European Commission

Directorate - General for Informatics
Directorate B – Digital Services
DIGIT B2 - Interoperability

Digital Europe Programme

D05.04 - Analysis of ABR practices at international level and dissemination activities

Action 'Promoting semantic interoperability amongst the European Union Member States (SEMIC)'

Specific Contract 098 under Framework Contract BEACON

Date: 15/10/2024

Doc. Version: v1.0

DOCUMENT CONTROL INFORMATION

Settings	Value
Document Title:	**Analysis of ABR practices at international level and dissemination activities**
Project Title:	Action 'Promoting semantic interoperability amongst the European Union Member States (SEMIC)'
Document Author(s):	Emilien Caudron Natasa Sofou Jean-Christophe Haffner
Project Manager (European Commission):	Alexandra Balahur, Georges Lobo
Contractor's Project Manager (CPM):	Catarina Arnaut
Doc. Version:	1.0
Sensitivity:	Limited
Date:	15/10/2024

REVISION HISTORY

Date	Version	Description	Author(s)
23/07/2024	0.1	First version for review	Jean-Christophe Haffner Emilien Caudron
16/09/2024	0.1	Reviewed by Natasa Sofou	Jean-Christophe Haffner Emilien Caudron
14/10/2024	0.2	Reviewed by interviewed countries	Jean-Christophe Haffner Emilien Caudron
15/10/2024	1.0	Created version 1.0 for publication	Jean-Christophe Haffner Emilien Caudron

DOCUMENT LOCATION

The latest version of this controlled document is stored in Confluence.

Table of Contents

Glossary

Full name	Abbreviation
Access to Base Registries	ABR
Base Registries	BR
Base Registries Access and Interconnection Framework	BRAIF
European Commission	EC
European Union	EU
Interoperability solutions for public administrations, businesses, and citizens	ISA^2
National Interoperability Framework Observatory	NIFO
Semantic Interoperability Community	SEMIC
European Interoperability Framework	EIF

1. Introduction

1.1. Context and scope of this document

Base Registries (BR) are trusted and authoritative sources of basic information, the "master data" of public administration such as birth certificates, company registry, building locations or vehicles license plates. In 2016, the Access to Base Registries (ABR) action was initiated by the ISA[2] program to facilitate the access and exchange of this information at both national and cross-border levels.

Over the years, several activities have been undertaken by the European Commission (EC) as part of the ABR initiative to develop various supporting tools that would favour the interconnection of Base Registries across the European Union. Today, activities and tools published around the ABR initiatives can be categorised into five non-exhaustive practices:

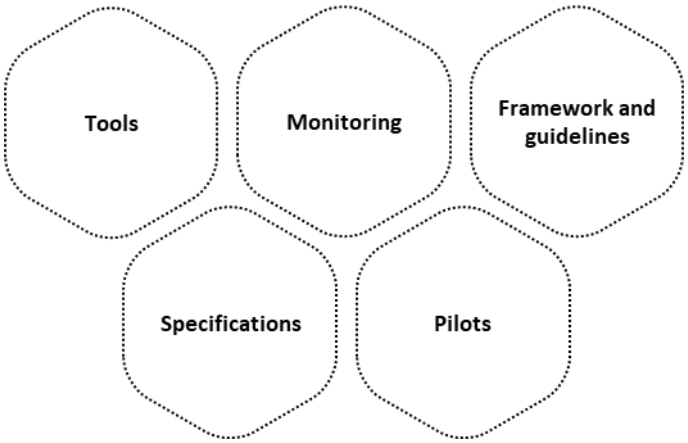

Figure 1: List of elements for ABR practices

In the course of 2023, the Semantic Interoperability Community (SEMIC) Action took over the work conducted under ISA² thereby integrating ABR into the wider framework of DIGIT B services to support public services interoperability. During the two previous phases of SEMIC, different actions have been initiated to shape the future of the ABR initiative including this study, which was conducted to expand the knowledge and understanding on ABR use cases and practices outside of the European Union. A particular focus was put on identifying specific use cases, needs, and challenges in countries in accession to the EU.

To build the study, the SEMIC team relied on a combination of desk research and semi-structured interviews organised with officials in charge of public data and public services digitalisation in six different countries (Albania, Bosnia and Herzegovina, Moldova, North Macedonia, Türkiye, and Serbia).

The purpose of this document is to report on the findings from the study.

1.2. Objectives of the study

The objectives of the study are the following:

- Provide an overview of BR access and interconnection outside of the EU.
- Identify needs, challenges, and lessons learnt.
- Identify possible actions or scenarios for the future of ABR at SEMIC.

1.3. Structure of the deliverable

The document includes the following chapters, each one touching upon a different step of the analysis conducted by the SEMIC team:

- Chapter 2 presents the current state of BR outside of the EU. In this chapter, the main insights and information collected through the desk research and interviews from six countries are described.
- Chapter 3 derives suggested actions for ABR in the EU based on the analysis made in chapter 1. Based on a summary of the different use cases identified in countries in accession, the chapter identifies the main needs related to base registries and defines potential solutions that could support Member States in the future.

2. Access to Base Registries outside of the EU: State of the art

Chapter 2 of this report provides an overview of ABR beyond the borders of the European Union. It presents a summary of the key findings obtained through the data collection process. As mentioned earlier, the purpose of this data collection was to gather information on the use cases and practices of BR in countries in the process of accession.

2.1. Access to Base Registries use cases

The purpose of this section is to explore the reasons why countries outside of the EU need to prioritise access and interconnections of their Base Registries. The document draws conclusions from both desk research and interviews conducted with officials responsible for public data and the digitalisation of public services in six countries in accession: Albania, Bosnia and Herzegovina, the Republic of North Macedonia, Serbia, Türkiye, and Moldova.

Overall, the research highlighted that from the perspective of candidate countries, ABR use cases are mainly related to three objectives:

- **The digitalisation of public administration and government services,**
- **the increase of transparency and open data,**
- **and the cross-border exchange of data.**

The subsequent sections of this report will delve deeper into these different use cases, with a specific focus on the digitalization of government services.

2.1.1. Digitalisation of government services

Digital public services, also known as eGovernment or smart public services, refers to the use of digital technologies to provide services to citizens at the local or national level. For many countries inside and outside of Europe, developing digitalised public services represents an opportunity to offer more accessible, efficient, and user-centric services[1].

In candidate countries for EU accession, various tools and processes have already been implemented to facilitate the development of eGovernment services. Albania has for instance created e-Albania, a portal that allows citizens and businesses to access 95% of public services in an electronic way[2]. Likewise, as part of its e-Government Development Programme, the Republic of Serbia has developed its national e-government portal, euprava.gov.rs, to serve as a one-stop shop for approximately 340 different government services[3]. Similar platforms exist in North Macedonia (uslugi.gov.mk), Moldova (servicii.gov.md), Türkiye (e-Government gateway) and Bosnia and Herzegovina (ex: identification services through IDDEEA) with different stages of implementation.

For improving the efficiency of e-government portals, the desk research and interviews highlighted that the digitalisation, **cleansing, and interconnection of the countries' primary databases**, hence Base Registries, represented key challenges[4]. Most candidate countries are therefore actively working on the development of improved Base Registries and databases interconnections to enhance their government digital services.

[1] https://digital-strategy.ec.europa.eu/en/policies/digital-public-services
[2] https://www.wbif.eu/technicalassistancegrants//WB26-ALB-DII-01
[3] https://neighbourhood-enlargement.ec.europa.eu/system/files/2023-11/SWD_2023_695_Serbia.pdf
[4] https://mduls.gov.rs/wp-content/uploads/e-Government-Development-Programme-2020-2022-FINAL-2.pdf

For example, to support the expansion of their e-government services, the Republic of North Macedonia, Albania, Türkiye[5], or Moldova, have established "interoperability platforms", a foundational architecture enabling interaction among digital systems of public institutions, facilitating the real-time exchange of data. These platforms are connecting the Base Registries of different public institutions and the e-government portals. This allows data to be seamlessly exchanged between institutions when required for delivering a service to the citizen. For instance, in Albania, 61 electronic registers are connected to the interoperability platform, thereby allowing 63% of online application form to be pre-filled for citizens[6]. Similarly, more than 300 public and private institutions across Moldova can exchange connection requests through MConnect, the Moldovan interoperability platform.

However, we also observed that the level of implementation of interoperability platforms and ABR practices for the delivery of e-government services was variable across the different candidate countries. For example, while Albania has made 61 public registers available on its interoperability platform, the Republic of North Macedonia has only made the central population register available to enhance digital government services (electronic identification, electronic signature).

Different challenges related to Base Registries can explain this disparity among the different candidate countries. First, in a communication on the EU enlargement policy, the European Commission (EC) has emphasized the need for improvements in **data quality within Base Registries** of certain candidate countries (ex: missing data, data not in a machine-readable format).

Next, an important problem concerns the **lack of awareness or political will when it comes to the interoperability of Base Registries**. The interviews highlighted that despite the efforts of several countries in building interoperability platforms, increasing their adoption by public administrations remains a challenge. Therefore, convincing public administrations of the relevance of such tools represents an important part of the work still to be done.

A last relevant example from the desk research was illustrated by the Serbian public services[8]. Currently, a total of 136 databases, records, or registries are in use by various government departments and ministries in the country. However, a **lack of clarity in the mandates that define responsibilities for collecting, maintaining, and using data from these different databases** creates a situation where public institutions work in silos. This lack of coordination hinders the effective exchange of data between these institutions.[7]

Table 1: List of challenges related to the digitalisation of government services.

#	Challenges
C1	Cleansing
C2	Interconnection of countries' primary databases
C3	Data quality within Base Registries
C4	Lack of awareness or political will when it comes to the interoperability of Base Registries
C5	Lack of clarity in the mandates that define responsibilities for collecting, maintaining, and using data from these different databases

[5] https://www.turksat.com.tr/sites/default/files/2020-07/turkish-e-government-catalog-en.pdf
[6] https://www.rcc.int/pubs/132/regional-interoperability-and-trust-services-in-western-balkans--methodology-implementation-vision-and-action-plan
[7] https://ciit.finki.ukim.mk/data/papers/9CiiT/9CiiT-15.pdf

2.1.2. Increase transparency and open data

Increasing transparency of the government services represents a key use case for countries in accession to the EU, particularly in the Western Balkan region. Since the early 2010's, most of them have decided to follow a strategy for opening their data to comply with the European standards on open data publication. Though most candidate countries already have an open data portal in place (Open data Kosovo ; Open data Albania ; Open Data Macedonia ; Open data Serbia ; Open data Moldova ; Open data Türkiye), different actions still need to be achieved regarding the publication of public data and the access to Base Registries on those portals (ex: **increase the publication of machine-readable government data**, **creation of data inventories**, **training and lack of awareness**)[8].

One concrete example of use case for the publication of government data as open data is the improvement of transparency in public procurement. Moreover, a special focus is put by candidate countries on public procurement of local governments. For instance, the Republic of North Macedonia has been working on the disclosure of information from the Registry of Beneficial Ownership, that is the publication of information on the beneficial ownership of companies awarded public procurement contracts, to fight against money laundering and corruption[9].

Next to this, the publication of authoritative government data as open data is also considered as relevant to improve the quality of different public and private services related to education, smart cities, or preventive healthcare in various candidate countries[10][11][12].

Table 2: List of challenges related to increase transparency and open data.

#	Challenges
C6	Increased publication of machine-readable government data
C7	Creation of data inventories
C8	Training and lack of awareness regarding open data

2.1.3. Cross-border exchange of data

The cross-border exchange of data is tightly related to the digitalisation of government services as the objective is to facilitate the delivery of services to citizens beyond the national borders. For instance, the exchange of data between two neighbour countries could facilitate the implementation of a single sign-on or digital signature on the e-government portals of both countries for their citizens.

When looking at candidate countries, this particular use case is tightly connected to the creation of an interoperable Western Balkan region[13], an action which aims at facilitating the delivery of cross-border services to citizens but also at facilitating the integration of the Western Balkan countries into the EU single digital market. Triggered by the Berlin process summit in 2020, this action defines a series of building blocks to achieve the vision of an Interoperable Western Balkans (ex: eIDAS compliant regulations, eID and Trust Services usage environments and APIs) including various components

[8] https://ogpkosova.org/assets/docs/OGP_Kosovo_Booklet_Summary.pdf
[9] https://www.opengovpartnership.org/wp-content/uploads/2021/11/North-Macedonia_Action-Plan_2021-2023_EN.pdf
[10] https://www.opengovpartnership.org/wp-content/uploads/2021/11/North-Macedonia_Action-Plan_2021-2023_EN.pdf
[11] https://www.undp.org/sites/g/files/zskgke326/files/migration/rs/UNDP_RS_The-Potential-Impact-of-Open-Data-in-Serbia.pdf
[12] https://ulasav.csb.gov.tr/

related to Base Registries (ex: **alignment of metadata standards for open data**, **agreement on minimum technical standards and specifications to allow exchange of data and documents**).[13][14]

Although the action has been in existence since 2020, it is still in its early stages. A few collaboration pilots exist (ex: Custom data exchanges between Moldova and Romania), but as highlighted in the different interviews, these are not yet fully developed. Currently, it is first necessary to **identify several useful cross-border services that each economy in the Western Balkans could offer to businesses and residents of other economies in the region**[15].

Table 3: List of challenges related to the cross-border exchange of data.

#	Challenges
C9	Alignment of metadata standards for open data
C10	Agreement on minimum technical standards and specifications to allow exchange of data and documents
C11	Identify several useful cross-border services that each economy in the Western Balkans could offer to businesses and residents of other economies in the region

2.2. Access to Base Registries practices

In this second part of the chapter, the focus is put on the description of relevant BR practices. For this, the SEMIC team decided to investigate how the different dimensions from the ABR initiative (see Figure *1*), were translated in the selected countries.

2.2.1. Framework and guidelines

In the European Union, the ABR initiative has introduced the BRAIF (Base Registries Access and Interconnection Framework) and the Guidelines for Base Registries interconnection to provide guidance for the national and cross-border implementation of Base Registries and registry of registries.

Beyond the borders of the EU, although not centred around Base Registries, various legislations, guidelines, or even frameworks also exist to regulate the development of an interconnected ecosystem of BR.

In several candidate countries, legislations are the first building block defining the framework of use for BR and public databases in general. These laws establish data governance principles (ex: definition of data owners, rules on data access) and obligations regarding data exchanges and data publication. In Albania, the law on state databases defines the rules for the establishment of new electronic databases and for the data collection responsibilities[16]. Likewise, the Republic of North Macedonia has published the law on the central population register to regulate the rights, obligations and duties of public administration which are delivering public services related to the central population register. Among others, it defines a data governance framework for the register, but also states the obligation for institutions to use the interoperability platform, meaning that the integration of this base registry in the interoperability platform is regulated by law[17]. This last point is particularly relevant as it came

[13] https://cefta.int/wp-content/uploads/2020/11/Common-Regional-Market-2021-2024-Action-Plan.pdf
[14] https://www.rcc.int/pubs/132/regional-interoperability-and-trust-services-in-western-balkans--methodology-implementation-vision-and-action-plan
[15] https://cefta.int/wp-content/uploads/2020/11/Common-Regional-Market-2021-2024-Action-Plan.pdf
[16] https://akshi.gov.al/wp-content/uploads/2018/03/ligji_10325_per_databazat.pdf
[17] https://obse.mioa.gov.mk/sites/default/files/pbl_files/documents/legislation/zcrn_eng.pdf

out of several interviews (Bosnia and Herzegovina, Serbia, North Macedonia and Türkiye) that legal obligation was often seen as the most appropriate solution to overcome the **lack of political will and awareness of public institutions regarding access to Base Registries**.

Next to legislations, most candidate countries (Moldova, Bosnia and Herzegovina, Serbia, Albania, and North Macedonia) have also developed National Interoperability Frameworks. These various frameworks all pursue the same objective of defining conceptual models for facilitating the exchange of information (cross-organisation, cross-sector, and cross-border) and thereby streamlining various procedures, ultimately improving the efficiency of public services. Currently, most of the documents have been created or updated to be in line with the latest version of the European Interoperability Framework (EIF). We observed that the majority of interoperability frameworks from candidate countries address interoperability in its four different layers (legal, organisational, technical, and semantic).

In Moldova, the framework was established by the law on data exchange and interoperability that defines measures to ensure legal, organisational, semantic, and technical interoperability. For instance, from an organisational perspective, the framework defines the rules and procedures for using the interoperability platform (including different provisions on the cross-border use of the interoperability platform). Regarding the semantic layer, the creation of a semantic catalogue for registering the different semantic assets needed to exchange data through the platform is mentioned[18].

Beyond the interoperability framework, other tools are also utilized by some candidate countries. For instance, Türkiye relies on its National Data Strategy and an Interoperability Principles Guide to guide the implementation of interoperability. The country has also established a set of specific principles for geospatial data and Smart Cities.

Table 4: List of challenges related to framework and guidelines.

#	Challenges
C12	Lack of political will and awareness of public institutions regarding access to Base Registries

2.2.2. Specifications and other semantic assets

Semantic assets play a crucial role in facilitating access and interoperability of Base Registries. They provide a common vocabulary and shared understanding of the data elements and their relationships. This allows for seamless integration and exchange of data across different systems and domains. As part of the ABR initiative, BRegDCAT-AP, an extension of DCAT-AP, has been developed to provide a standard data model for describing Base Registries across the EU[19]. In candidate countries, different efforts have already been made to support their ABR initiatives with semantic assets. Currently, these are mainly related to the standardisation of data models and vocabularies to overcome the challenge of the **highly fragmented ecosystem of Base Registries**. This was particularly highlighted by countries like Serbia or Bosnia and Herzegovina.

The research highlighted that different approaches were used to achieve this standardisation (with different levels of implementation).

A first approach consists in the creation of a catalogue of semantic assets to ensure the unification and standardisation of definitions, or descriptions of data structures, thereby facilitating the exchange

[18] https://www.legis.md/cautare/getResults?doc_id=142805&lang=ro
[19] https://joinup.ec.europa.eu/collection/semic-support-centre/abr-specifications

of data on the interoperability platform. For instance, Moldova has created a semantic catalogue based on EU definitions of entities, classifiers, operations, or events. In a similar manner, Türkiye has launched the National Dictionary Project. This project aims among others at identifying the different data models used across Türkiye and creating a common terminology. At the time being, 171 data dictionaries have been created with around 50 of them compliant with the ISO/IEC 11179 standard (with ongoing compliance efforts for other data dictionaries).

Regarding specific data models or specifications used in the semantic catalogues or in institutions, no information could be found during the research or the interviews. Officials from Bosnia and Herzegovina mentioned that pilots using CPSV-AP and DCAT-AP had been explored. Additionally, for the publication of data on open data portals, DCAT-AP (in Serbia[20]) and CKAN (in Moldova) were also mentioned.

Next to the establishment of a semantic catalogue, the creation of mappings between the different data models was also mentioned as an alternative approach. This can be achieved, for example, by creating a data exchange layer. This approach was considered as an interesting solution to overcome the **lack of awareness of institutions on the importance of semantic models and semantic interoperability** and was considered by Türkiye (Public Sector Data Space) and Moldova for the data spaces domain.

Table 5: List of challenges related to specifications and other semantic assets

#	Challenges
C13	Highly fragmented ecosystem of Base Registries
C14	Lack of awareness of institutions on the importance of semantic models and semantic interoperability

2.2.3. Pilots and tools

To support Member States in their journey towards enhanced access to Base Registries, the ABR initiative has developed various supporting tools and materials over the years. Some examples of support materials are open-source tools to support the implementation of BRegDCAT-AP[21] or Access to Base Registries e-learning course[22]. Similar supporting tools could be observed in candidate countries during this research.

First, and as previously mentioned, interoperability platforms have been developed in most candidate countries to facilitate the creation of interoperable solutions. The semantic catalogues linked to those platforms (will) allow institutions to be guided in their choice of data model, or terminology. For instance, Moldova's semantic catalogue portal contains the following features to facilitate the work of public administrations on Base Registries: search semantic assets, list categories, list semantic asset owners, view semantic asset details, submit a request to be connected to the interoperability platform, download technical specifications for a semantic asset (CSV, XSD, JSON schema, WSDL, etc.), reference semantic asset by using user-friendly URL[23]. Likewise, as part of its National Dictionary Project, Türkiye has created a separate portal to facilitate the exploration, research, and discovery of data dictionaries[24]. Additionally, in Türkiye, platforms, such as the National Registration System and

[20] https://data.europa.eu/sites/default/files/odm2023_report.pdf
[21] https://joinup.ec.europa.eu/collection/semic-support-centre/bregdcat-ap-tools
[22] https://joinup.ec.europa.eu/collection/semic-support-centre/online-trainings
[23] https://indrivo.com/stories/design-and-development-semantic-catalog-only-it-inventory-semantic-assets-moldova
[24] https://uvs.gov.tr/login.xhtml

the National Geographic Information Platform (TUCBS), designed to enhance interoperability in specific areas have also been developed[25].

Then, the research highlighted that Serbia had created or was in the process of creating a meta-register[26], that is a type of registry that provides information about other registries, such as their existence, purpose, scope, and technical details. This meta-register can help institutions in locating and accessing specific BR more easily.

Finally, we observed that several tools were made available by the different countries as part of their open data platform. For instance, Serbia provides an API guide and guidelines for the different users[27]. Additionally, the country gives support on the publication of metadata, or the implementation of real-time data[28].

Despite investments in tools to facilitate the work of public institutions, their impact remains limited. As previously mentioned, some candidate countries still face significant challenges, related to the **adoption of interoperability platforms and open data portals**. This comes as an additional illustration of the **lack of awareness or political will from the different administrations regarding access to Base Registries**. Another factor potentially influencing this situation is also the **absence of training materials** on this topic. This lack of training or knowledge was for instance mentioned as an area of improvement by Türkiye and Serbia.

Table 6: List of challenges related to pilots and tools.

#	Challenges
C15	Adoption of interoperability platforms and open data portals
C16	Lack of awareness or political will from the different administrations regarding access to Base Registries
C17	Absence of training materials

2.2.4. Monitoring

Effective monitoring and reporting on BR play a crucial role in improving access and interconnection of these registries. By referencing their overall approach to ABR (interoperability strategy, existing initiatives and practices, usage of Base Registries data, etc.), countries can support users in quickly finding the necessary information through better online documentation. Enhanced monitoring and reporting capabilities can also help identify needs surrounding ABR, enabling European-level organisations such as SEMIC to define more targeted supporting actions.

Through interviews and desk research, we observed that efforts and practices made by candidate countries on ABR are already documented and accessible. The table below provides an overview of documents that could be found during this study:

Table 7: List of practices and documentation per country (based on the interviews and desk research)

Countries/Practices	Framework and guidelines	Specifications and other semantic assets	Pilots
Albania	Law on state database		Interoperability platform

[25] https://tucbs.gov.tr/ ; https://www.tuik.gov.tr/en/
[26] https://ciit.finki.ukim.mk/data/papers/9CiiT/9CiiT-15.pdf
[27] https://data-gov-rs.translate.goog/sr/documents/?_x_tr_sl=sr&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc
[28] https://data.europa.eu/sites/default/files/odm2023_report.pdf

	National Interoperability Framework		
Moldova	National Interoperability Framework	Semantic catalogue Use of CKAN for the open data portal	Interoperability platform
Serbia	National Interoperability Framework	Use of DCAT-AP for the open data portal	Meta-register API guide
Republic of North Macedonia	Law on central population register National Interoperability Framework		Interoperability platform
Türkiye	Interoperability Principles Guide National data strategy	National Data Dictionaries	National Data Dictionaries Interoperability platform
Bosnia and Herzegovina	National Interoperability Framework	Pilots on CPSV-AP and DCAT-AP	

Additionally, since 2024, the National Interoperability Framework Observatory (NIFO) has compiled national-level information on BR for each candidate country, which is published in a dedicated section of the Digital Public Administration Factsheets. These factsheets provide insights into each country's general strategy towards interoperability, current interoperability levels based on the EIF layers, and an overview of e-Government public services utilising BR data. For instance, one can learn that the Central Register of Credits of Legal Entities and Natural Persons in Bosnia and Herzegovina contains data on credit and other debts of business entities and individuals with entities in the Register[29].

While existing documentation and reporting practices are noteworthy and the integration of monitoring efforts into European initiatives through the NIFO Digital Public Administration Factsheets represents significant progress, interviewees also mentioned a specific challenge connected to monitoring. This challenge was related to the **important efforts required for reporting activities, especially when done manually**.

Table 8: List of challenges related to monitoring

#	Challenges
C18	Important efforts require for reporting activities, especially when done manually

[29] https://joinup.ec.europa.eu/sites/default/files/inline-files/NIFO_2024_Supporting%20Document_Bosnia_and%20Herzegovina_vFinal_Final.pdf

3. Potential Access to Base Registries initiatives at SEMIC

Chapter 3 of this report aims at identifying potential actions or scenarios for the Access to Base Registries at SEMIC. Starting from the information gathered in the previous chapter, this section summarises the needs related to ABR identified in candidate countries. Potential solutions that could support SEMIC's community in the future are then derived from a gap analysis. SEMIC could rely on this knowledge to strengthen its current role in supporting Base Registries interconnection across Europe.

3.1. Summary of Base Registries use cases

The desk research, combined with the interviews, highlighted that access and interconnection of Base Registries efforts were implemented for the following three main objectives:

- **the digitalisation of public administration and government services,**
- **the increase of transparency and open data,**
- **and the cross-border exchange of data.**

Furthermore, the analysis showed that the most important objective was the enhancement of digital public services (at both national and cross-border level) as better access to Base Registries would allow for digital signature, single sign-on, automated form filling, and many other features that would facilitate the life of citizens and businesses.

To achieve this goal, most of the participants to this study have taken steps to implement legal texts, including regulations and interoperability frameworks that define roles, responsibilities, processes, and assets related to access to BRs. From a semantic point of view, they have employed semantic assets, such as semantic catalogues, mapping, meta-registers and defined specifications, to ensure standardisation at a national level. However, we observed that specifications developed by SEMIC (ex: DCAT-AP, CPSV-AP) were not implemented in the contacted countries.

3.2. Summary of challenges in Access to Base Registries practices

Despite the implementation of these practices, the different countries still face various challenges in their journey towards the digitalisation of public services. The research identifies 19 challenges grouped into areas of improvement, which vary in degree across countries.

Table 9: List of challenges and areas of improvement

#	Challenges	Areas of improvement
C1	Cleansing	Data management
C2	Interconnection of countries' primary databases	Interoperability
C3	Data quality within Base Registries	Data management
C4	Lack of awareness or political will when it comes to the interoperability of Base Registries	Political will and awareness
C5	Lack of clarity in the mandates that define responsibilities for collecting, maintaining, and using data from these different databases	Data management
C6	Increased publication of machine-readable government data	Political will and awareness
C7	Creation of data inventories	Political will and awareness
C8	Training and lack of awareness regarding open data	Training
C9	Alignment of metadata standards for open data	Interoperability

C10	Agreement on minimum technical standards and specifications to allow exchange of data and documents	Interoperability
C11	Identify several useful cross-border services that each economy in the Western Balkans could offer to businesses and residents of other economies in the region	Political will and awareness
C12	Lack of political will and awareness of public institutions regarding access to Base Registries	Political will and awareness
C13	Highly fragmented ecosystem of Base Registries	Interoperability
C14	Lack of awareness of institutions on the importance of semantic models and semantic interoperability	Political will or awareness
C15	Adoption of interoperability platforms and open data portals	Political will or awareness
C16	Lack of awareness or political will from the different administrations regarding access to Base Registries	Political will or awareness
C17	Absence of training materials	Training
C18	Important efforts required for reporting activities, especially when done manually	Reporting

3.3. Gap analysis with SEMIC's service offering

Based on the identified challenges and areas for improvement, this section aims at identifying possible gaps in the SEMIC services related to ABR. For this gap analysis, the current SEMIC service offering for ABR (as depicted in Figure 1) was compared to the different challenges identified through desk research and interviews.

Table 10: Gap analysis

Challenges	SEMIC services	Gap analysis
Political will and awareness	Raising awareness around the importance of semantic interoperability is one of the core objectives of the SEMIC action. Hence, its offering includes different services that could support public administrations in their ABR journey. For example, the yearly SEMIC Conference and the organisation of Roadshows across the EU represent channels to foster the discussion around interoperability. SEMIC's materials and frameworks, for example the European Interoperability Framework (EIF), or the Guidelines on ABR Registries also provide levels of awareness for encouraging countries to take actions around interoperability, semantic interoperability or ABR. Finally, SEMIC, as the Semantic Interoperability Community, adopts a community-based approach for its	As SEMIC follows a community-based approach, and the assets developed through the action are not mandatory for use, it is also important to mention that SEMIC does not have the authority to enforce political actions or regulations. Nevertheless, SEMIC could enhance its support by developing concrete propositions and tailored use cases that clearly demonstrate the value and practical benefits of interoperable solutions for ABR. The development of national registries of registries is an example of use case that was discussed during the interviews conducted for the study. Besides, the new European Interoperability Act introduces the Interoperable Europe Board, which could have a political impact: *"A new governance structure, with the*

	mission. The community-based approach means a voluntary-based collaboration with various stakeholders engaged in the field of semantic interoperability, where initiatives are defined by the community member's own use cases and priorities. Public administrations can benefit from this SEMIC experience in raising awareness and promoting interoperability within a community.	*Interoperable Europe Board (the 'Board') at its centre, should be established and should have a legal mandate to drive, together with the Commission, the further development of cross-border interoperability in the Union, including the European Interoperability Framework (EIF) and other common legal, organisational, semantic and technical interoperability solutions, such as specifications and applications."*[30]
Interoperability	As the core competence of SEMIC, the Action develops various tools to assist the community in achieving semantic interoperability of Base Registries. For example: The SEMIC team can be contacted via the SEMIC Support Centre for direct support regarding semantic interoperability. The Base Registries Access and Interconnection Framework (BRAIF) offers guidance on establishing an ecosystem of interconnected base registries that exchange data. BReg-DCAT-AP is an extension of DCAT-AP designed specifically for describing BRs. It facilitates efficient data exchange among different registries, including cross-border interactions. The SEMIC team also developed additional tools and pilots to assist with the implementation of BReg-DCAT-AP. Alongside BReg-DCAT-AP, Core Vocabularies can also be used to describe the core attributes of most BRs (ex: Core Person, Core Business, or Core Public Organisation) To finish, the SEMIC Support Centre offers access to a catalogue of solutions developed at both the national and European levels. These solutions can serve as a source of inspiration and provide practical examples for public	As semantic interoperability represents the core competence of SEMIC, we did not observe important gaps for this area. For example, we did not identify the need for a new specification or a change in specification during the study. Although SEMIC regularly works on pilot projects and other real-life implementations, the study showed that there are always needs for hands-on support. For example, we discussed about implementation of national registries of registries in many interviews. We also discussed about the challenges that administrations face when starting cross-border digital projects as well as cross-border exchange of data. Therefore, as public administrations welcome this type of support but are not always aware that SEMIC can help them, we can emphasise the importance for SEMIC to pro-actively communicate and propose support for pilots and Proof-of-Concepts. In short, SEMIC could engage a targeted search for ABR pilot projects. Another role that SEMIC could play is to connect cross-border pilots with existing interoperability solutions such as eDelivery, SDG OOTS, and eWallet. This approach would provide a hands-on opportunity to test these technologies

[30] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32024R0903

	administrations to leverage their interoperability efforts.	from various perspectives (technical, semantic, and organisational) in specific cases within new countries. Furthermore, it would create an opportunity to onboard the countries in a collaborative dynamic.
Data management	In addition to providing guidance on the access and interconnection of BRs, the Base Registries Access and Interconnection Framework (BRAIF) comes with complementary guidelines offering recommendations on the four layers of interoperability (legal, organisational, semantic and technical). The organisational layer contains recommendations for data management (ex: data privacy, security, governance, quality). For more practical solutions, candidate countries can refer to the catalogue of solutions. By exploring these examples, candidate countries can gain insights into practical strategies and approaches that can be adopted to address specific data management challenges, such as data quality tools or metadata management examples. To conclude, SEMIC developed a series of tools that can support data quality management. "Validators" can check data compliance between a BR and a given semantic specification. These tools allow users to receive feedback on how to harmonise their descriptions by identifying inconsistencies, errors and missing attributes, eventually helping to improve the quality of the data.	The study confirmed that data management challenges foster the interest of the community. Data management embodies many capabilities which include but are not limited to data governance and quality. The SEMIC team could investigate further the needs for data management best practices (with a focus on interoperability) to identify opportunities to develop more specific services which could be valuable to the community. This could lead to a revision of the BRAIF, precision in the ABR guidelines, the development of new resources and tools, or the development of pilots. Note that any development related to data management should be thought as levers to support semantic interoperability, as this remains the competence of the SEMIC action. For example: "Solutions involving citizens, businesses and service providers in the process result advantageous as they facilitate data checks and validation directly by users through secured electronic channels" (page 28 from ABR guidelines).
Training	Throughout the years, SEMIC has developed a range of materials such as studies, trainings, and pilots on semantic interoperability. These resources can be utilised to enhance the knowledge and awareness of semantic interoperability within the public institutions of candidate countries.	Although SEMIC develops training materials, these materials are usually developed on an ad-hoc basis, based on ongoing initiatives (ex: a new specification has been developed, which triggers the creation of its training materials). During our study, we observed that public administrations have various

		training needs (related to semantic capabilities or other various type of needs). SEMIC could adopt a more holistic approach, by investigating the needs for semantic trainings directly with the community.
Reporting[31]	SEMIC does not provide support about reporting. Nevertheless, as part of the NIFO Action, valuable information around Base Registries (ex: list of BRs in a country, frameworks) can be found in the dedicated factsheets available on the SEMIC Support Centre.	As the challenges discussed during the interviews were mainly about the manual efforts required for reporting activities, the SEMIC team, in collaboration with NIFO, could start exploring different ways of improving the monitoring and reporting around Base Registries. For example, based on URLs shared by countries, the SEMIC team could explore how to use AI to automatically parse and analyse the content of those pages. This would streamline the preparation of reports by reducing manual effort and ensuring that the data is current and comprehensive. Such automation could also help detect potential actions around ABR, making the reporting process more efficient and insightful. Furthermore, we observed that it could be beneficial for SEMIC to have access to more granular information about ABR to better understand practices in Europe and adapt its support accordingly. Examples of such information are: Is the Base Registry queryable through an endpoint? In what format and under what conditions (open access, consent management)? Is the interface human-readable or machine-readable? Is there a capacity to connect via API for continuous services? Providing such detailed and practical information would not only enhance the accuracy and utility of reports but also provide users with a clearer understanding of

[31] By reporting, we understand the process by which a country creates and provides documentation, reports, and any type of information related to its Base Registries. This includes detailed descriptions of the activities, management, updates, and policies surrounding these registries. The purpose of this reporting is to ensure transparency, facilitate oversight, and provide stakeholders with a comprehensive understanding of how the Base Registries are being maintained and utilised.

		the capabilities and accessibility of Base Registries in different countries, thereby supporting more informed decision-making and policy development. Therefore, in collaboration with NIFO, it could be decided to retrieve other type of data as part of the existing reporting processes (ex: Digital Administration Factsheets).

4. Conclusions

4.1. Desk research and interviews

This study conducted by the SEMIC team aimed to expand the knowledge and understanding of ABR use cases, needs, and challenges outside the European Union. Focusing on countries in the process of accession, our analysis was based on desk research and interviews with officials responsible for digitalisation programs in six candidate countries: Albania, Bosnia and Herzegovina, Moldova, North Macedonia, Serbia, and Türkiye. We would like to express our sincere gratitude to all the participants who took time to share with SEMIC the context, challenges, and practices related to ABRs in their administrations. Their valuable insights were essential for the development of this report.

Findings revealed that access and interconnection of Base Registries is a priority for three main objectives: the digitalisation of public administration and government services, the increase of transparency and open data, and the cross-border exchange of data.

Furthermore, to achieve these objectives, candidate countries have taken steps to implement various ABR initiatives (ex: legislations, interoperability frameworks, semantic assets, platforms). Nonetheless, several challenges remain. Our research revealed challenges in effectively demonstrating the importance of BR access and interconnection to key decision-makers. Additionally, a need for improved semantic and cross-border interoperability, as well as a need for better governance and quality of the data have been highlighted.

4.2. Gap analysis and possible actions

Throughout this report, interviewees consistently emphasised the value of Base Registries (BR), underscoring the importance of robust, interconnected registries for the delivery of public services. Nonetheless, we observed that administrations continue to face various challenges that slow down the achievement of their goals. We grouped these challenges in areas of improvements.

By addressing these areas, SEMIC can significantly enhance its impact, contributing to the broader goal of achieving seamless interoperability across Europe and facilitating the gradual integration of candidate countries into the single digital market. Overall, we observed that SEMIC's service offering comprehensively addresses the needs of candidate countries in terms of Base Registries access and interconnection.

Nevertheless, the analysis also highlighted gaps and opportunities for actions where SEMIC could further support public administrations:

1. **Political will**: SEMIC does not have the authority to enforce political actions or regulations. However, the new Interoperable Europe Board should have a legal mandate to drive, together with the Commission, the further development of cross-border interoperability in the Union.
2. **Interoperability**: We emphasise the importance for SEMIC to pro-actively communicate and propose support for pilots and other real-life implementations. SEMIC could engage a targeted search for ABR pilots.
3. **Data management**: SEMIC could explore the community's needs for data management best practices in the context of interoperability. This exploration could lead to new services, refined ABR guidelines or semantic solutions for data quality and integration such as "Solutions involving citizens, businesses and service providers in the process result advantageous as they facilitate data checks and validation directly by users through secured electronic channels" (page 28 from ABR guidelines).
4. **Trainings**: SEMIC could adopt a more holistic approach, by further investigating the needs for semantic trainings within the community.
5. **Reporting**: In collaboration with NIFO and Member States, the SEMIC team could explore ways of improving the reporting practices around ABR (ex: automated data collection, specificity of reported information). This could significantly enhance the effectiveness of monitoring and reporting practices, thereby improving the overall utility of Base Registries.

In conclusion, while SEMIC's support for Base Registries is comprehensive, there are still opportunities for SEMIC to further assist public administrations and to raise awareness about ABR and semantic interoperability across Europe.