the digital public service uses custom standards to semantically align some of the data, information and knowledge consumed. Consider performing the necessary actions so as to enable the digital public service to use standards such as e-Government Core Vocabularies to semantically align most of the data, information and knowledge consumed.

	Essential (3)	Sustainable (4)	Currently, the digital public service uses standards such as e-Government Core Vocabularies to semantically align most of the data, information and knowledge consumed. Consider performing the necessary actions so as to enable the digital public service to use standards such as e-Government Core Vocabularies, Asset Description Metadata Schema (ADMS) or DCAT Application Profile for Data Portals in Europe (DCAT-AP)), CPSV-AP to semantically align any data, information and knowledge consumed.
	Sustainable (4)	Seamless (5)	Currently, the digital public service uses standards to semantically align any data, information and knowledge consumed (like ADMS, DCAT-AP, CPSV-AP, etc.). Consider performing the necessary actions so as to enable the digital public service to use ontology classes to semantically align any data, information and knowledge consumed.
C3.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not apply any rules to map the data, information and knowledge consumed. Consider performing the necessary actions so as to enable the digital public service to apply data mapping rules to map some of the data, information and knowledge delivered.
	Opportunistic (2)	Essential (3)	Currently, the digital public service applies data mapping rules to map some of the data, information and knowledge consumed Consider performing the necessary actions so as to enable the digital public service to apply data mapping rules to map any of the data, information and knowledge consumed.
	Essential (3)	Sustainable (4)	Currently, the digital public service applies data mapping rules to map any of the data, information and knowledge consumed Consider performing the necessary actions so as to enable the digital public service to apply common semantic tools to map any data, information and knowledge consumed (e.g. mapping.semic.eu).
	Sustainable (4)	Seamless (5)	Currently, the digital public service applies common semantic tools to map any data, information and knowledge consumed (e.g. mapping.semic.eu). Consider performing the necessary actions so as to enable the digital public service to apply rules, in open data format, to map any data, information and knowledge consumed.
C4.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not consume any documentation about the data, information and knowledge consumed. Consider performing the necessary actions so as to enable the digital public service to consume, at least, human-readable documentation about the data, information and knowledge consumed.

	Opportunistic (2)	Essential (3)	Currently, the digital public service consumes human-readable documentation about the data, information and knowledge consumed. Consider performing the necessary actions so as to enable the digital public service to be able to consume, at least, human-readable documentation about the data, information and knowledge consumed.
	Essential (3)	Sustainable (4)	Currently, the digital public service consumes ad-hoc machine-readable documentation about the data, information and knowledge consumed (e.g. provides an unformatted introduction and explanation of the data, information and knowledge consumed). Consider performing the necessary actions so as to enable the digital public service to consume formatted machine-readable documentation about the data, information and knowledge consumed (e.g. written in JSON).
	Sustainable (4)	Seamless (5)	Currently, the digital public service consumes formatted machine-readable documentation about the data, information and knowledge consumed (e.g. written in JSON). Consider performing the necessary actions so as to enable the digital public service to consume a standard formatted machine-readable documentation about the data, information and knowledge consumed (e.g. following an API schema).
C5.	Ad hoc (1)	Opportunistic (2)	Currently, the digital public service does not consume data, information and knowledge from any Master data repository Consider performing the necessary actions so as to enable the digital public service to deliver basic data, information and knowledge to limited Master data repositories.
	Opportunistic (2)	Essential (3)	Currently, the digital public service consumes basic data, information and knowledge from limited Master data repositories. Consider performing the necessary actions so as to enable the digital public service to consume data, information and knowledge from specific Master Data repositories.
	Essential (3)	Sustainable (4)	Currently, the digital public service consumes data, information and knowledge from specific Master Data repositories. Consider performing the necessary actions so as to enable the digital public service to consume data, information and knowledge from a national Master Data repository (e.g. business registry).
	Sustainable (4)	Seamless (5)	Currently, the digital public service consumes delivers data, information and knowledge from a national Master Data repository (e.g. business registry). Consider performing the necessary actions so as to enable the digital public service to consume data, information and knowledge from a trans-European Master Data repository (e.g. reference data or base registry across borders).