European Commission

# Blueprint reference architecture

## European Higher Education Interoperability Framework

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*The European Digital Education Hub (EDEH) is an online community for practitioners from all sectors of education and training aiming to contribute to improving digital education in Europe. To achieve this goal, EDEH is not only a place for exchange and discussions but also offers a variety of different events and activities. These activities included a dedicated workgroup and a series of squads on higher education interoperability. This document is part of the results of these specific EDEH activities.*

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# Table of Contents

# Introduction

This blueprint reference architecture has been developed as part of an interoperability project within the European Digital Education Hub (EDEH). It describes the technical aspects of the reference architecture as built in the open architecture modelling language ArchiMate.

The architecture presents three complementary views for each of the eight priority use cases identified: organisational, semantic, and technical. These illustrate the relationships and dependencies between the involved business and technical building blocks that make up the architecture, offering a clear and structured overview of the elements involved in each use case. Each view serves as a structured guide, enabling institutions to identify and evaluate their current set-up, thereby gaining insight into how their components in place interact with the recommended architectural blocks. This approach provides a tangible pathway for institutions to achieve an advanced level of interoperability.

Jointly with the EDEH community of experts in Higher Education (HE) and interoperability, the reference architecture has been developed iteratively through the refinement of the draft architecture. This blueprint not only delivers the final architecture, but also gives insights into its progressions and iterations.
Complementary to this document, the mapping report provides an overview of the gaps that technologies, standards, and services leave unaddressed. In the full ineroperability framework report, this reference architecture information is embedded in the respective business processes and design architecture.

# Shared building blocks

All the use cases adhere to the overarching principles of **data privacy** and **legal compliance.** The following building blocks from the European Interoperability Reference Architecture (EIRA) are key enablers relevant to all use cases.

| Building block | Type | Description |
|---|---|---|
| **Access Management** | Application Component | Access management ABB is an application component implementing the process of granting rights to users and preventing access to non-authorised users. |
| **Access Management** | Application Service | Access management ABB is an application service aimed at granting authorised users the right to use a service while preventing access to non-authorized users. |
| **Access Rights** | Business Object | Access rights govern who has the ability to view, edit, and delete data, and proper control over access rights is essential for maintaining the confidentiality, integrity, and availability of information. |
| **Admin Staff** | Business Role | Admin staff ABB is a role that represents the administrative staff of the institutions. |
| **Agreement of the Use on Common Infrastructure** | Contract | Agreement of the use on common infrastructure ABB is a contract between multiple parties that outlines the terms and conditions for sharing and utilising a specific infrastructure or facility. The agreement on the use of common infrastructure typically outlines the rights and responsibilities of each party, the terms and conditions for access and usage, the payment or cost-sharing arrangements, and the procedures for resolving any disputes or issues that may arise. |
| **Agreement on Data Sharing** | Contract | Agreement on data sharing ABB is a contract formalising the information requirements, syntax bindings, protocols and semantic artefacts that must be used for the exchange of data. |
| **Agreement on Interoperability Security** | Contract | Agreement on interoperability security ABB is a contract formalising governance rules and conditions to grant the identification, authorisation, and transmission of the data, information and knowledge being exchanged between digital public services. |

| | | |
|---|---|---|
| **Agreement on Privacy** | Contract | Agreement on privacy ABB is a contract that enables a set of rules for the personal data of individuals' collection, processing and transference by public administrations. |
| **API** | Application Interface | API ABB is an application interface that enables a set of rules and specifications that allow different software components or systems to communicate and exchange data. |
| **API Catalogue** | Application Component | API catalogue ABB is an application component that refers to the (open) software interface functionalities that are aligned with the implementation structure of the digital services. |
| **API Discovery and Catalogue** | Application Service | API discovery and catalogue service ABB is an application service that enables the discovery and/or maintenance of the API Catalogue ABB. |
| **Asset** | Business Object | A resource, either physical or digital available and managed by an institution. |
| **Asset Access Management** | Business Service | The service is responsible for controlling and regulating access to assets, ensuring authorised use and preventing unauthorised access. |
| **Asset Availability Management** | Business Service | The service ensures assets are available for use when required, addressing reliability and performance needs. |
| **Asset Discovery** | Business Service | The service is used to identify and locate existing assets within an environment or system, enabling better utilisation and reusability. |
| **Asset Management** | Business Service | The service for overseeing the lifecycle of assets, including acquisition, maintenance, and disposal, to ensure their optimal use. |
| **Asset Metadata** | Business Object | Structured information that describes the characteristics, relationships, and attributes of an asset to facilitate its identification and management. |
| **Asset Provisioning** | Business Function | The process or activity that ensures assets are supplied, configured, or allocated to users or systems to meet specific needs. |
| **Availability Information** | Business Object | Data or details that indicate the current status and accessibility of a resource, asset, or service, providing insights into its readiness for use. |

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| **Catalogue Management** | Business Function | The activity or process of creating, maintaining, and organising a catalogue of resources, services, or products to enable easy discovery and access. |
| **Catalogue Management Solution** | Application Component | A software application or module designed to support the catalogue management function by providing tools for storing, organising, and maintaining catalogues efficiently. |
| **Catalogue Operator** | Business Actor | An organisation or unit designated to manage and operate a catalogue. Oversees validation processes and overall quality of the catalogue contents. |
| **Catalogue Publication** | Application Service | Catalogue publication ABB is an application service that enables the processes of making content such as learning opportunities, assets or educational resources available through the adoption of discoverable, accessible, and reusable mechanisms. |
| **Central Catalogue** | Application Component | A centralised software system or module that consolidates and manages catalogues of resources, tools, or courses, providing a unified repository for easy discovery, access, and governance. |
| **Citizen** | Business Actor | Citizen ABB is a business actor providing and/or consuming public services. A citizen is a member of a particular country who has rights because of being born there or because of being given rights. |
| **Claim** | Business Object | A claim made by an issuer. |
| **Content Management** | Application Service | A service that provides tools and processes for creating, organising, storing, and managing content within a system, ensuring its accessibility, accuracy, and proper version control throughout its lifecycle. |
| **Content Validation** | Business Process | Business process that supports the validation of the contents of an element being updated or created |
| **Controlled Vocabulary** | Data Object | Controlled vocabulary ABB is a data object that enables a carefully curated set of terms used to describe concepts or objects in a specific field or domain. It is a standardised list of terms used to ensure consistency and accuracy in indexing, searching, and information retrieval. |
| **Create Entry** | Business Process | Business process that supports the creation of a new element in the repository or catalogue |

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| **Credentials Storage Solution** | Application Component | Credential storage solution ABB represents the application component responsible for storing and managing certain parts of the credential. It interacts with other application components by sharing the credential and making it accessible in a readable format. This application component is adaptable to any type of available solution, such as a national registry or a wallet, for example. |
| **Data** | Data Object | Data ABB is a data object that enables the implementation of digital or non-digital information that is collected, stored, or processed by a computer system or other information technology infrastructure. This information can take many forms, including text, numbers, images, video, audio, and more. |
| **Data Custodian** | Business Role | A natural or legal person, public authority, agency, or any other body that processes personal data on behalf of the controller. There are situations where an entity can be a data controller, or a data processor, or both. |
| **Data Exchange** | Application Interaction | The interaction or communication between application components to facilitate the secure transmission of messages, records, forms, or other data. |
| **Data Exchange** | Application Service | Data exchange ABB is an application service enabling the secure exchange of messages, records, forms, and other kinds of data between different individuals, organizations or systems. This includes data routing, except endpoint discovery. |
| **Data Mapping** | Data Object | Data mapping ABB is a data object aiming to bring equivalence in a relationship between two data items with ontological value. |
| **Data Model** | Data Object | Data model ABB is a data object aiming to be a collection of entities, their properties and the relationships among them, which focus on formally representing a domain, a concept or a real-world thing. |
| **Data Policy** | Business Object | Data policy ABB is a business object aiming to form the guiding framework in which data management can operate. |

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| **Data Portability Policy** | Business Object | Data portability policy ABB is a business object that regulates data reuse and data transference between public administrations. |
| **Data Publication** | Application Service | A service that enables the dissemination and sharing of data with authorised users or systems, ensuring accessibility and compliance with predefined formats, standards, and policies. |
| **Data Quality** | Application Service | A service that enables the implementation of verifying that the value of a data item comes from a given set of acceptable values. Data validation may be followed by corrective actions, such as data editing or data imputation. |
| **Data Representation** | Representation | Data representation ABB is a representation that refers to the method or mechanism in which data is encoded and stored in a computer system. It involves transforming data from its original form into a format that can be processed and manipulated by a computer. |
| **Data Standard** | Data Object | A predefined structure that guides the organisation, integration, and management of data. It includes data models, data formats, protocols, and other technical specifications that ensure data consistency, interoperability, and efficient data exchange. |
| **Dataset** | Data Object | Dataset ABB is a data object representing a collection of related data that is organized and presented in a structured format. |
| **Dataset Catalogue** | Data Object | Dataset catalogue ABB is a data object aimed at indexing a collection (inventory) of datasets in a systematic manner. |
| **Digital Public Service Delivery** | Business Interface | Digital public service delivery ABB is a business interface representing how the public sector delivers digital technologies and public services to citizens and businesses. |
| **Educational Credential** | Business Object | A credential is an attestation, evidence or proof of qualification, activities, assessments, or entitlements. |
| **Educational Resource** | Business Object | A business object describing an educational resource. |

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| **Educator** | Business Role | Educator ABB is a business role representing the educator's position within an institution. |
| **Enrolment** | Business Object | Information or a record representing the process of registering or being registered for a specific service, program, or institution. |
| **Human Interface** | Application Interface | Human interface ABB is an application interface that enables the exchange of data between stakeholders (individuals, public administration, or legal entities) and a service. |
| **Include Repository Entry in Catalogue** | Business Interaction | The collaboration or communication between business roles or systems to add a new repository entry into a catalogue, ensuring it is registered, described, and made accessible according to established guidelines and standards. |
| **Incorporate to Repository** | Business Interaction | The interaction to add educational resources to the repository |
| **Information Management** | Capability | Information management describes, organises, distributes, and governs information. |
| **Interoperable Catalogue** | Application Component | Application component which main function is the exchange of data between catalogues. |
| **Interoperable Search Solution** | Application Component | Interoperable search solution ABB is an application component that specialises in the search functions for learning records and is aggregated into the interoperable learning management solution ABB. |
| **Learner** | Business Role | Learner ABB is a business role that represents the role of learners within the ecosystem of institutions and alliances. |
| **Learning & Teaching Resource Management** | Capability | Learning & teaching resource management ensures learning resources are available and accessible to students and staff in the relevant learning systems, repositories, and facilities. |
| **Learning Assessment** | Business Object | Learning assessment assesses the student's knowledge of learning outcomes across all delivery modes including blended learning and work-based and work-integrated learning. |

| | | |
|---|---|---|
| **Learning Assessment** | Capability | Learning assessment assesses the student's knowledge of learning outcomes across all delivery modes including blended learning and work-based and work-integrated learning. |
| **Learning Offering** | Business Object | An instance of a learning specification in an academic period. Includes scheduling information. |
| **Learning Outcome** | Business Object | A statement regarding what a learner knows, understands and is able to do on completion of a learning process, which is defined in terms of knowledge, skills, responsibility, and autonomy. |
| **Learning Record** | Business Object | Digital record for a learning experience that one learner has participated in. |
| **Learning Specification** | Business Object | The specification of a learning opportunity. Includes information on the requisites, learning activities, assessments and learning outcomes. |
| **Machine to Machine Interface** | Application Interface | Machine to machine interface ABB is an Application Interface that enables the exchange of data between a service and other services. |
| **Manage Learning Records** | Business Service | Manage learning records ABB is a business service that provides functionalities for managing learning records, such as storage and modification. |
| **Mapping Service** | Application Service | Mapping service ABB is a service that enables the translation between data models, standards, or controlled vocabularies. |
| **Master Data** | Data Object | Master data ABB is a data object that enables the implementation of non-transactional information to play a key role in the core operation of a business in public administrations and re-used for multiple purposes. |
| **Master Data Policy** | Business Object | Master data policy ABB is a business object being applied to the authoritative, most accurate data that is available about key business entities, used to establish the context for business transactions and transactional data. |
| **Metadata** | Data Object | Metadata ABB is a data object providing information about one or more aspects of the data. |

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|---|---|---|
| **Metadata Catalogue** | Data Object | Metadata catalogue ABB is a data object that represents the collection of descriptive information about data, resources or information objects related to public services. |
| **Metadata Exchange** | Application Interaction | Metadata exchange ABB is an application interaction that represents the metadata exchange between interoperable applications. |
| **Metadata Exchange** | Business Interaction | The collaboration or communication between business roles or organisations to share and transfer metadata, ensuring interoperability, consistency, and understanding of data or resources across different contexts. |
| **Open Data Policy** | Business Object | Open data policy ABB is a business object formalising the procedures to publish FAIR data generated by different parties. FAIR data means being aligned and compliant with FAIR principles, making data findable, accessible, interoperable, and reusable. |
| **Organisational Interoperability Agreement** | Contract | Organisational interoperability agreement ABB is a contract formalising governance rules enabling collaboration between digital public services with enabling seamless interoperability enablement value. |
| **Privacy Policy** | Business Object | Privacy policy ABB is a business object that regulates the personal data of any customer, client or employee information. |
| **Reference Data** | Data Object | Reference data ABB is a data object that enables the definition of a set of values or codes that are used to categorise, classify, or describe data elements in a consistent and standardised way. |
| **Reject Change** | Business Process | A formalised process within an organisation that involves reviewing, evaluating, and deciding to reject a proposed change to a system, service, or process. |
| **Remove Entry** | Business Process | Business process that supports the removal of an existing element from the repository or catalogue |
| **Repository Access Management** | Business Function | A repository access management building block includes the processes required to administer users' access rights to different assets. |

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|---|---|---|
| **Repository Content Management** | Business Function | A business function that implements multiple processes to manage the repository of resources |
| **Request Access** | Business Process | This ABB represents the process initiated by a user to request access to a specific learning record. |
| **Revoke Access** | Business Process | This ABB represents the process initiated by an authorised entity to remove or deny a user's access to a specific system, resource, or service, typically due to changes in permissions, roles, or compliance requirements. |
| **Role** | Business Object | This ABB represents the business object related to a user role. |
| **Search** | Application Service | Application service to enable the procedures to discover, filter, and order content, such as learning opportunities, assets, or educational resources |
| **Search** | Business Function | The function that enables users or systems to initiate procedures for discovering, filtering, and ordering content, such as learning opportunities, assets, or educational resources, based on specific criteria or queries. |
| **Security Framework** | Business Object | Security framework ABB is a business object that enables the protection of various aspects of data, information and knowledge assets and the organizational resources handling them. |
| **Security Policy** | Business Object | Security policy ABB is a business object that regulates the protection of customer or client data. |
| **Semantic Agreement** | Contract | Semantic agreement ABB is a contract formalising an agreement from a peer to the common ontology that is the result of a matching or mapping process that is used to resolve their semantic discrepancies. The combination matching process consists of a linguistic base, internal and external structure comparison. The result of the matching combination will be used to develop an agreement unit as a component of the agreement. |
| **Sharing Learning Record** | Business Service | Sharing learning record is a business service that exposes the functionality related to the sharing of stored learning records. |

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|---|---|---|
| **Store in Catalogue** | Application Interaction | The interaction between application components that facilitates the process of adding and storing data, resources, or assets into a catalogue, ensuring it is properly categorised, indexed, and available for future retrieval. |
| **Store Learning Record** | Business Process | Store learning record ABB is the business process that represents the process by which learning records are shared between systems. This process is strongly linked to the data policies regarding security and privacy. |
| **Student Record Maintenance** | Capability | Student record maintenance captures and manages information on each student, including permanent evidence of their attainment and attendance. |
| **Update Entry** | Business Process | Business process that supports the modification of an existing element. |
| **Validation** | Application Service | Application service that enables the procedures to ensure the data is accurate, complete and consistent |
| **Verified Profile** | Business Object | A representation of a learner, educator or administrative staff related to an institution. |
| **Verify Credential** | Application Service | Verify credential ABB is an application service enabling the procedures to ensure that the claims in a credential are valid. |

PART 1

# Use case 1 – Discovery

# Use case 1 – Discovery

USE CASE 1

**Discover**

Enhancing the visibility and comparability of diverse learning and mobility opportunities across HEIs, emphasising the importance of machine-readable metadata for easy comparison and discovery.

CMS (Website) | Course catalogue | Curriculum management

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This use case lies at the start of the learner's journey. The chosen scope of the use case takes a specific focus on the concept of a course catalogue, which is the key information tool that higher education institutions and European University alliances (EU-As) provide to prospective students. Whereas the broader phase of discovery might also involve the learner gaining insight into the demands of the labour market or using tools to discover one's own preferences and talents, these are not necessarily in the remit of EU-As.

The course catalogue is a tool for the management and online display of various learning opportunities available within an institution, consortium, alliance, or any other form of collaboration between higher education institutions (HEIs).

A joint course catalogue, being implemented by many EU-As, enhances the visibility and comparability of diverse learning and mobility opportunities across HEIs. In the use case, the importance of aligned metadata of courses is emphasised so that learning opportunities can easily be collected for comparison and discovery.

## Challenges

The discovery process exposes some of the most salient interoperability challenges affecting several layers. From the perspective of the semantic layer, each organisation employs a specific data model to characterise its learning opportunities and adheres to a unique vocabulary to describe the content and scope of these opportunities. This is because, at the time of their establishment, HEIs developed their data models based on the needs of that moment. However, these models have since become outdated, as the current era of

interoperability requires mutually compatible data models. Creating a catalogue of opportunities offered by different institutions requires aligning in both structure and contents. On the technical side, some solutions used to manage the local catalogues do not offer a straightforward way to export the contents and, depending on the approach followed to present the information, there may be some scalability issues. From the organisational point of view, a joint catalogue faces several challenges. Institutions define their local processes to manage the lifecycle of the learning opportunities in their catalogues. Exposing learning opportunities in a joint catalogue requires considering the different processes involved in the creation, modification, and deletion of learning opportunities.

## Draft architecture

The discover use case requires several building blocks depicted in the figure below.

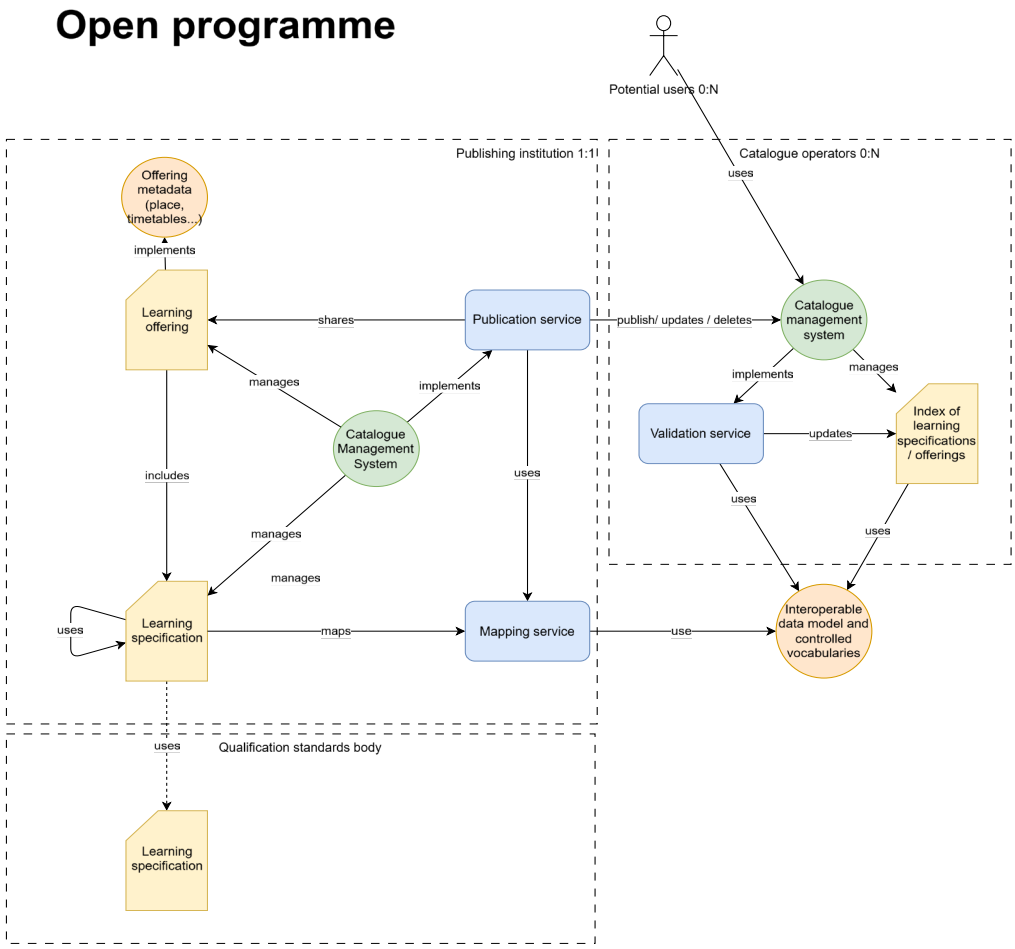


*Figure 1 - Use case 1 discover required building blocks and their relationships.*
*© 2025 European Union*

The main components inherent in this use case are:

**Business objects**

- **Learning specification:** The definition of a learning opportunity, includes the description of the different learning activities that will be conducted, the set of requisites to enrol, the specification of the learning assessments and learning outcomes achieved upon completing the opportunity.
- **Learning offering:** A specific instance of a learning specification that takes place in a specific academic calendar. Includes scheduling information. Even if the European Leaning Model (ELM)[1] standard does not differentiate between learning specification and offering, most alliances' management systems clearly differentiate. This differentiation is reflected accordingly in the architecture to support existing implementations. Throughout this report, specifications and offerings will be referred to as learning opportunities.

**Services**

- **Mapping service:** Service to translate between different data models and standards. Mapping services are widely used to enable interoperability between systems exposing a data model that differs from the receiving system. In this use case, mapping services play a key role in enabling seamless communication with the catalogue.
- **Harvester:** Service in charge of collecting information from management systems that do not offer publishing or exporting mechanisms. Harvesters usually scrape data from existing systems and prepare it to be sent to the central catalogue. Another usage of harvesters is to collect and merge information from different services to facilitate the mapping between different data models or standards.
- **Publication service:** Service sending information from a local catalogue to the central one. Publication services should use the same communication protocol as the catalogue ingesting service.
- **Validation service:** Service to check that data received adheres to the data standards and complies with the minimal required fields agreed upon beforehand. Validation services are not intended to interfere nor overlap with quality assurance processes and focus only on data structures compliance.

**Systems**

- **Catalogue management system:** System to manage the catalogue of learning opportunities.

[1] https://europa.eu/europass/elm-browser/index.html

# Reference architecture

## Organisational view

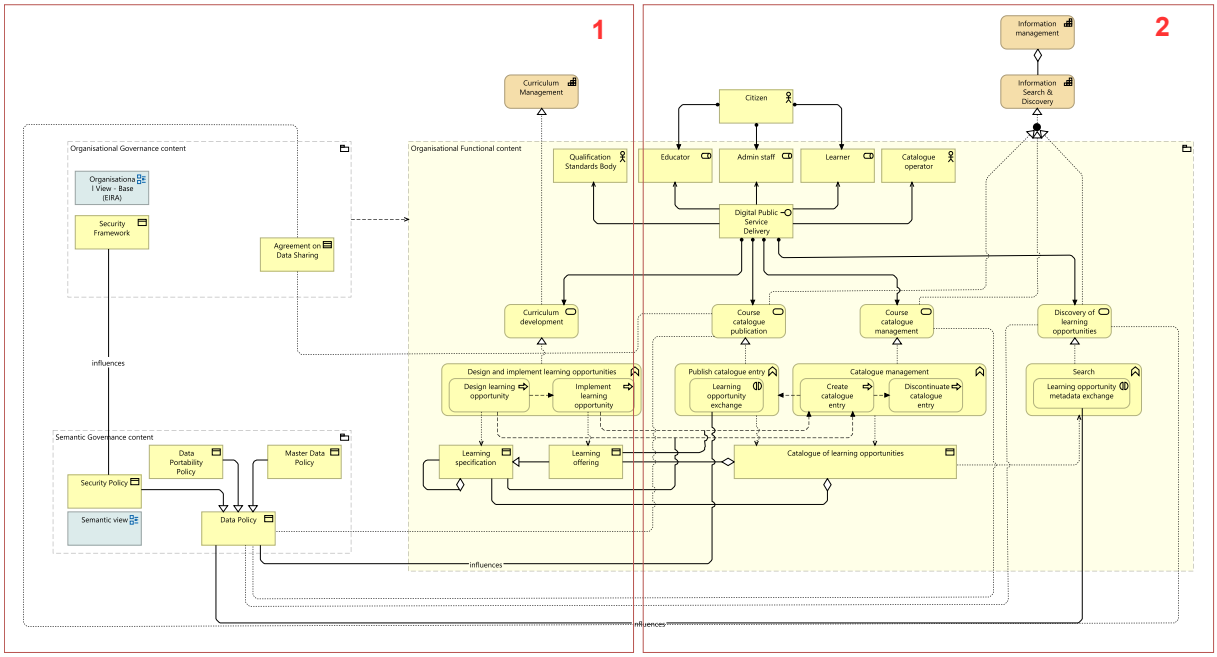


*Figure 2.1 - Use case 1 reference architecture organisational view.*
*© 2025 European Union*

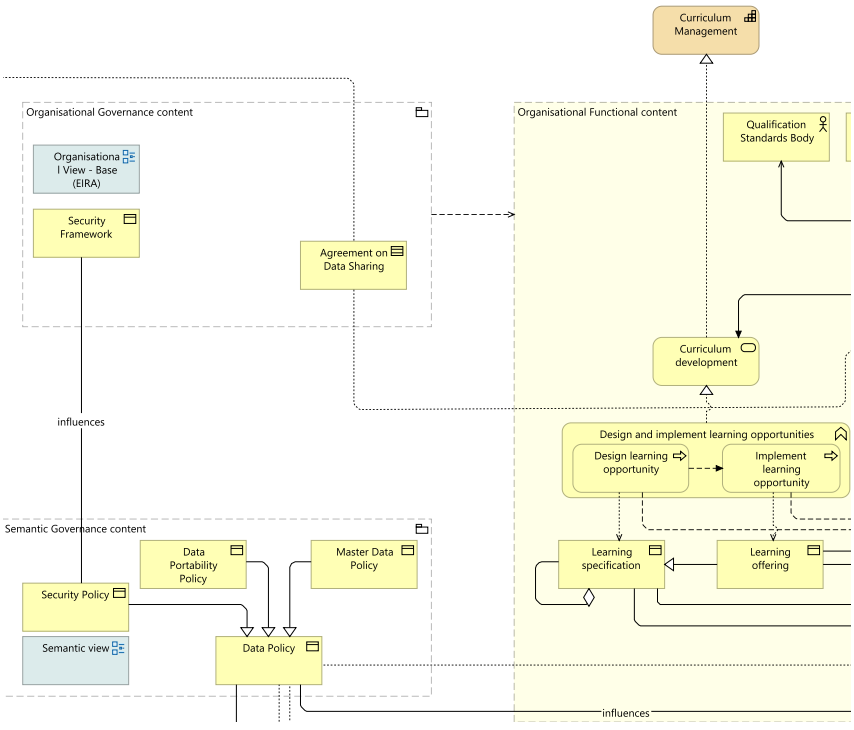


*Figure 2.2 - Use case 1 reference architecture organisational view.*
*© 2025 European Union*

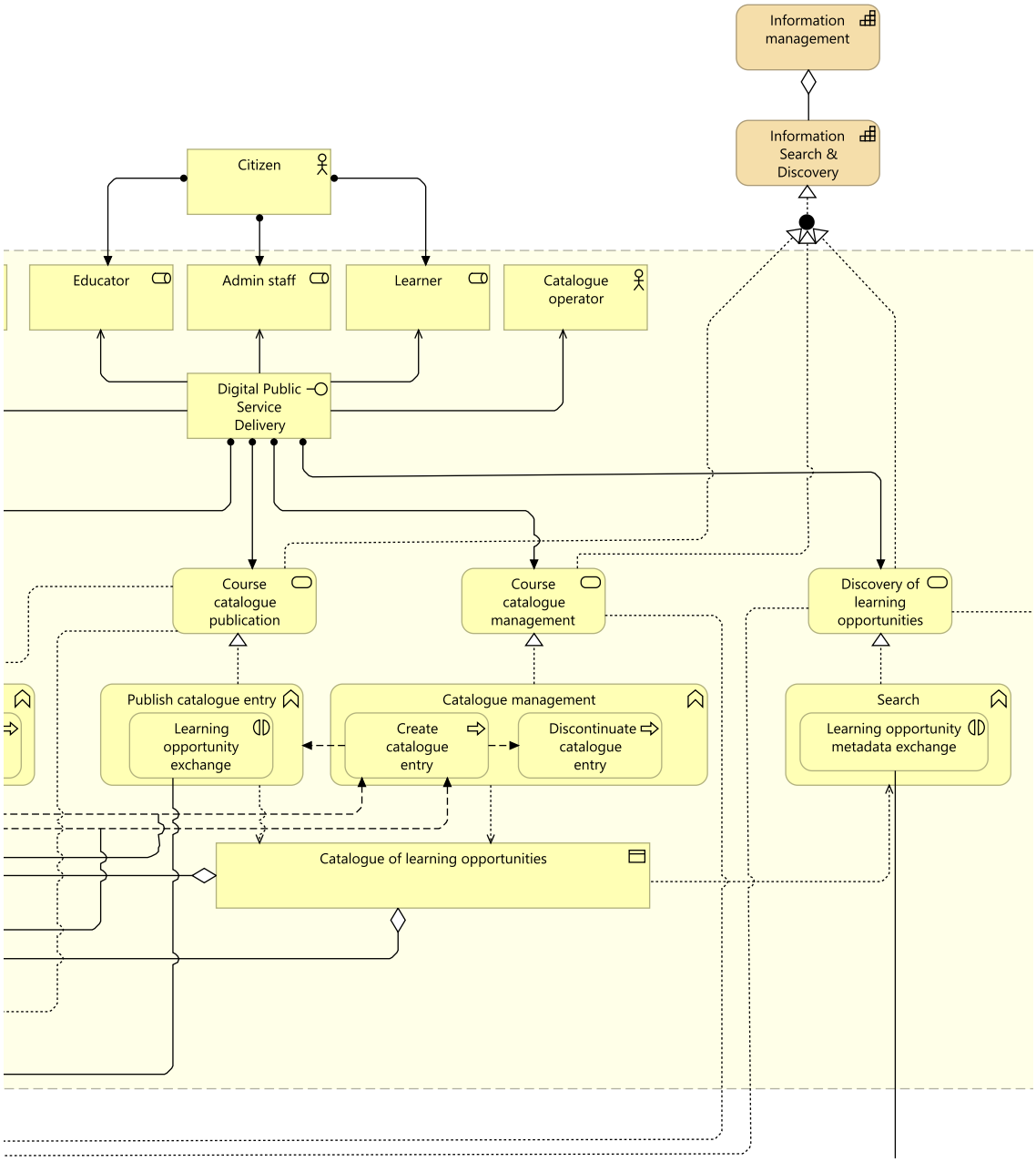


*Figure 2.3 - Use case 1 reference architecture organisational view.*
*© 2025 European Union*

In the previous diagram corresponding to the organisational view, the necessary capabilities for this use case can be identified, such as *curriculum management and information search & discovery*. These required capabilities are implemented by the four main services: *Curriculum development, Course catalogue publication, Course catalogue management, and Discovery of learning opportunities*. These services are further implemented through their corresponding functions and processes and influenced by the necessary data policies and agreements.

The following table describes the main building blocks that have been refined over the course of the first squad series. For the missing blocks see the shared building blocks table.

| Building block | Type | Description |
|---|---|---|
| **Agreement on Data Sharing** | Contract | Agreement on data sharing ABB is a contract formalising the information requirements, syntax bindings, protocols and semantic artefacts that must be used for the exchange of data. |
| **Catalogue of Learning Opportunities** | Business Object | Collection of learning opportunities offered by one or multiple institutions. |
| **Course Catalogue Management** | Business Service | Course catalogue management ABB provides services for maintaining a collection of courses and learning opportunities offered by an institution. |
| **Course Catalogue Publication** | Business Service | Course catalogue publication ABB represents the service for making the course catalogue available to students. |
| **Create Catalogue Entry** | Business Process | Create catalogue entry is the process of adding new courses or learning opportunities to the course catalogue. |
| **Curriculum Development** | Business Service | Curriculum development ABB is an application service that enables the processes to produce complete specifications of structured learning opportunities such as courses or programmes. |
| **Curriculum Management** | Capability | Curriculum management designs and produces, or sources, structured learning activities such as courses, subjects, and units, and ensures the institution is able to deliver them. |

| | | |
|---|---|---|
| **Design and Implement Learning Opportunities** | Business Function | Design and implement learning opportunities ABB is a business function to create and deploy structured educational programs that provide learning experiences. |
| **Design learning opportunity** | Business Process | Produces complete specifications of structured learning opportunities. |
| **Discontinue Catalogue Entry** | Business Process | Discontinue catalogue entry ABB represents the process of removing or deactivating a course or learning opportunity from the course catalogue, often due to changes in curriculum or course availability. |
| **Discovery of Learning Opportunities** | Business Service | Discovery of learning opportunities ABB is the service that represents the search for courses or programmes. |
| **Implement Learning Opportunity** | Business Process | Implement learning specifications as deliverable educational products. |
| **Information Search & Discovery** | Capability | Information search & discovery provides tools, catalogues, and services that help people locate and access information. |
| **Learning Opportunity Exchange** | Business Interaction | Learning opportunity exchange ABB is a business interaction that represents the sharing and access to various learning opportunities between different educational institutions or platforms. |
| **Learning Opportunity Metadata Exchange** | Business Interaction | Learning opportunity metadata exchange ABB refers to the transfer of structured information or metadata about learning opportunities between systems to ensure interoperability. |
| **Publish Catalogue Entry** | Business Function | Publish catalogue entry is the action of making a specific course or learning opportunity publicly available in the course catalogue for discovery by potential learners. |
| **Qualification Standards Body** | Business Actor | Qualification standards body ABB is a business actor that represents an organisation or authority responsible for defining and maintaining the standards and criteria for various qualifications or credentials. |

## Semantic view

The following ArchiMate view corresponds to the semantic view. In this view, building blocks from both the business and technical layers are combined to represent the flow of mapping non-standardised data to standardised data. The use of semantic agreements for this standardisation is represented through the relationship between the business ArchiMate Building Block (ABB) Semantic Agreement and the technical ABB Data Standard.

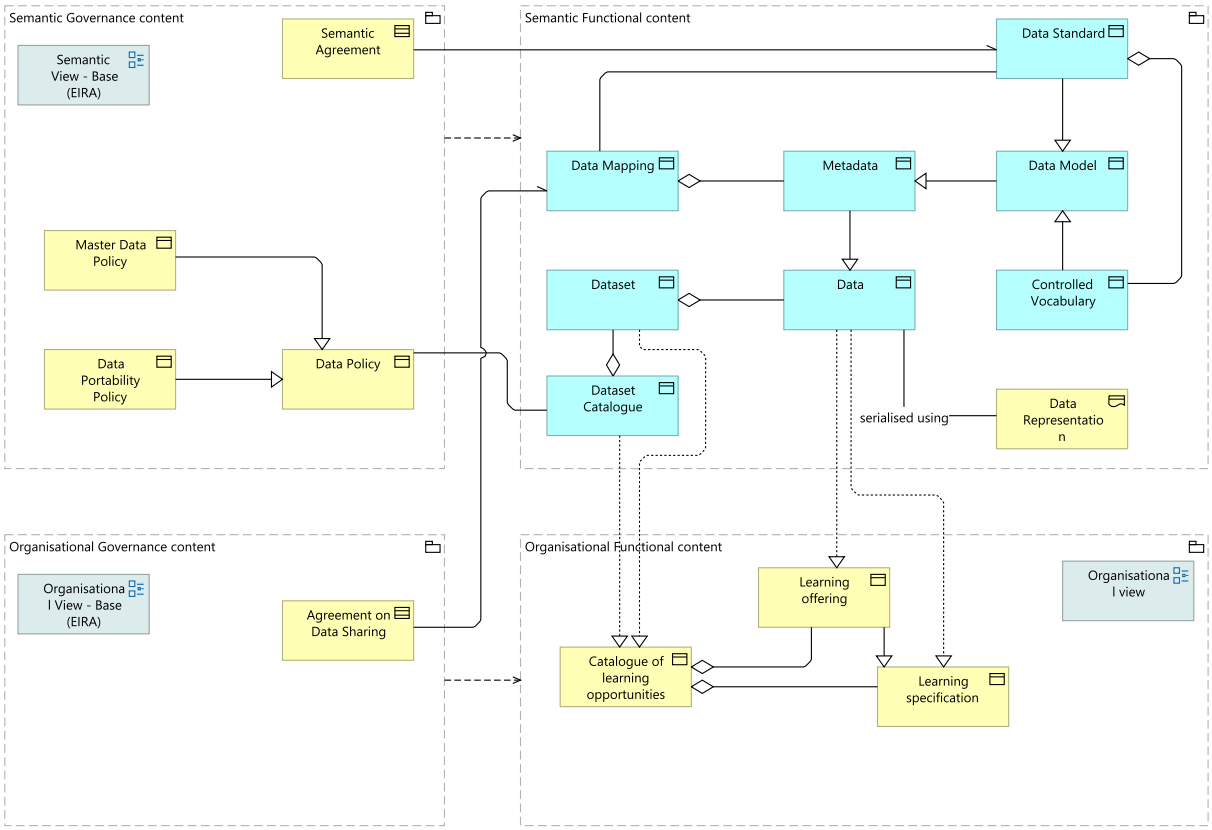


*Figure 3 - Use case 1 reference architecture semantic view.*
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## Technical view

The final view presented in this architecture for use case 1 represents the technical layer. This view includes not only the target interoperable solutions but also the current solutions implemented by institutions. In addition, to representing these as active components within the architecture, the relationship between non-interoperable and interoperable components is detailed, providing a coexistence view that can facilitate a transition towards interoperability. The interoperable solutions rely on the use of standardised metadata through a mapping service, with this data standardisation supported by the semantic agreements defined in the semantic layer.

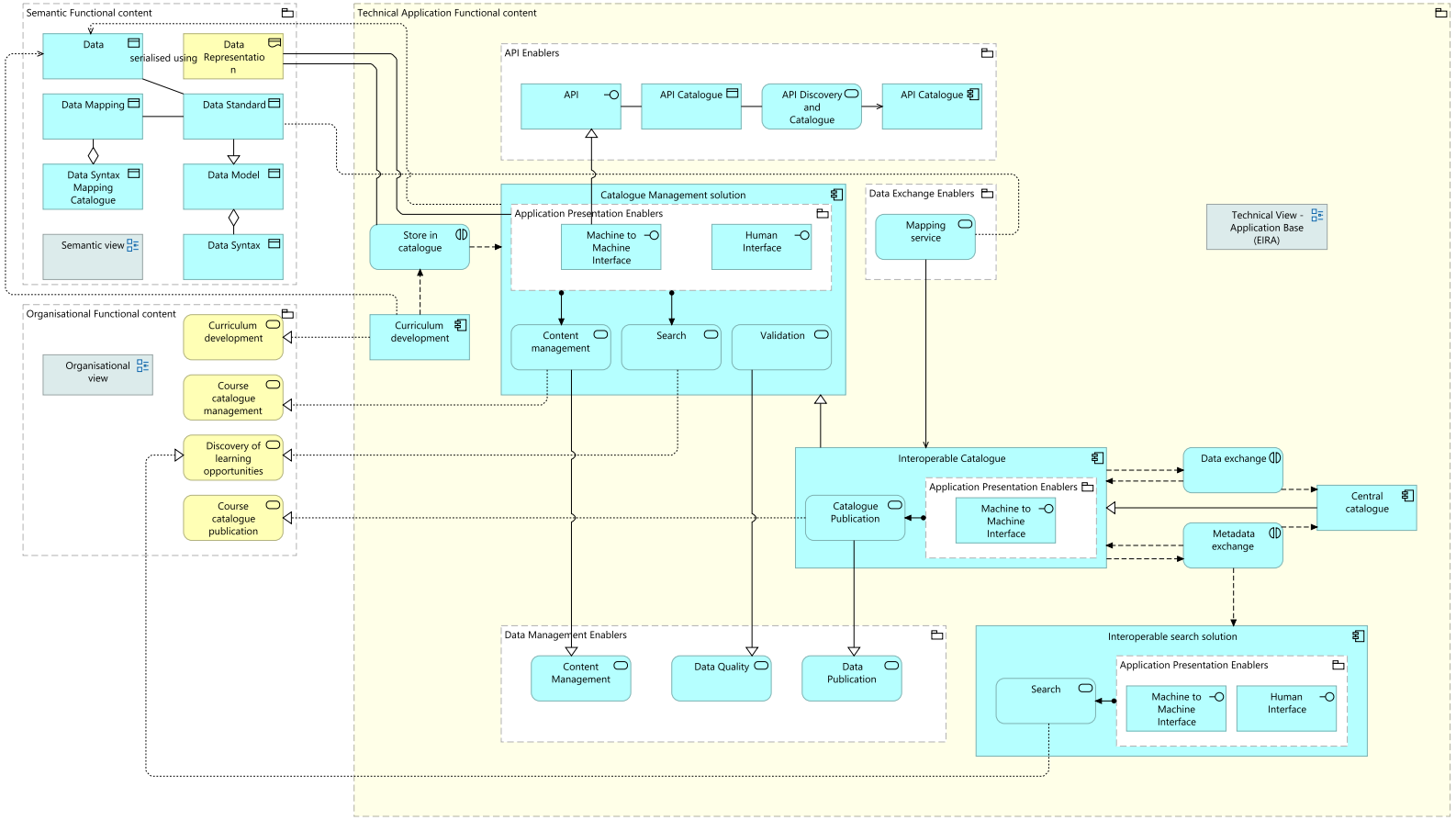


*Figure 4 - Use case 1 reference architecture technical view.*
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In the following table, the most prominent building blocks refined during the first squad series are described. For the missing blocks, see the shared building blocks table.

| Building block | Type | Description |
|---|---|---|
| **API Catalogue** | Data Object | API catalogue ABB is a data object that corresponds to a collection of (open) software interfaces that allow data consumption by a specific digital solution. |
| **Course Catalogue Publication** | Business Service | Course catalogue publication ABB represents the service for making the course catalogue available to students. |
| **Data Syntax** | Data Object | Data syntax ABB is a data object defining the way in which data is put together with appropriate identifiers, delimiters, separator character(s), and other non-data characters to form messages. |
| **Data Syntax Mapping Catalogue** | Data Object | Data syntax mapping catalogue ABB is a data object bridging the differences between two systems, or data models, so that when data is moved from a source, it is accurate and usable at the destination. |

For a more comprehensive view of this architecture, it is recommended to review the ArchiMate diagrams associated with this document.

PART 2

# Use case 2 – Apply and get recognition

# Use case 2 - Apply and get recognition

USE CASE 2

**Apply and get recognition**

Simplifying credit recognition and cross-institutional enrolment, emphasising seamless data exchange to support all forms of learner mobility and academic continuity.

Admissions | Recognition

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The Apply and get recognition use case focuses on the processes required to manage study applications, including candidate evaluation, admission and finally enrolment. Getting recognition refers to the appraisal of the learner's previous credentials, which is critical for an admission decision. Thus, the use case aims to simplify credit recognition and cross-institutional enrolment, emphasising seamless data exchange to support all forms of learner mobility and academic continuity.

## Challenges

This use case addresses various challenges related to interoperability. One key aspect is recognising prior learning experiences by mapping the learning outcomes listed in educational credentials to the requirements evaluated during the admission process. On the semantic level, different controlled vocabularies used to describe learning outcomes have to be mapped to enable comparison. From the organisational perspective, interinstitutional agreements play a key role in defining the set of rules and processes required to recognise credentials issued by other institutions.

The proposed architecture considers the existence of a designated registrar. This stakeholder centralises the registration of student applications. This centralisation requires that institutions receiving the applications can use the information seamlessly in their internal admission processes. The same challenges are relevant for the enrolment and matriculation processes conducted in centralised platforms.

## Draft architecture

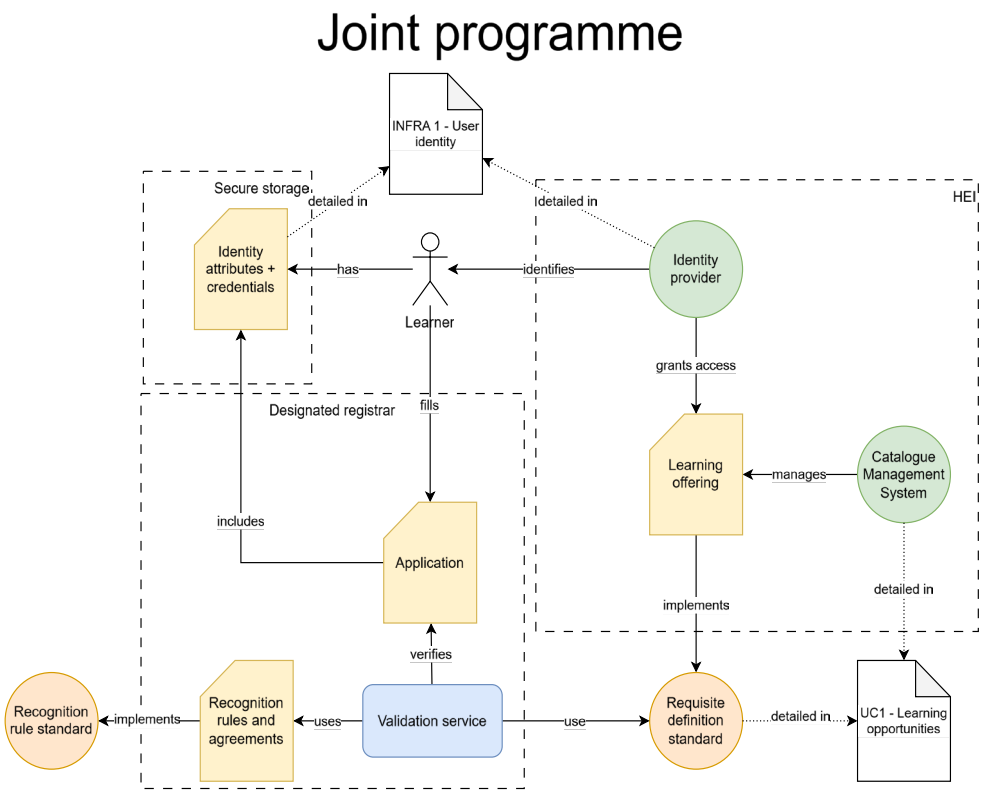


*Figure 5 - Use case 2 required building blocks and their relationships – scenario 1.*
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The mobility scenario is heavily influenced by the existing Erasmus+ process. In this scenario, learners are already registered in their home institution and have an identifier available. Both institutions have previously assessed the quality requirements of the other institution, exam committees have verified the assessment policies, and an inter-institution agreement has been signed.

# Mobility

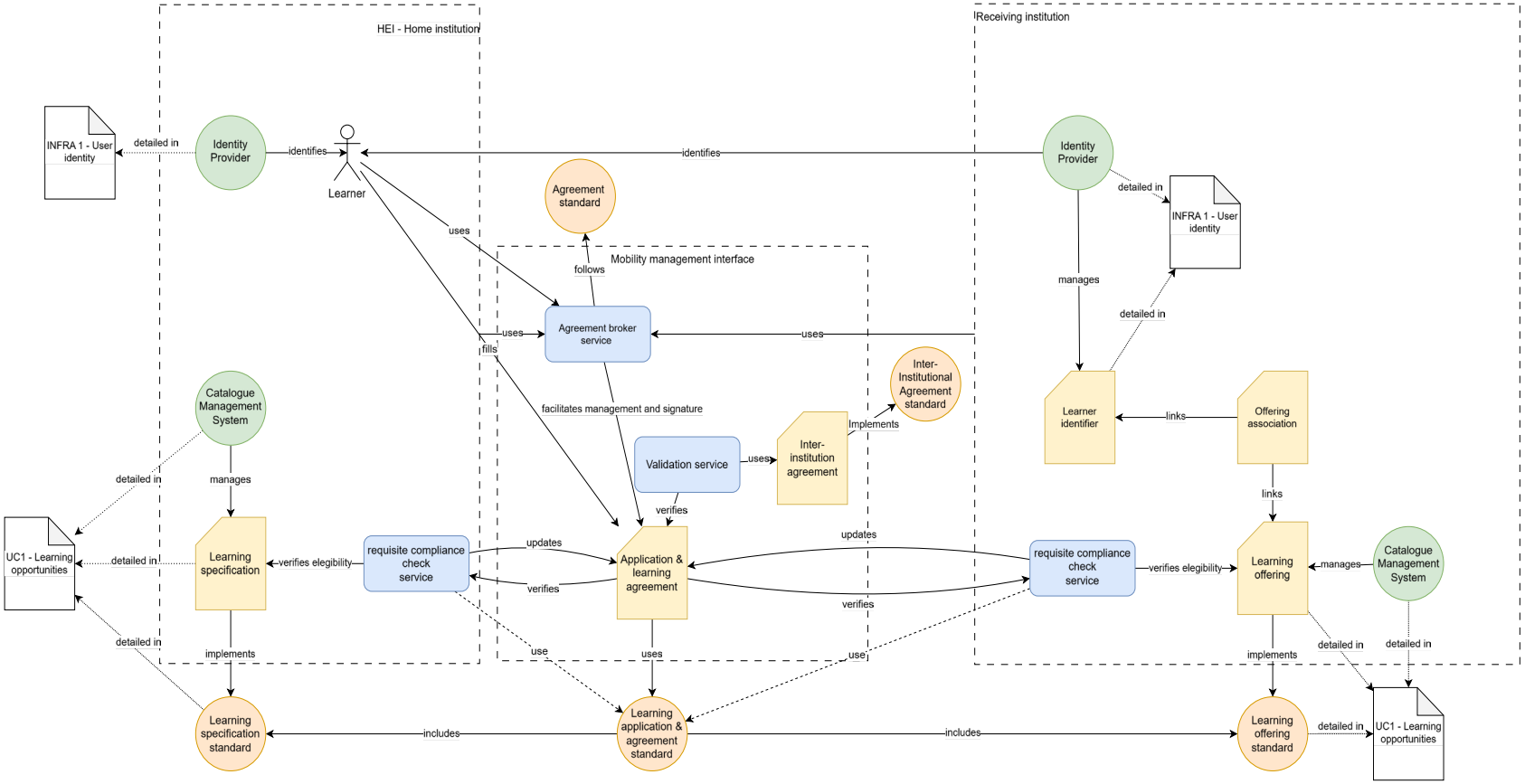


*Figure 6 - Use case 2 required building blocks and their relationships – scenario 2.*

The process begins with an application form filled by learners, including the list of learning offerings they wish to take in the receiving institution and the list of learning specifications to be recognised upon successful completion in the receiving institution. The application must be validated in both institutions. To make this validation process interoperable, learning agreements should adhere to a data standard facilitating the requisite compliance check process. Once the application has been approved, a learning agreement is signed by all the interested parties: the learner, the sending institution and the receiving institution. The agreement broker facilitates the signing process and is outside the scope of this project. The learner's identity is then transferred to the receiving institution to facilitate the local enrolment process.

The main components inherent to this use case are:

**Business objects**

- **Identity attributes:** Attributes required to verify the identity of a learner. This data object will be explained in detail in the use case focused on user identity.
- **Credentials:** Physical or digital credentials certifying previous learning achievements or claims presented by a learner.
- **Application:** Includes all the required data to validate and verify the eligibility of a learner to participate in a learning opportunity.
- **Recognition rules and agreements:** An organizational interoperability agreement including rules to recognize previous achievements presented by a learner.
- **Learning offering:** A specific instance of a learning specification that takes place in a specific academic calendar. Includes scheduling information.
- **Learning specification:** Definition of a learning opportunity, includes the description of the different learning activities that will be conducted, the set of requisites to enrol, the specification of the learning assessments and learning outcomes achieved upon completing the opportunity.

**Services**

- **Validation service:** Service to validate the information from an application.
- **Requisite compliance check service:** Service overseeing the verification of learner's previous achievements match the required skills to enrol in an opportunity. In some scenarios the scheduling constraints of a specific offering must be considered.

**Systems**

- **Identity provider:** System managing learner identity. Described in detail in the use case focused on user identity. Oversees the identification of learners and manages identity attributes required to authenticate and authorize access to the required systems.
- **Catalogue management system:** System to manage the catalogue of learning opportunities.

# Reference architecture

## Organisational view

For this use case, aligning with the draft architecture, four main capabilities are identified: Credit for Prior Learning Management, Cross-Institutional Study, Study Application Management, and Enrolment. All of these capabilities are connected to the process of enrolling learners across different institutions, considering processes such as the prior recognition of credits granted by other institutions. This can be seen in the previous diagram, which represents the organisational layer. In this layer, these capabilities are shown as being implemented by their corresponding services, exposed through an interface.

Key elements and potential pain points include the processes related to agreements between institutions during enrolment and the credit recognition process. Both processes can pose significant challenges, as they rely on concepts like trust between institutions and the potential lack of uniformity in learning outcomes.

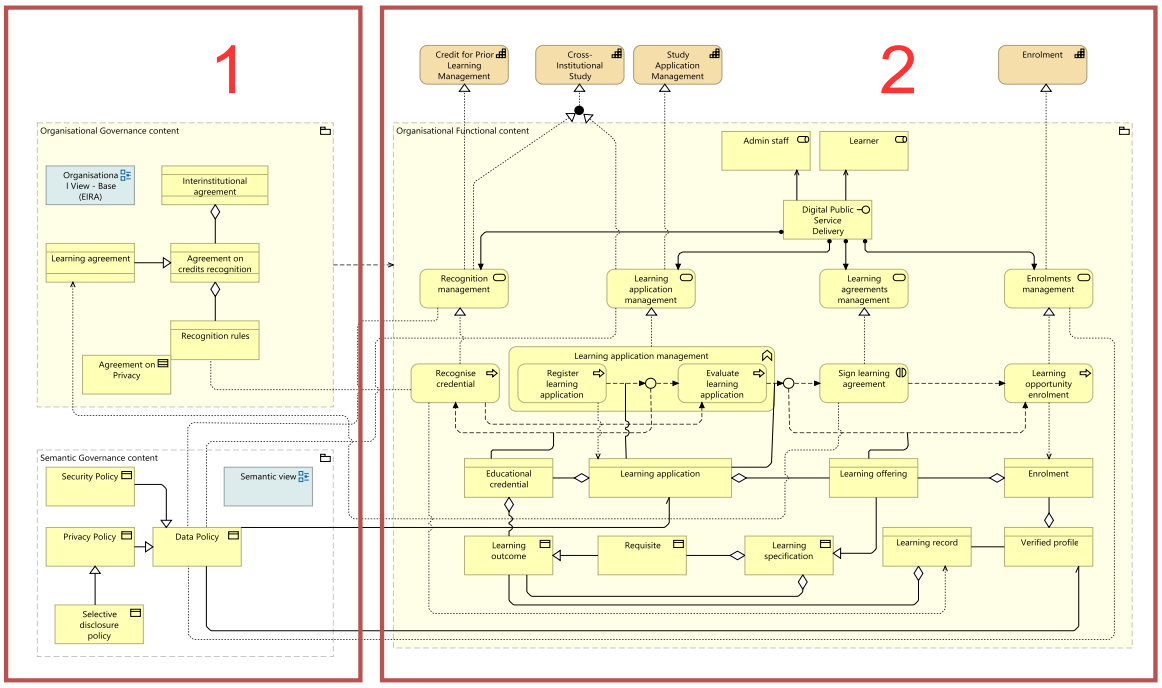


*Figure 7.1 - Use case 2 reference architecture organisational view.*
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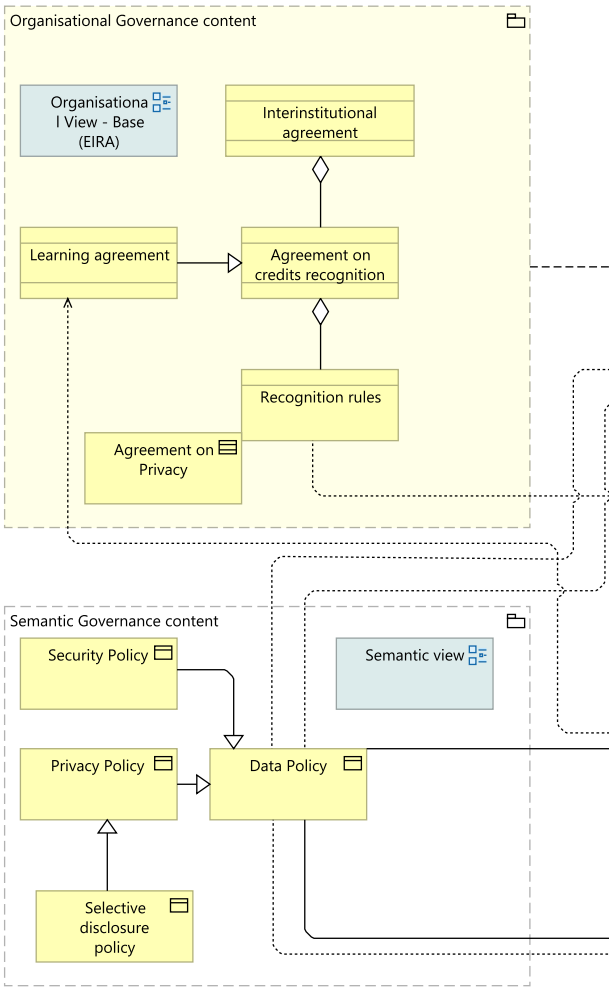


*Figure 7.2 - Use case 2 reference architecture organisational view.*
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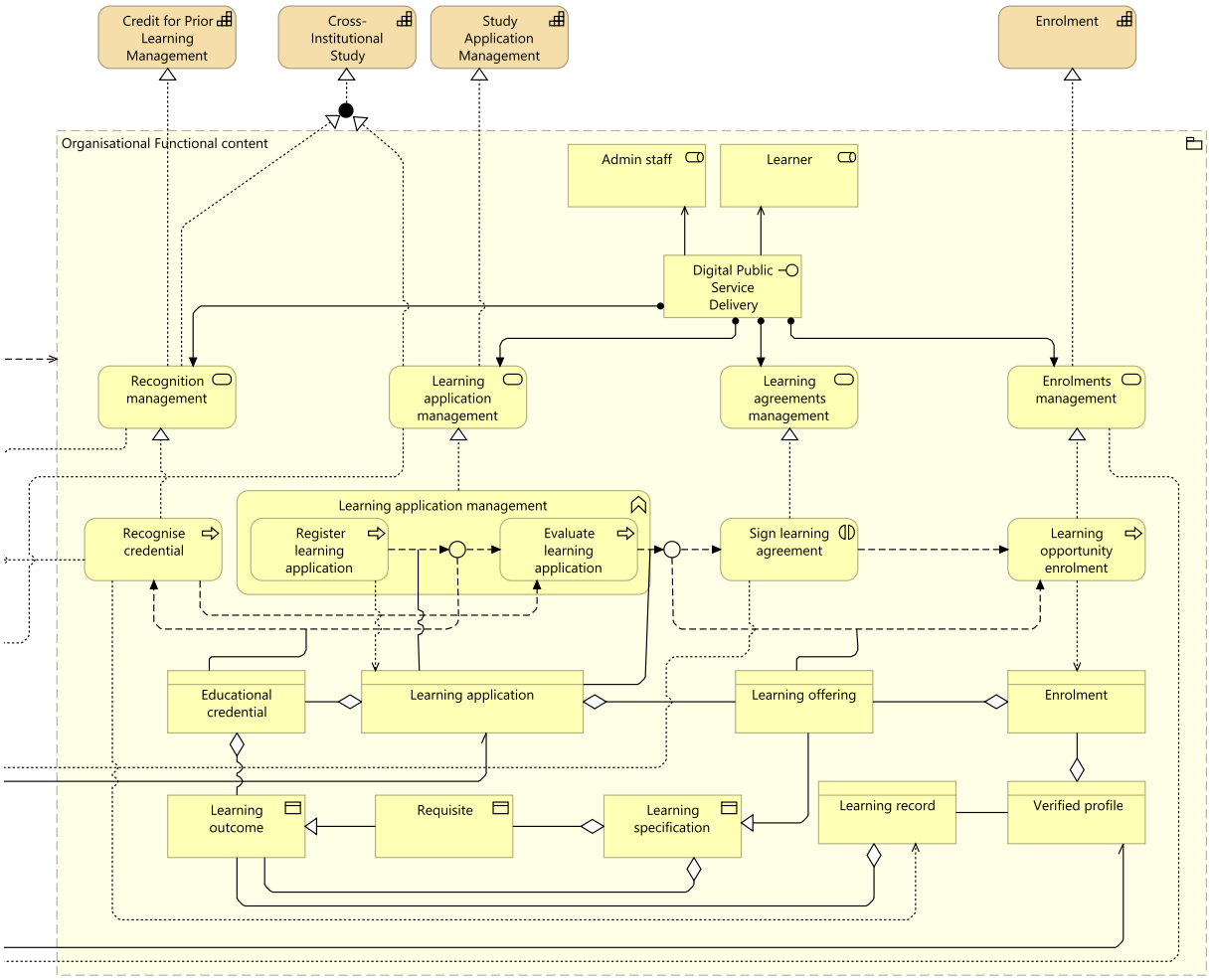


*Figure 7.3 - Use case 2 reference architecture organisational view.*
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In the following table, the most prominent building blocks are described.

| Building block | Type | Description |
|---|---|---|
| **Agreement on Credits Recognition** | Contract | A formalised contract or agreement between institutions that outlines the terms and conditions under which academic or professional credits are recognised, transferred, or applied in different contexts or programs. |
| **Credit for Prior Learning Management** | Capability | Credit for prior learning management receives, assesses, and responds to applications for credit in recognition of equivalent prior study or experience. |
| **Cross-Institutional Study** | Capability | Cross-Institutional study manages formal study away from the home institution. |
| **Enrolment** | Capability | Enrolment manages students' formal registration in curriculum elements. |
| **Enrolments Management** | Business Service | A service that facilitates the administration of enrolment processes, including the registration, tracking, and management of individuals in programmes or courses, ensuring accurate records and compliance with institutional requirements. |
| **Evaluate Learning Application** | Business Process | A process that involves assessing and reviewing a learning application (such as an educational program or course). |
| **Interinstitutional Agreement** | Contract | The interinstitutional agreement ABB is a contract that aggregates agreements on credit recognition. This contract represents high-level interinstitutional agreements for the recognition of credits when carrying out joint programs. |
| **Learning Agreement** | Contract | A formal agreement between a learner and an institution or organisation that outlines the terms and conditions of the learning experience, including objectives, responsibilities, and assessment criteria. |
| **Learning Agreements Management** | Business Service | A service that oversees the creation, tracking, and management of learning agreements between learners and institutions, ensuring compliance with educational standards, updating terms as necessary, and maintaining accurate records throughout the learner's journey. |
| **Learning Application** | Business Object | A record or application that contains information submitted by a learner to request participation in a learning program or course, including details such as personal data, qualifications, and intended learning outcomes. |

| | | |
|---|---|---|
| **Learning Application Management** | Business Function | Learning application management ABB is a business function that encompasses the business processes of registering a learning application and evaluating the learning application. These processes are integrated with credential recognition and serve as a preliminary step before the learner's enrolment. |
| **Learning Application Management** | Business Service | A service that encompasses the processes of receiving, processing, and tracking learning applications from learners, including the evaluation of eligibility, assessment of qualifications, and integration with other services such as credential recognition and enrolment. |
| **Learning Opportunity Enrolment** | Business Process | Learning opportunity enrolment ABB is a business process that represents the final step in the learner's enrolment. This process updates the enrolment business object, which is in turn aggregated by the verified profile business object, capable of representing a learner. |
| **Recognise Credential** | Business Process | Recognise credential process determines whether an education credential of previous learning activities meets the requirements to be recognised by the institution. |
| **Recognition management** | Business Service | A service that enables the business process of credential recognition |
| **Recognition Rules** | Business Object | Set of rules to be followed when evaluating an application. |
| **Register Learning Application** | Business Process | A business process in which an actor registers a learning application business object |
| **Requisite** | Business Object | A business object that represents the series of requisites for a learning application |
| **Selective Disclosure Policy** | Business Object | Selective disclosure policy ABB is a business object that regulates the access to personal data of any actor interacting with the systems. Includes for each business process requiring access to personal data, the minimum set of attributes required. Based on recommendation 13 of the European Interoperability Framework (EIF), users should be asked to provide only the information that is absolutely necessary to obtain a given public service. |
| **Sign Learning Agreement** | Business Interaction | Sign learning agreement ABB is a business interaction that implements the learning agreements management service. This business interaction is the step preceding the learner's enrolment and encompasses the processes of signing interinstitutional agreements. |
| **Study Application Management** | Capability | Study application management receives, assesses, and responds to applications to study. |

## Semantic view

For use case 2, the view of the semantic layer highlights the agreements around the standards used to define not only learning outcomes but also learning offerings and learning specifications. An identified pain point in this architecture relates specifically to these learning outcomes, as for agreements to exist, they must be well defined and interoperable - an aspect that can be challenging when trying to reach a consensus between different institutions. The recommendations section provides more details on how to make learning outcomes more interoperable.

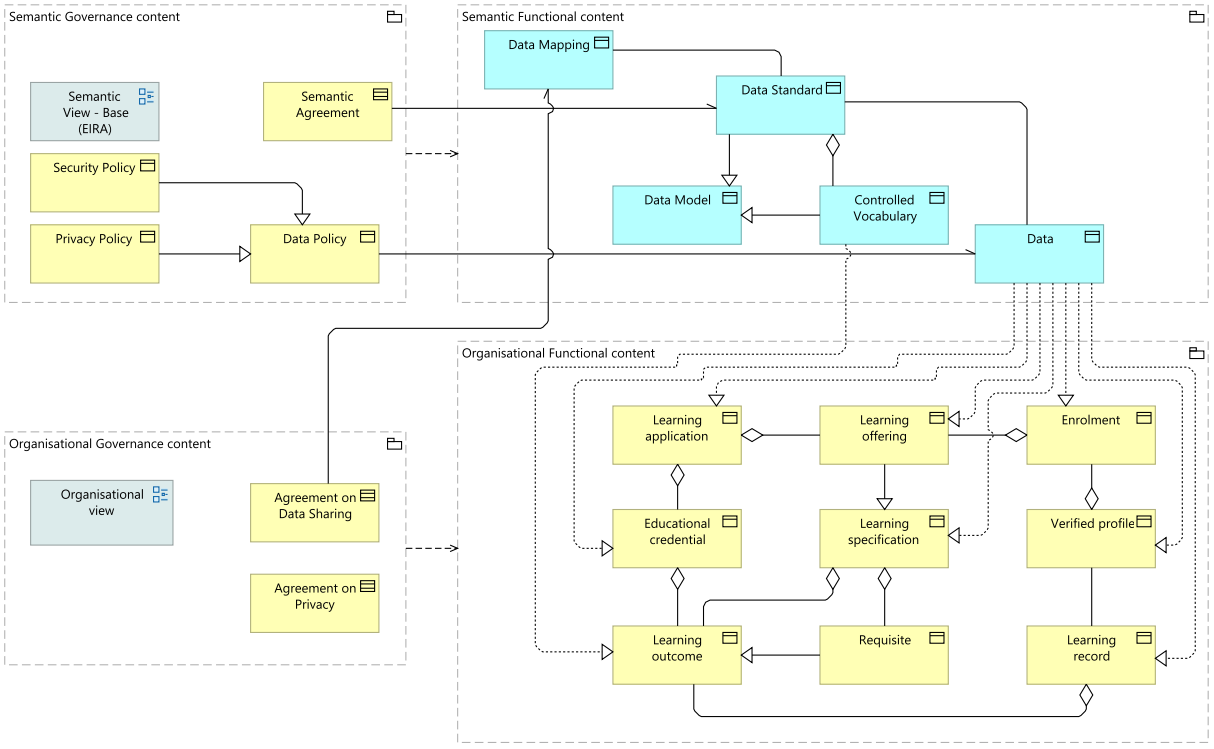


*Figure 8 - Use case 2 reference architecture semantic view.*
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## Technical view

In the technical view of use case 2, several groupings can be distinguished based on their function. Multiple types of enablers are defined according to their field: those related to trust management, data exchange, privacy, security, and data management. In addition to these enablers, there is the application block related to student management. This large block contains the services that implement the enrolment and credit recognition process, which are exposed through interfaces. Also, these application ABBs are linked to their counterparts in the business layer.

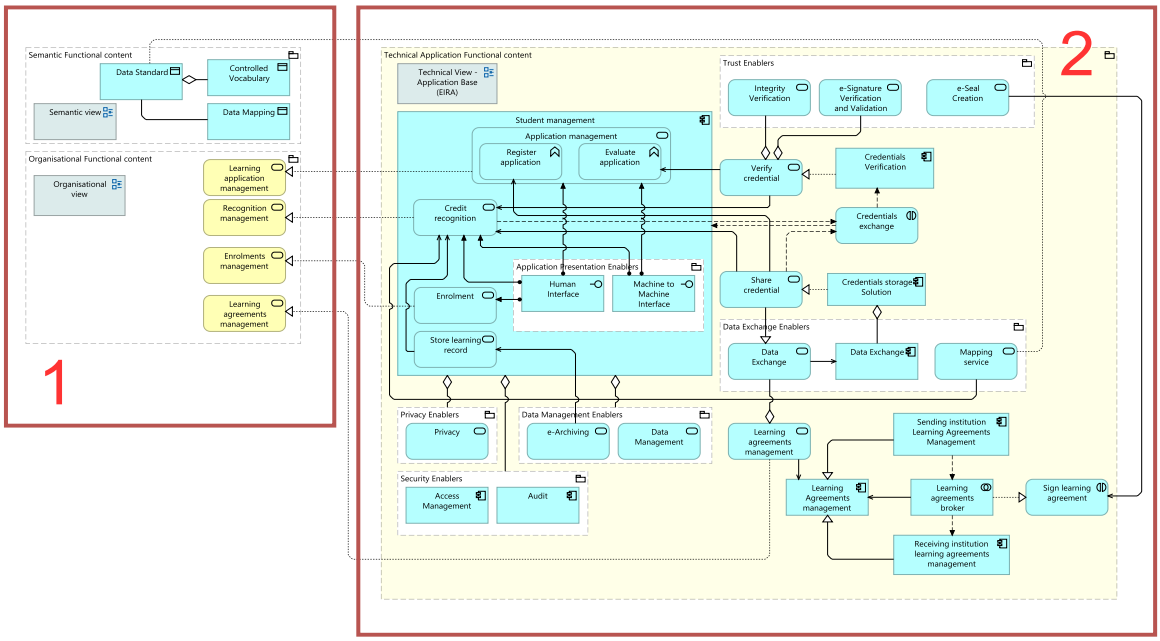


*Figure 9.1 - Use case 2 reference architecture technical view.*
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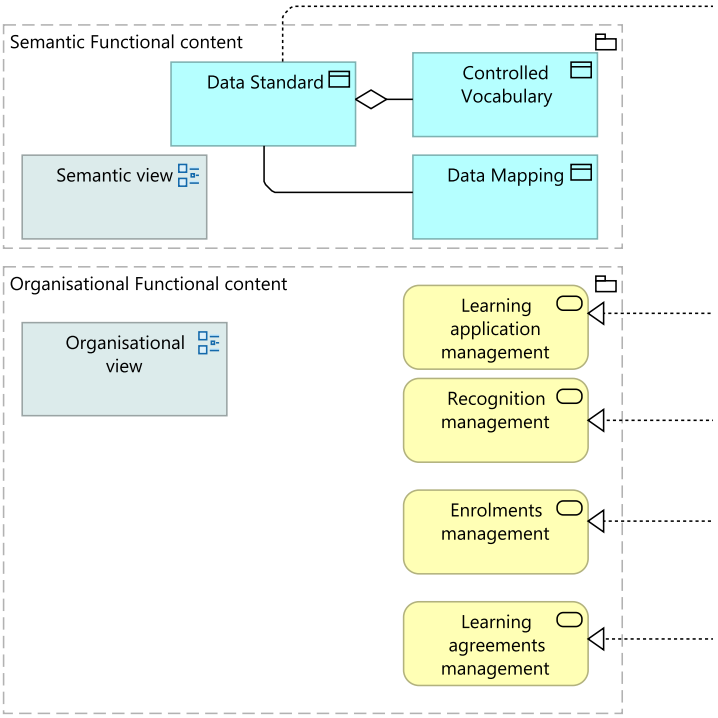


*Figure 9.2 - Use case 2 reference architecture technical view.*
*© 2025 European Union*

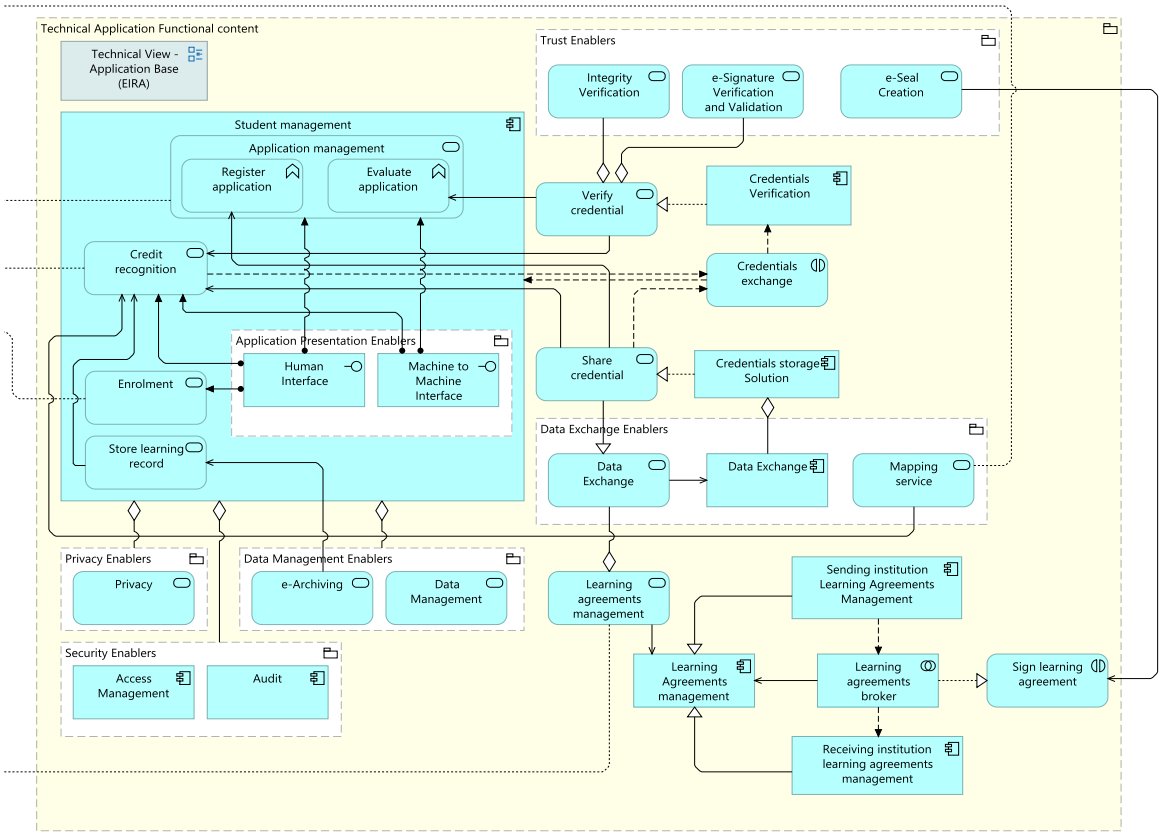


*Figure 9.3 - Use case 2 reference architecture technical view.*
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The following table describes the most prominent building blocks refined during the first squad series.

| Building block | Type | Description |
|---|---|---|
| **Application Management** | Application Service | Application management ABB is an application service that allows application management |
| **Audit** | Application Component | Audit ABB is an application component that monitors, records, and analyses system activities to ensure compliance, detect anomalies, and enhance security. |
| **Credentials Exchange** | Application Interaction | Credentials exchange ABB is an application interaction that represents the data flow interactions followed by the credentials that are shared to be recognised in the learner's application. |
| **Credentials Verification** | Application Component | Credentials verification ABB is an application component that represents the application responsible for verifying user credentials through the verify credentials service in the evaluate application process. |
| **Credit Recognition** | Application Service | A service that facilitates the assessment and validation of credits earned by a learner, ensuring their recognition and transferability across institutions or programs. |
| **Data Exchange** | Application Component | A software component that enables the secure and structured exchange of data between different systems, applications, or organisations, supporting interoperability and compliance with data standards. |
| **Data Management** | Application Service | A service responsible for the collection, storage, organisation, and governance of data, ensuring its availability, accuracy, security, and compliance with regulations throughout its lifecycle. |
| **e-Archiving** | Application Service | e-Archiving ABB is an application service enabling the permanent or long-term storage of selected (by an authority) electronic documents or information for preservation purposes like their enduring research value and memory aid. |
| **e-Seal Creation** | Application Service | e-Seal creation ABB is an application service that enables the signing of data in electronic forms on behalf of a legal person. |
| **e-Signature Verification and Validation** | Application Service | e-Signature verification and validation service ABB is an application service that enables the process of verifying and confirming that an electronic signature or a seal is valid. |

| | | |
|---|---|---|
| **Integrity Verification** | Application Service | Integrity Verification ABB is an application service that enables the procedures to ensure that information has not been altered in an unauthorised manner since it was created, transmitted or stored. |
| **Learning Agreements Broker** | Application Collaboration | Learning agreements broker ABB is an application collaboration that synchronises the agreements among all parties involved in the learner's application process. |
| **Learning Application Management** | Business Service | Learning application management ABB is a business service that enables the implementation of the study application management business capability. |
| **Privacy** | Application Service | Privacy ABB is an application service enabling the share of functionalities such as storing, securing, anonymising, pseudonymising, rectifying and erasing personal data. |
| **Receiving Institution Learning Agreements Management** | Application Component | A software component used by the receiving institution to manage the lifecycle of learning agreements, including their creation, approval, tracking, and updating to ensure alignment with institutional and inter-institutional requirements. |
| **Register Application** | Application Function | A function that enables the registration of applications submitted by learners, ensuring their proper entry into the system and preparing them for subsequent evaluation and processing. |
| **Sending Institution Learning Agreements Management** | Application Component | A software component used by the sending institution to manage the creation, validation, and sharing of learning agreements, ensuring compliance with academic and institutional standards. |
| **Share Credential** | Application Service | A service that enables the secure and verified sharing of academic or professional credentials between individuals, institutions, or organisations, ensuring authenticity and compliance with relevant standards. |
| **Store Learning Record** | Application Service | A service that provides secure storage for learning records, ensuring their integrity, accessibility, and proper organisation for future reference or verification. |
| **Student Management** | Application Component | Student management ABB is an application component that encompasses and implements the services related to the learner's application workflow, making them accessible through interfaces. |

For a more comprehensive view of this architecture, it is recommended to review the ArchiMate diagrams associated with this document.

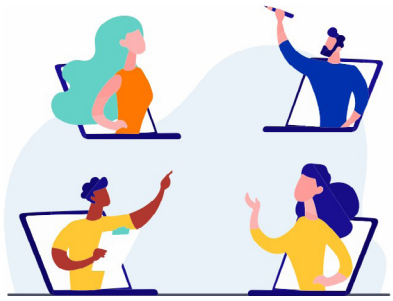
PART 3

# Use case 3 – Access tools

# Use case 3 – Access tools

USE CASE 3

## Access tools



Streamlining the management and governance of shared resources among alliance members, covering both physical and virtual assets.

Laboratory access | Library systems | Research tool registry



The goal of this use case is to streamline the procurement, management, and governance of shared tools among alliance members, covering both physical and virtual resources.

Shared physical and virtual tools are infrastructures, devices, or applications used to support learning. These tools can include, but are not limited to:

- Physical Resources: Specialised laboratories, physical libraries, hardware equipment such as cameras, 3D printers, or augmented reality devices.
- Virtual Resources: Digital whiteboard software, video conferencing platforms, virtual training systems, interactive simulators, and community software for online collaboration.

These tools differ from educational resources, which are addressed in use case 4. Educational resources refer to pedagogical content designed specifically to support learning, such as courses, modules, reading materials, or question banks.

While these tools are relevant for facilitating joint activities, they are not considered a critical obstacle to the primary goals of the alliances, such as managing credential recognition or academic data exchange. Work to date has shown that the discoverability of virtual and physical resources is not currently a priority for alliances, as the volume of requests is still manageable following local and manual processes.

As alliances continue their journey towards interoperability, the sharing of tools, especially for joint programme scenarios, will become more common. Yet, being able to expose the assets can be important for institutions and alliances focused on research as part of their institutional identity.

Outside of the scope of this use case are interoperability with tools provided by external partner companies to the alliance as well as the negotiation of the terms of use and pricing.

## Challenges

Sharing assets between institutions poses several challenges. The diversity of tools with different purposes and descriptions leads to different data models. Thus, complicating a harmonized presentation of their information and centralised search portals. Language barriers and differing terminologies between institutions complicate the discoverability and comparison of tools. Additionally, the procedures to gain access to specific tools vary across institutions. The need for a common method to describe the availability of information is also a significant challenge.

## Draft architecture

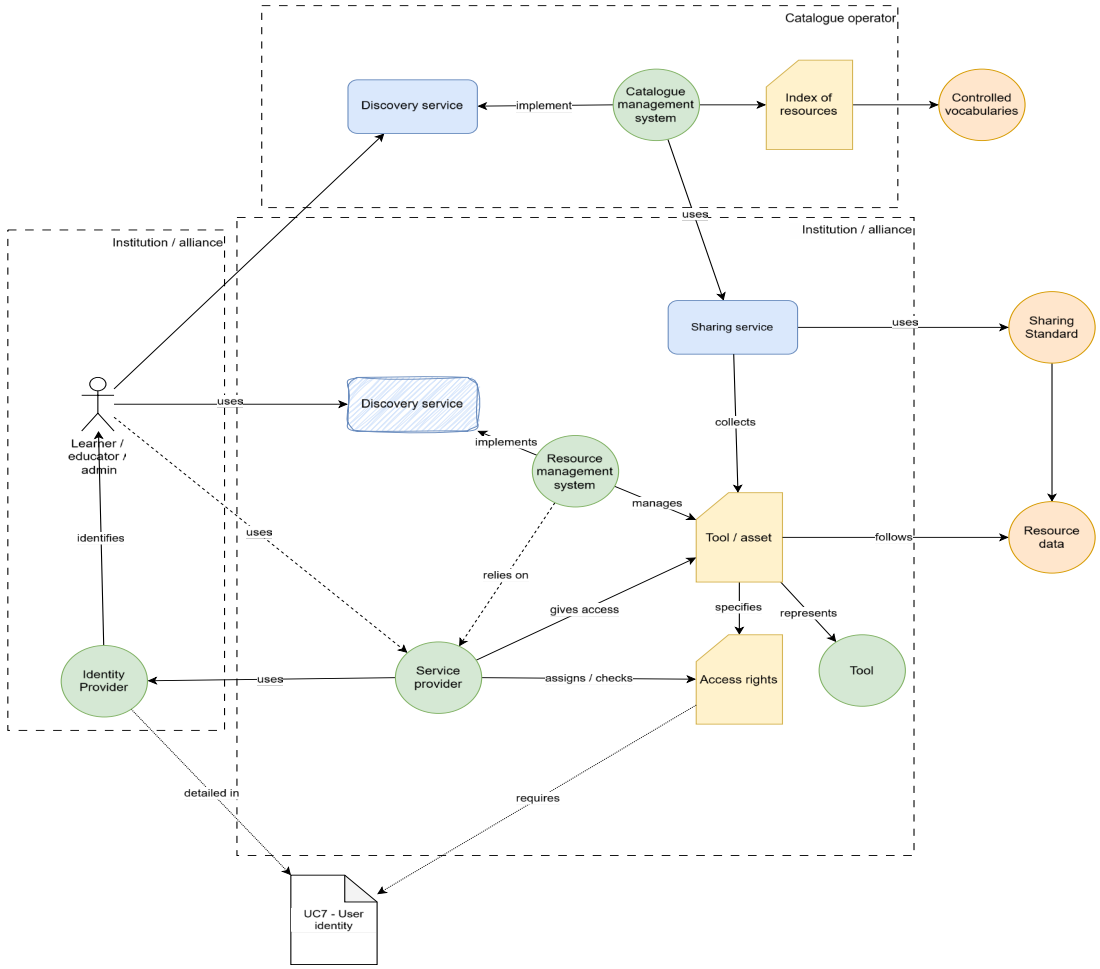



*Figure 10 - Use case 3 required building blocks and their relationships.*
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Main components inherent to this use case are:

**Data objects:**

- **Tool / asset:** Describes a tool, software package, laboratory equipment or any other kind of physical or virtual asset available in an institution.
- **Access rights:** Set of permissions required to use a tool. Different users may need a different set of access rights to manage or use the tool based on their role. i.e., administrators may require specific

access rights to manage requests or change configurations, students may require read only access to a tool. Details on access rights and how are they handled is described in detail in use case 7.

- **Index of resources:** Collection of assets ready to be shared. Includes information of each tool and how to get access to such tool.

**A sharing service** collects data from the assets and exposes the information following the sharing standard. This process can be complicated given that certain tools include their own management systems and others rely on manual processes, leading to tailored services that mainly rely on manual processes.

As mentioned previously, some alliances follow a centralizing approach, others follow a peer-to-peer approach. Centralizing information requires incorporating a central catalogue that will store standardized information. The **catalogue management system** manages an **index of available tools** and exposes a **discovery service** for search. The peer-to-peer approach requires each institution to provide a local catalogue with the discovery service. Currently there are no discovery services as such, educators work based on previous experiences and collaborations with colleagues from other institutions.

Making the request to use a tool follows a local process and thus is not included in the reference architecture. The process of granting access to an asset depends on the type of asset and its specific management system. Physical resources may require getting an access card from a desk service in the facilities of the institution, whereas virtual assets or with a digital access can leverage on the identity use case to grant access rights to the identity.

## Reference architecture

### Organisational view

In the following diagram corresponding to the organisational view, the necessary capabilities for this use case can be identified, such as the Learning & teaching resource which parent is the Curriculum Delivery. In the business logic for this use case, the main interface would be a Digital public service delivery which must implement the following business services: asset provisioning, asset management, asset discovery, asset access management and asset availability management.

These services are further implemented through their corresponding functions and processes and influenced by the necessary data policies and agreements.

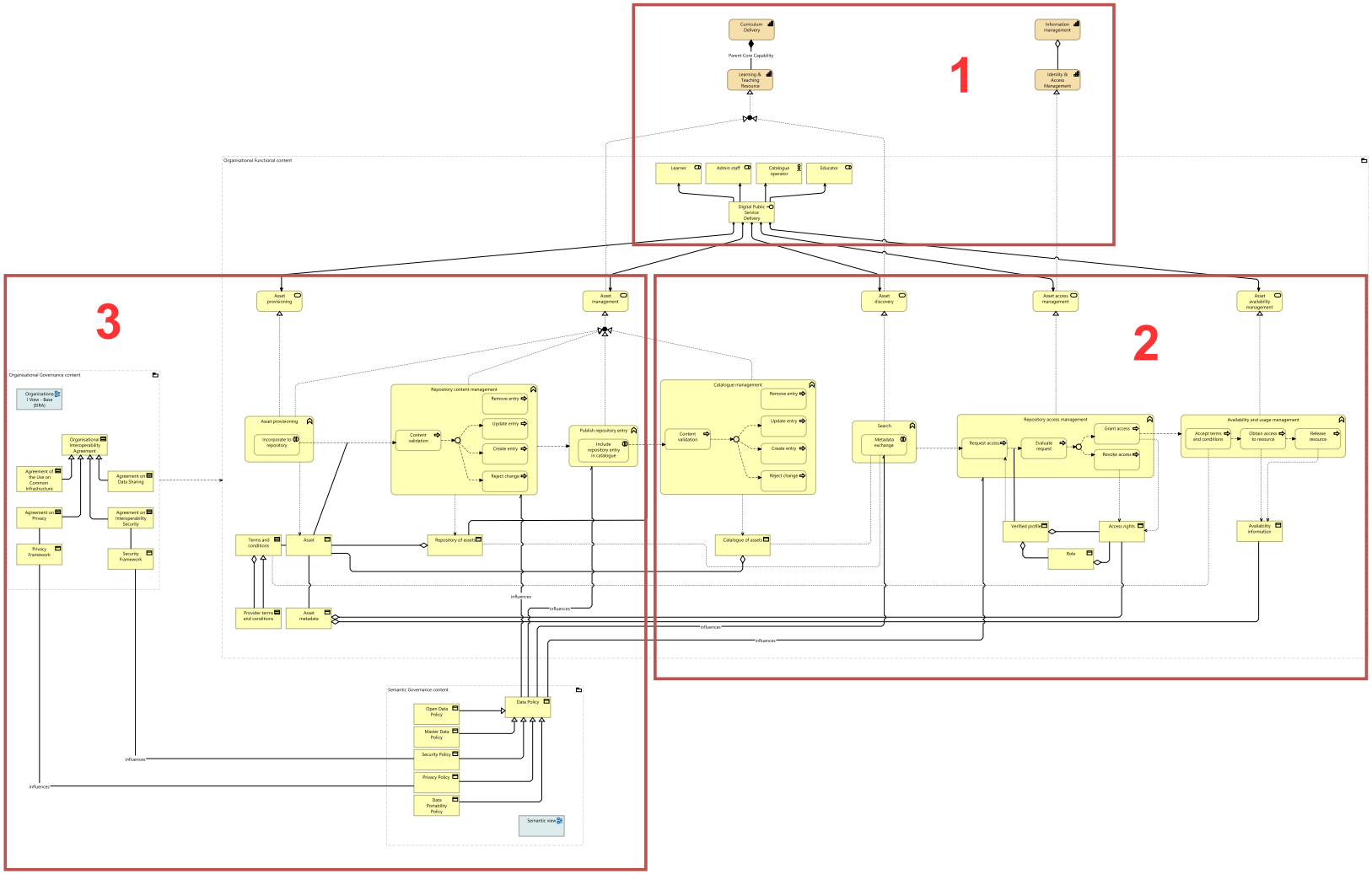


*Figure 11 - Use case 3 reference architecture organisational view.*

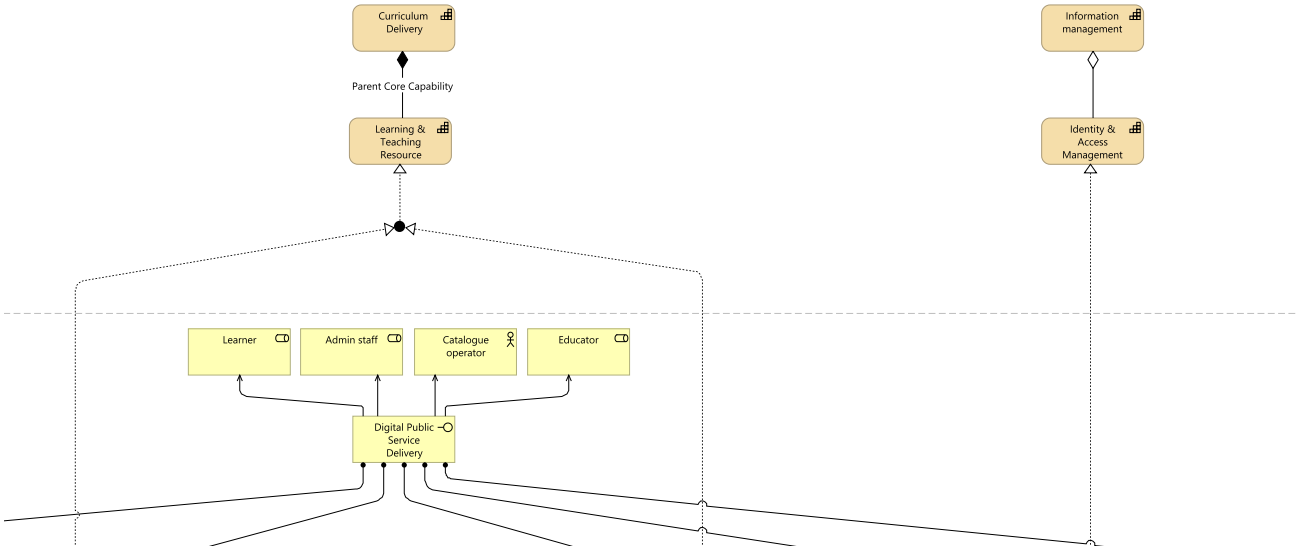


*Figure 12 - Use case 3 reference architecture organisational view - part 1.*
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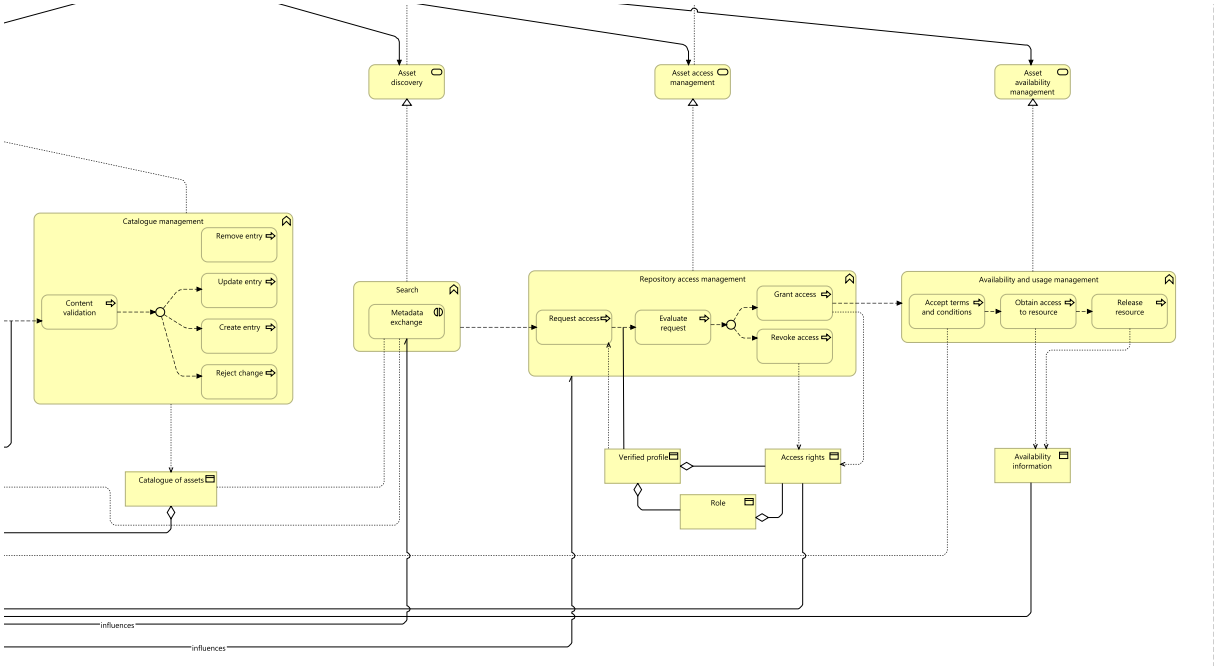


*Figure 13 - Use case 3 reference architecture organisational view - part 2.*
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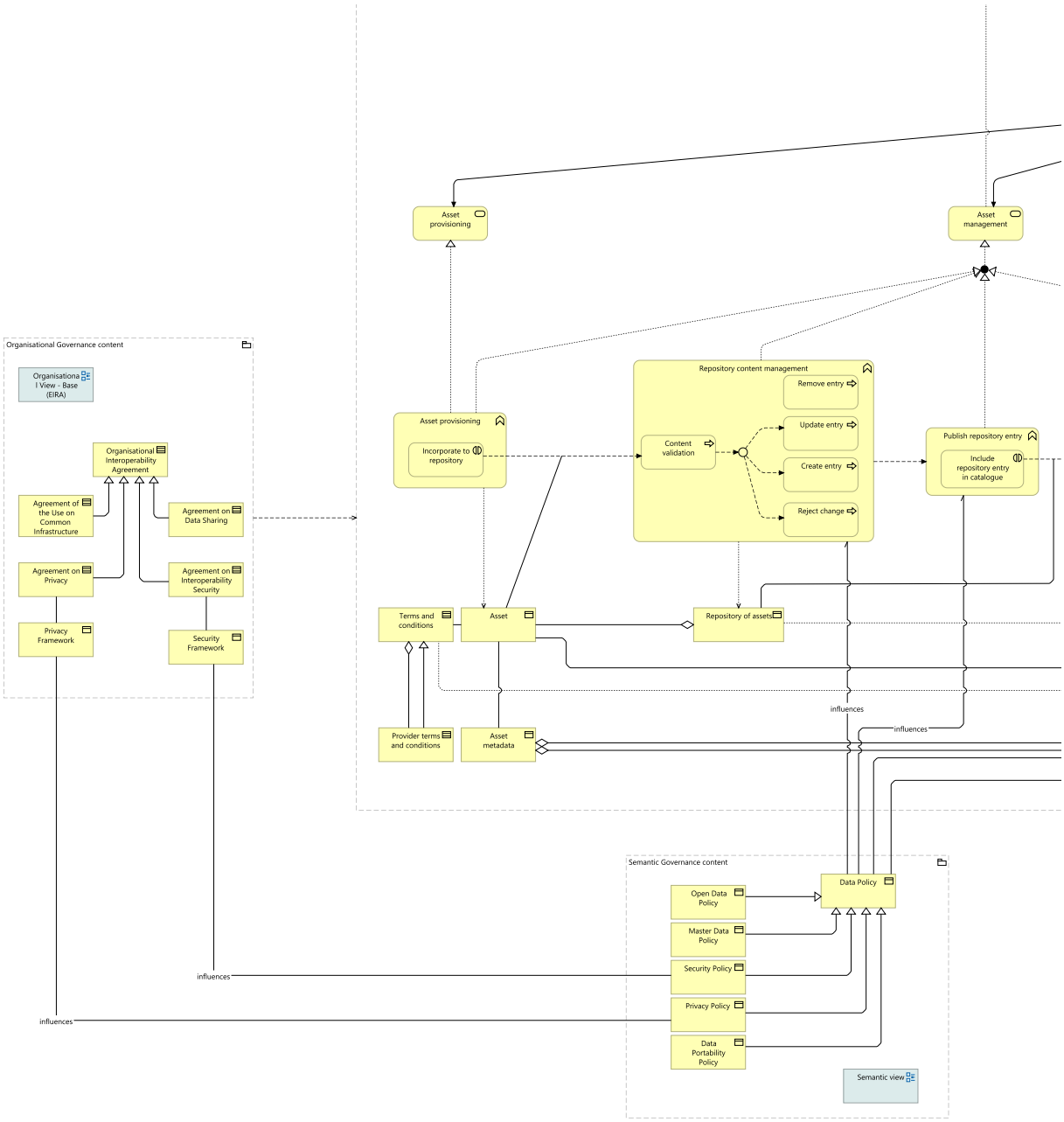


*Figure 14 - Use case 3 reference architecture organisational view - part 3.*
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In the following table, the most prominent building blocks are described.

| Building block | Type | Description |
|---|---|---|
| **Accept Terms and Conditions** | Business Process | The process by which a user or entity formally agrees to the stipulated terms and conditions of a service, application, or contract, often as a prerequisite for access or usage. |
| **Asset Provisioning** | Business Service | A service that enables the setup, configuration, and delivery of required assets (such as tools, applications, or data) to users or systems, ensuring they are ready for use in compliance with defined policies. |
| **Availability and Usage Management** | Business Function | The function responsible for overseeing the accessibility and utilisation of assets, tools, or resources, ensuring they are available when needed and used according to predefined guidelines or limits. |
| **Catalogue of Assets** | Business Object | A structured repository or document that contains detailed information about available assets, including their descriptions, conditions, and access protocols, facilitating discovery and usage. |
| **Curriculum Delivery** | Capability | Curriculum delivery administers and operates the institution's curricula. |
| **Evaluate Request** | Business Process | Evaluate request process enables assessing existing requests to either accept or reject them. |
| **Grant Access** | Business Process | Grant access ABB is a business process that authorizes users or systems to access specific resources, ensuring compliance with security policies. |
| **Identity & Access Management** | Capability | Identity & access management manages information about people and things, instantiates and enforces organisational business rules and policy regarding entitlements to systems and services, and mediates access requests and identity verification. |
| **Learning & Teaching Resource Preparation** | Capability | Learning & teaching resource preparation acquires, assembles, or creates learning resources for delivery, including artefacts such as books and excerpts, documents, X-Reality experiences, 3D models and prints, and video presentations, and so forth. |

| | | |
|---|---|---|
| **Obtain Access to Resource** | Business Process | Obtain access to resource ABB is the business process that enables the obtention of access to a resource. |
| **Privacy Framework** | Business Object | Privacy framework ABB is a business object that enables the confidentiality aspects of data, information and knowledge assets and organisational resources handling them. |
| **Provider Terms and Conditions** | Contract | Legal agreement between an institution and the end user of an asset. Provides a set of conditions to make use of an asset. |
| **Publish Repository Entry** | Business Function | The function responsible for making a repository entry publicly available or accessible to authorised users. |
| **Release Resource** | Business Process | The process of freeing or making a resource available for use. |
| **Repository of Assets** | Business Object | A storage or database that holds assets. |
| **Terms and Conditions** | Contract | Legal agreement between an institution and the end user of an asset. Provides a set of conditions to make use of an asset. |

## Semantic view

As for use case 2, in the semantic layer of use case 3, the importance of agreements is highlighted. One of the main pain points in the following architecture is mainly related to them as this use case is focused on tools and sharing, thus, the problem here is how to manage the terms and conditions in a collective and interoperable way.

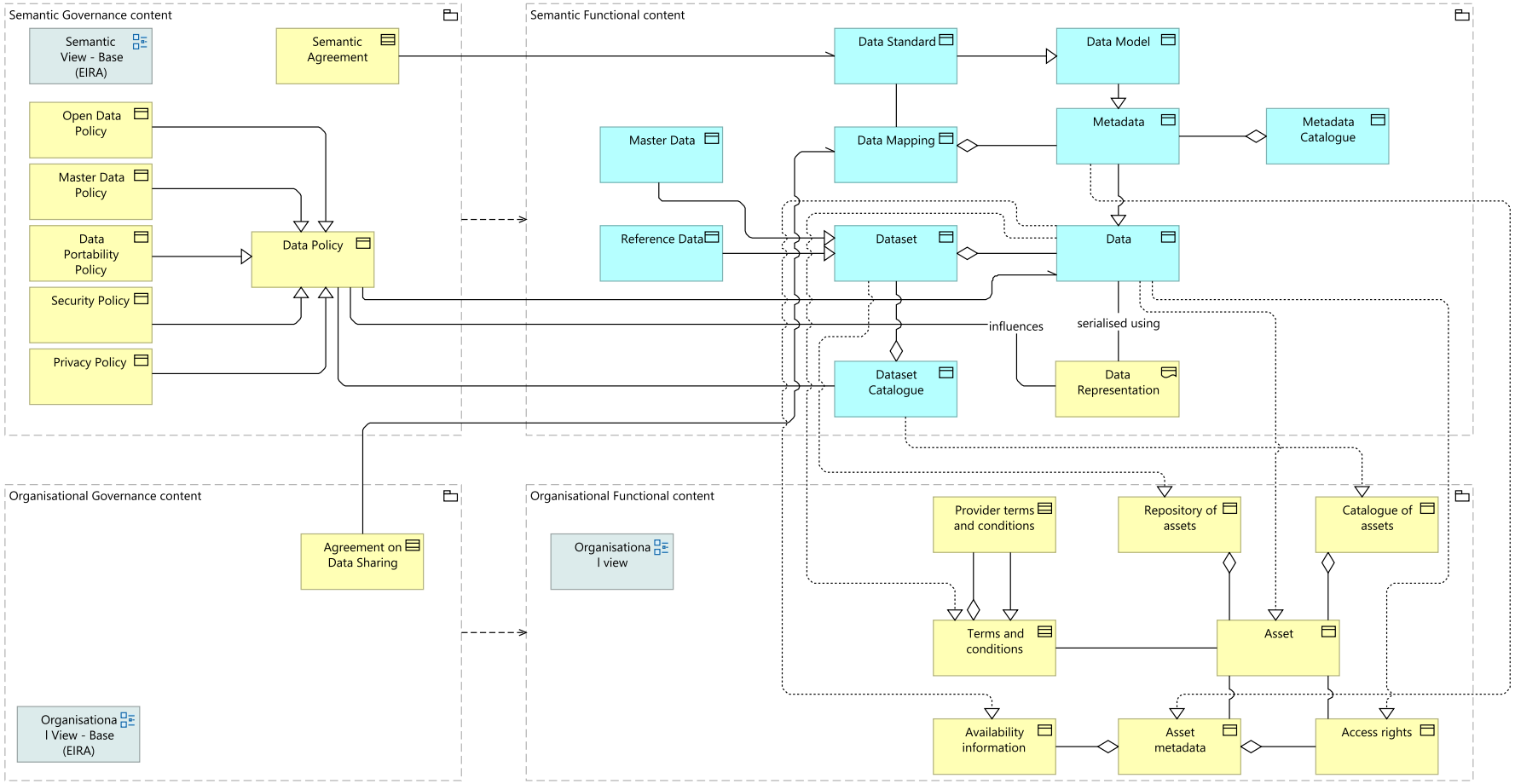


*Figure 15 - Use case 3 reference architecture semantic view.*

## Technical view

Since this use case is primarily understood as a catalogue of tools, the main need here is their search and usage. This is where standards and metadata play a crucial role.

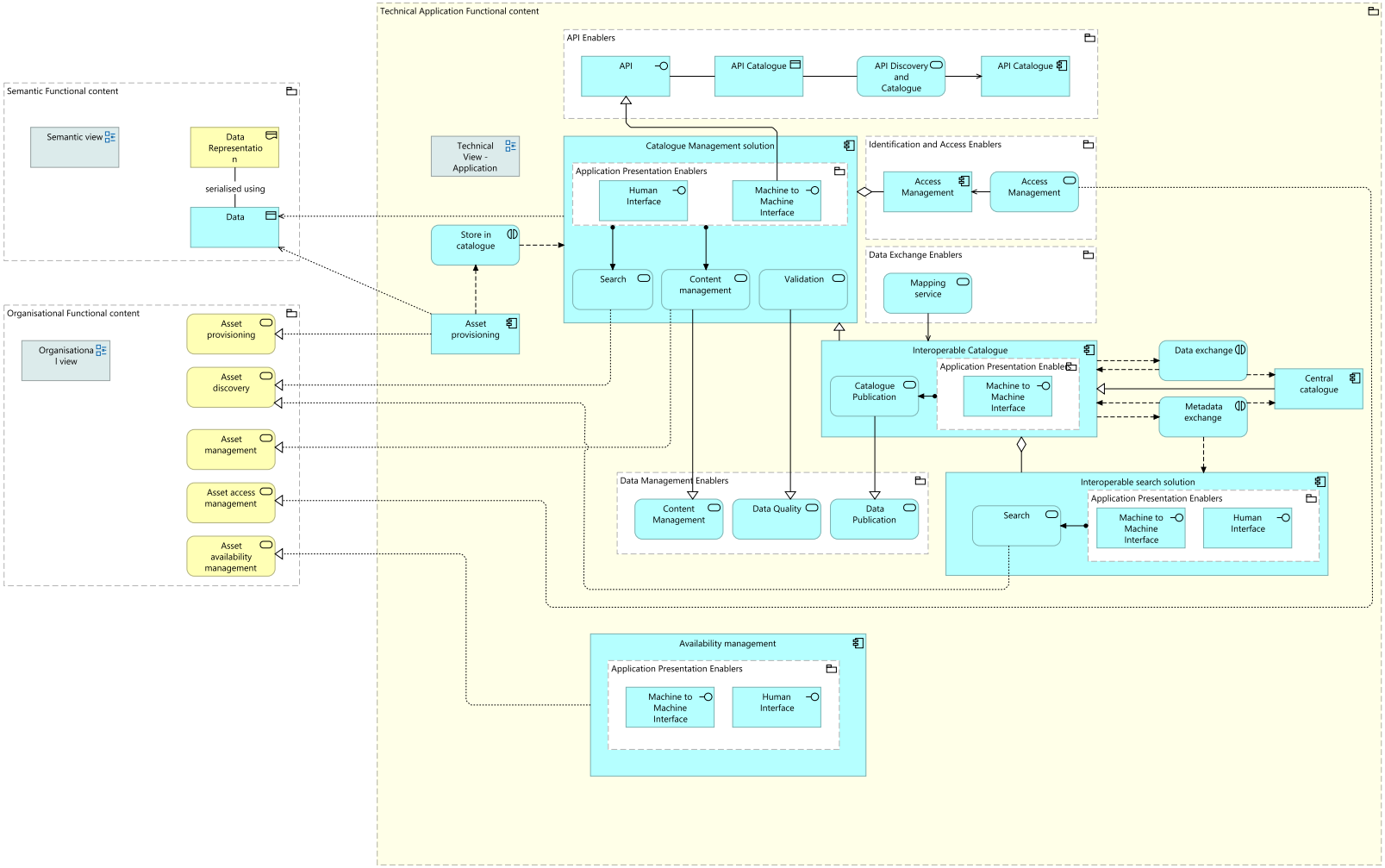


*Figure 16 - Use case 3 reference architecture technical view.*

The essential building blocks of the technical layer are detailed below.

| Building block | Type | Description |
|---|---|---|
| **Asset Provisioning** | Application Component | Asset provisioning ABB is an application component that ensures the allocation and delivery of digital or physical resources. |
| **Availability Management** | Application Component | Availability management is an application component that ensures digital systems, services, and resources are consistently accessible and operational. |

For a more comprehensive view of the architecture, it is recommended to review the ArchiMate diagrams associated with this document.

PART 4

# Use case 4 – Manage educational resources

# Use case 4 - Manage educational resources

USE CASE 4

## Manage educational resources

Promoting the accessibility and mobility of educational materials, fostering a collaborative and accessible educational environment.

Content generation | Sharing | Use and re-use

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It is paramount that educational resources can be easily presented on various platforms. Therefore, it is valuable to decouple the resource from the platform. Thus, this use case focuses on the ability to (co-) create a resource, and then the capability to access and share these educational materials. This bolsters collaborative and accessible educational environments. A typical learning management system often has the capability to create, and/or export the educational resource.

## Challenges

Sharing educational resources between institutions presents several challenges. From the semantic point of view, institutions use different systems and data formats, following different processes in the creation and categorisation of resources. From the organisational point of view, the most prominent challenge is ensuring quality control across different institutions. From a legal point of view, ensuring that local copyright laws are followed is essential when sharing educational resources across borders. Lastly, from a technical point of view, harmonising access control, which involves determining and managing who has access to shared resources, can be a complex task when dealing with numerous users across different institutions.

## Draft architecture

Educators design educational resources for the learning specification in which they are involved. Those educational resources are stored in a registry and discoverable by other educators or learners. To fulfil this use case, the following main components are required:

**Data objects and data standards:**

- **Educational resource:** Represents any kind of educational material. Includes metadata attributes to fully characterize and classify the resource.
- **Shared index of educational resources:** An index of educational resources.
- **Educational resource standard:** A data standard specifying the attributes and controlled vocabularies used to represent educational resources.

**Services and systems:**

- **Mapping services** oversee translating from local registry data models to the **educational resource standard.**
- **Sharing service:** Exposes information from a local registry. Use the mapping service to translate data before exposing it. Depending on the selected approach can play an active role sending the information to a catalogue or collecting data in real time responding to external requests.
- **Validation service:** Checks that information received complies with the data standard and minimum set of required attributes.
- **Search service:** Exposes search capabilities to find educational resources. Relies on the index of educational resources and controlled vocabularies in place to make resources searchable.

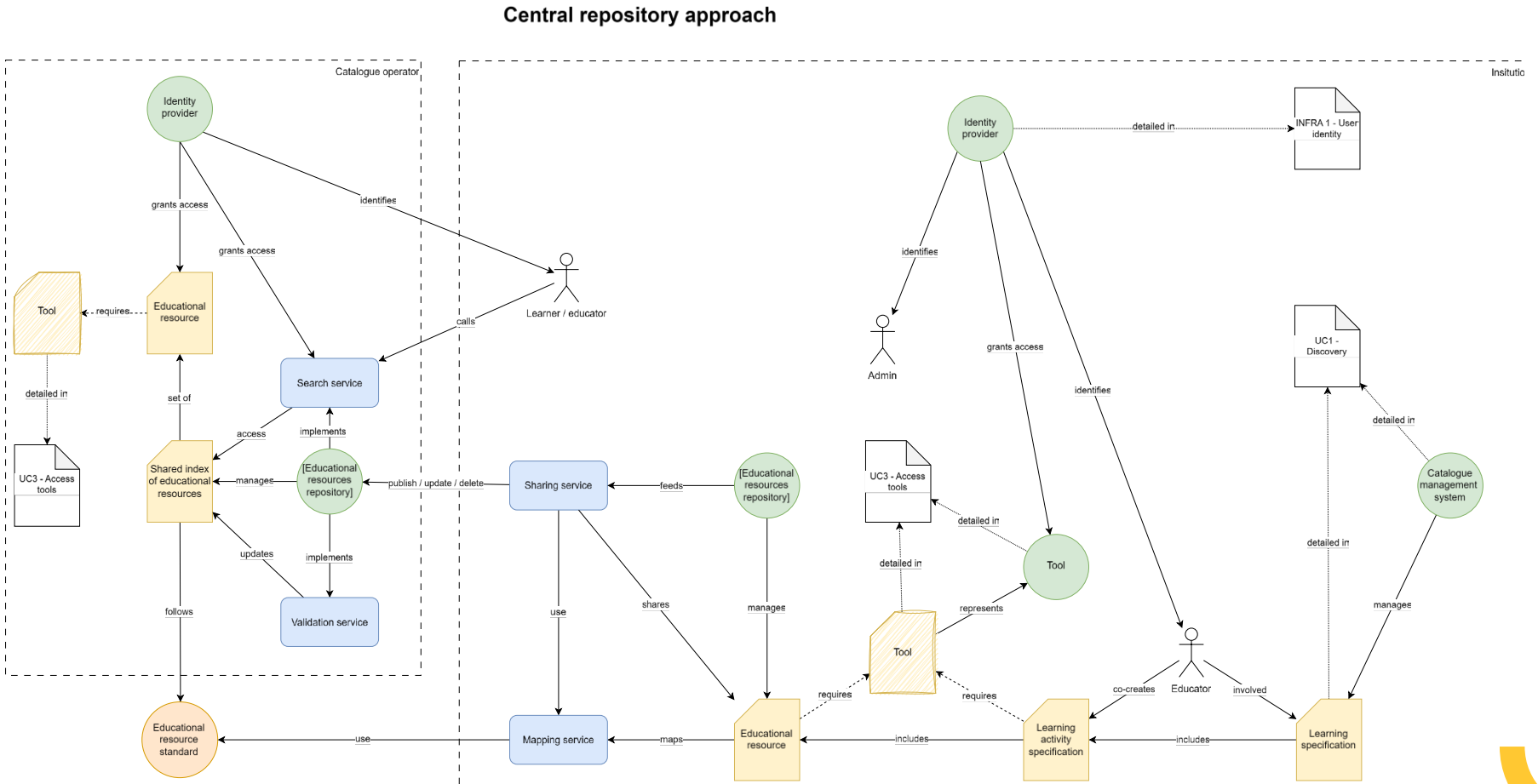


*Figure 17 Use case 4 required building blocks and their relationships – scenario 1.*

As shown in the figure above, the central repository approach can be implemented in two ways. If the central repository oversees collecting information from the local repositories, the sharing service has to accept the request and expose changes to the central repository. The extent to which the central repository is aware of the HEIs' local repositories sets the limits. Yet, data collection can be scheduled and based on available infrastructure.

**Central repository metadata approach**

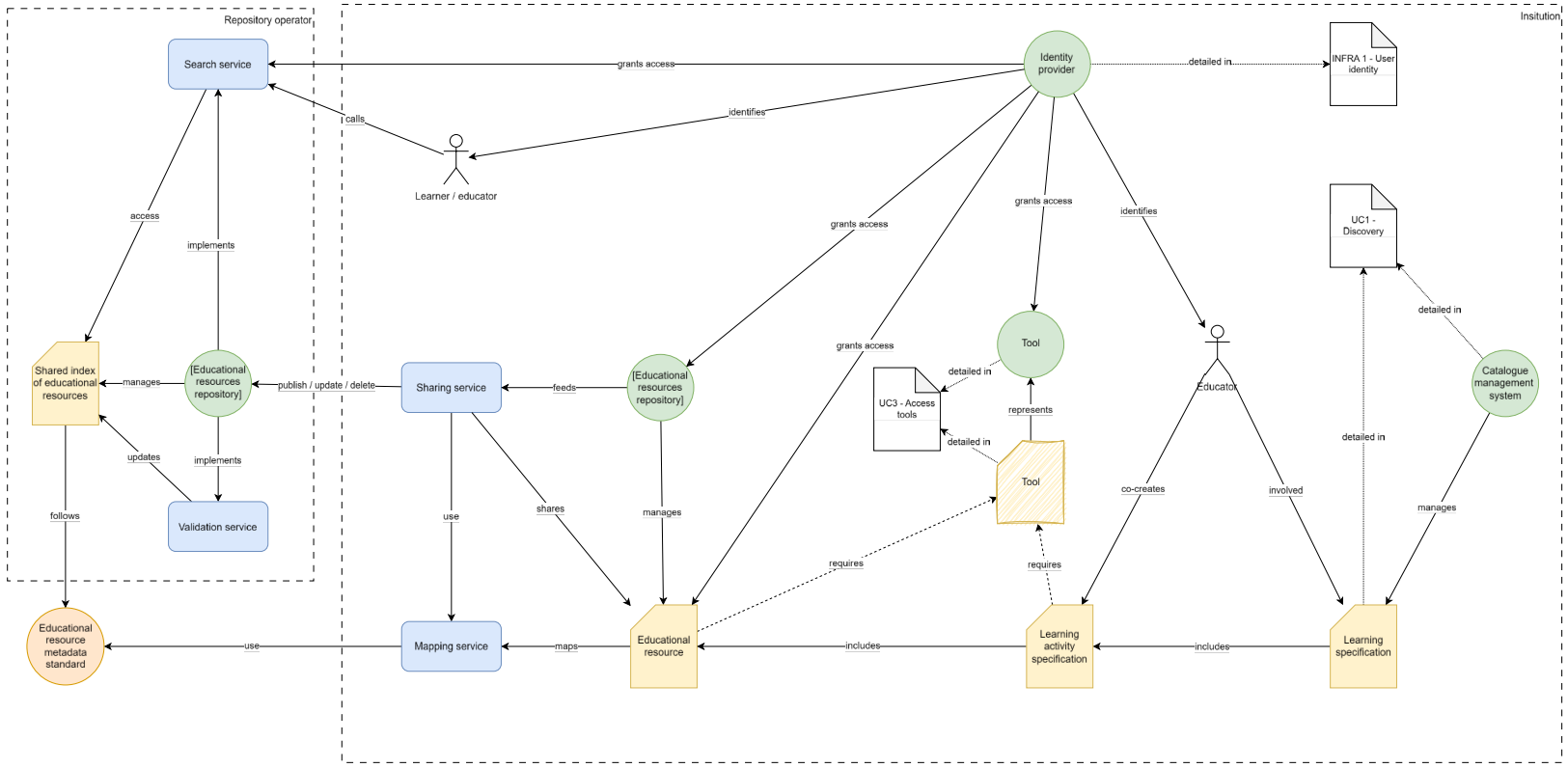


*Figure 18 - Use case 4 required building blocks and their relationships – scenario 2.*

The difference between the diagram above and the central repository approach diagram is the management of access to the actual resource. In this case, the identity provider of the central repository is replaced by local identity providers and their internal management of user permissions.

In comparison, decentralised repositories require the local repositories to collect and send data to the central one. This may require scaling the infrastructure of the central catalogue to ingest all the updates. In this approach, the central repository exposes the search service used by end users.

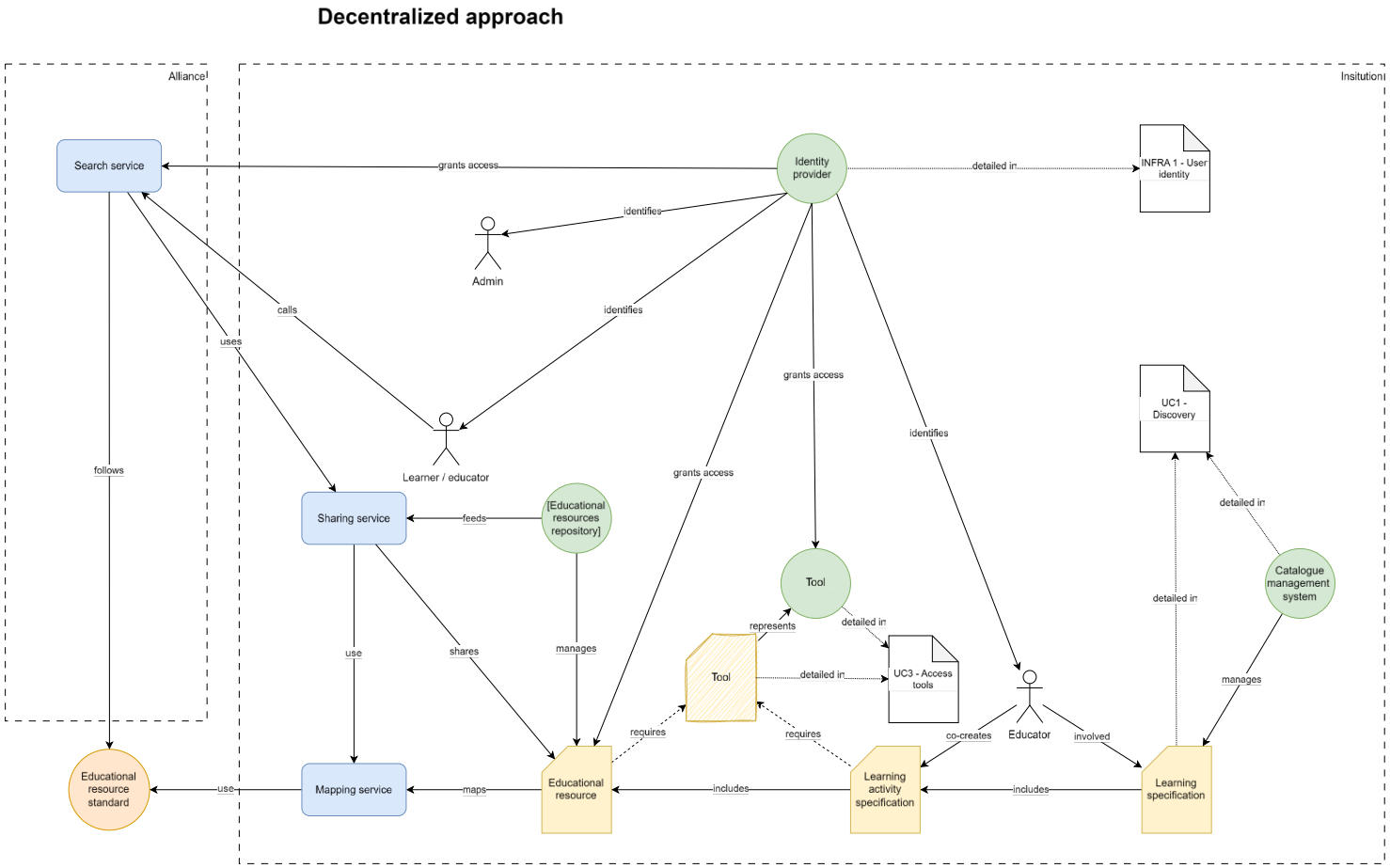


*Figure 19 - Use case 4 required building blocks and their relationships – scenario 3.*

Data standards play a major role in semantic interoperability. The chosen data standard should meet a set of metadata and attribute requirements that facilitate the communication between systems.
In the decentralised approach each repository must either follow the same data standard or implement the mapping service to send data following the required structure. End users either use the search capabilities of each repository or the alliance exposes a central search service that relies on the local repositories to collect and present the data to the user.

## Reference architecture

### Organisational view

In the following diagram corresponding to the organisational view, the necessary capabilities for this use case can be identified, such as the Learning & teaching resource or the Learning & Teaching Resource preparation, both fundamental for this use case. In the business logic for this use case the main interface would be a Digital public service delivery which must implement the following business services: educational resources development, educational resources repository content management, and educational resources publication.

These services are further implemented through their corresponding functions and processes and influenced by the necessary data policies and agreements.

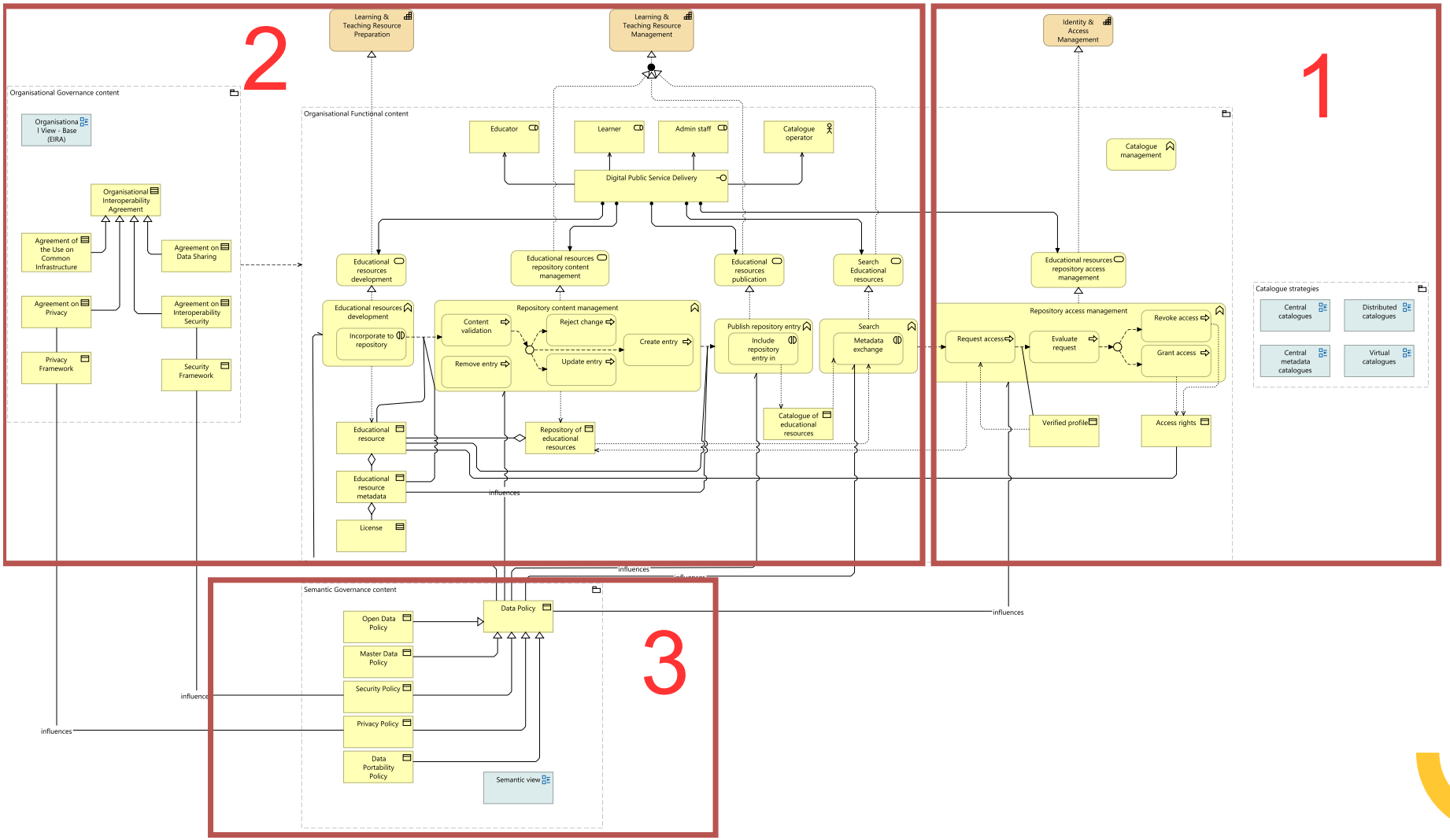


*Figure 20 - Use case 4 reference architecture organisational view.*

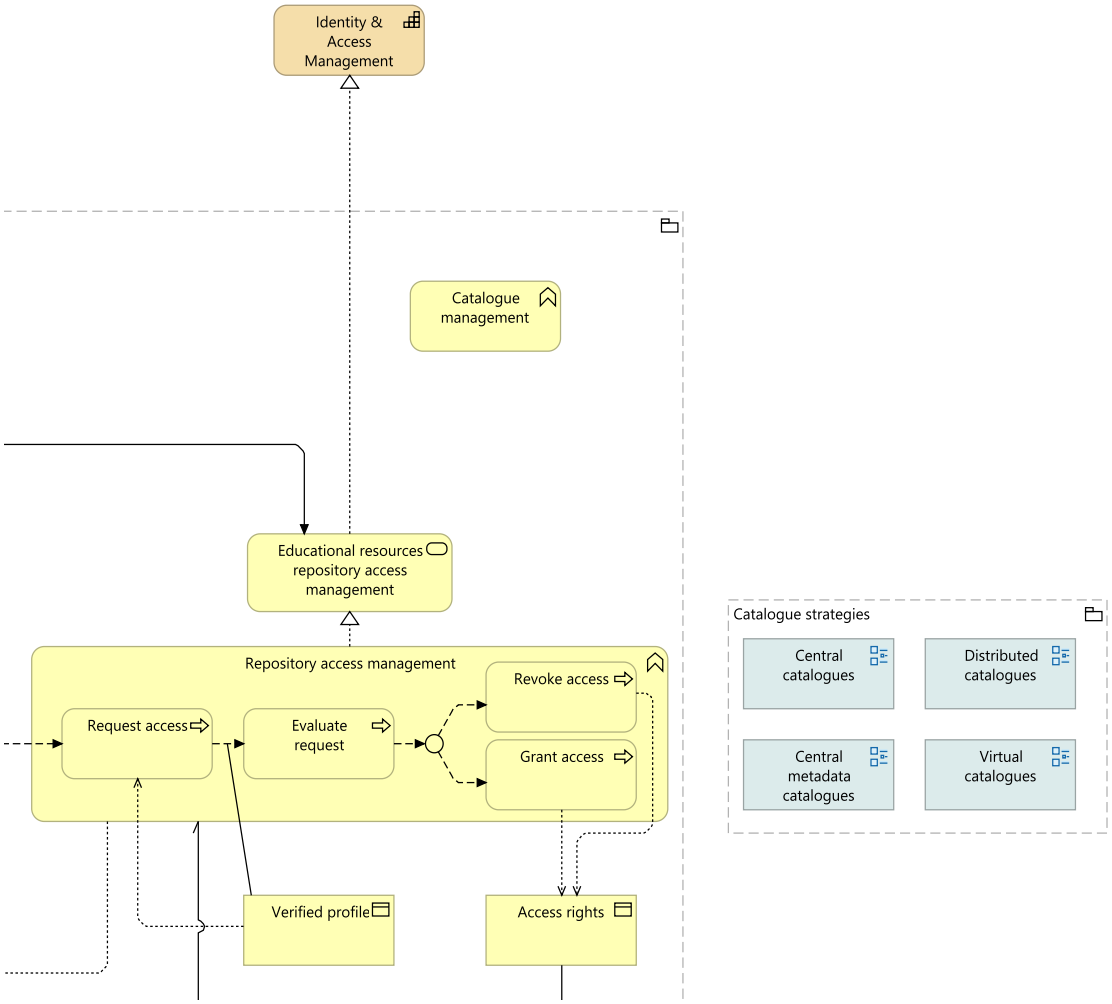


*Figure 21 - Use case 4 reference architecture organisational view - part 1.*
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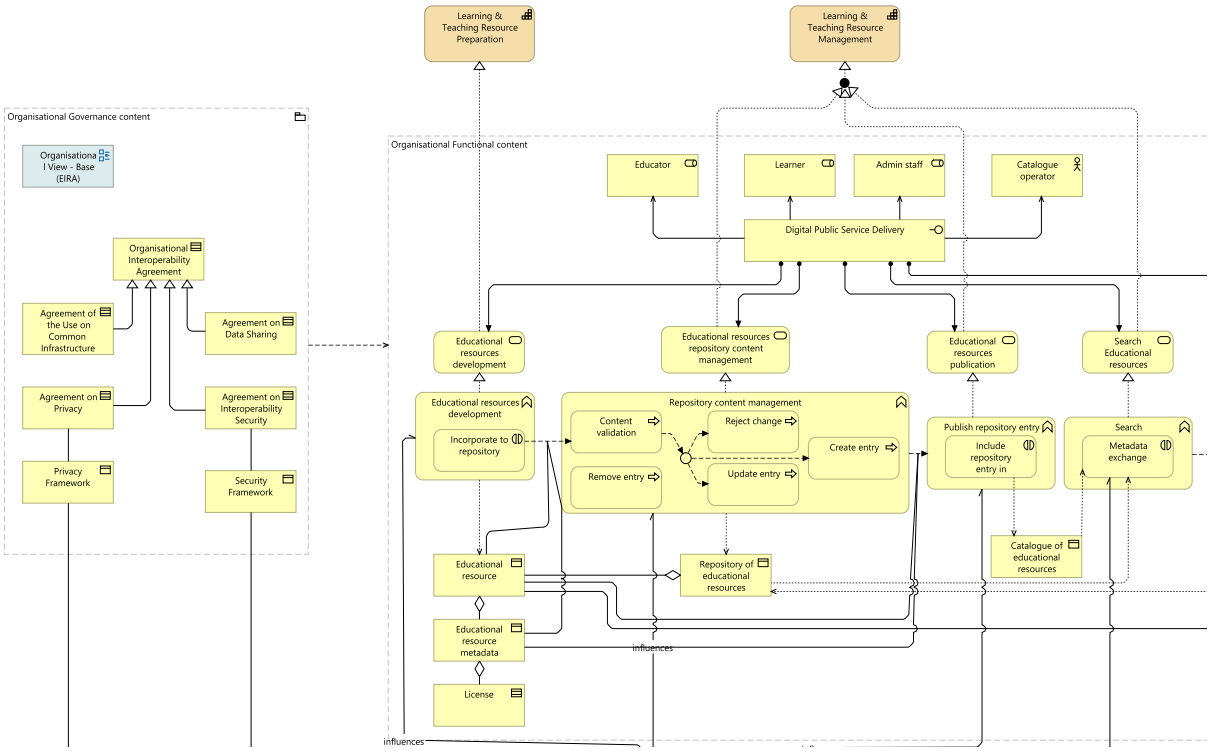


*Figure 22 - Use case 4 reference architecture organisational view - part 2.*
*© 2025 European Union*

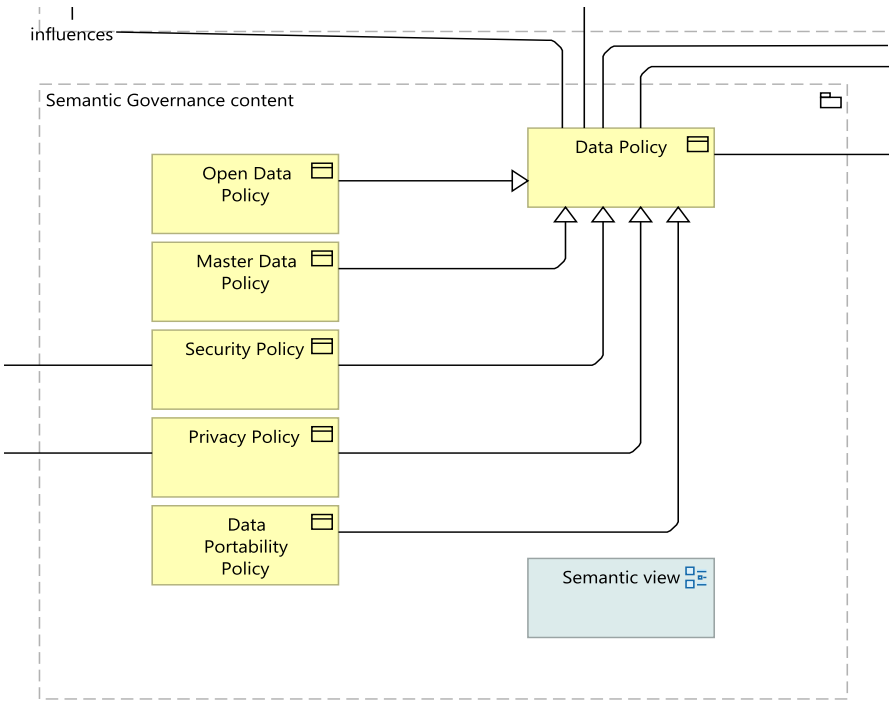


*Figure 23 - Use case 4 reference architecture organisational view - part 3.*
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The following table describes the most prominent building blocks.

| Building block | Type | Description |
|---|---|---|
| **Catalogue of Educational Resources** | Business Object | Catalogue that contains all the educational resources |
| **Educational Resource Metadata** | Business Object | Educational resource metadata ABB is a business object that describes the characteristics, content, and context of educational resources. |
| **Educational Resources Development** | Business Function | Functions to create and update existing educational resources. |
| **Educational Resources Publication** | Business Service | Educational resources publication is a business service that makes educational content available for access within repositories or platforms. |
| **Educational Resources Repository Access Management** | Business Service | Educational resources repository access management is a business service that controls permissions and access to stored educational materials. |
| **Evaluate rRequest** | Business Process | Evaluate request process enables assessing existing requests to either accept or reject them. |
| **Grant Access** | Business Process | Grant access ABB is a business process that authorises users or systems to access specific resources, ensuring compliance with security policies. |
| **Identity & Access Management** | Capability | Identity & access management manages information about people and things, instantiates and enforces organisational business rules and policy regarding entitlements to systems and services, and mediates access requests and identity verification. |
| **License** | Contract | License is a contract ABB that defines the terms and conditions for using, sharing, or distributing resources. |
| **Repository of Educational Resources** | Business Object | Repository of educational resources ABB is a business object that represents a system for storing educational materials. |
| **Search Educational Resources** | Business Service | Search educational resources ABB is a business service that enables the discovery, filtering and order of information. |

## Semantic view

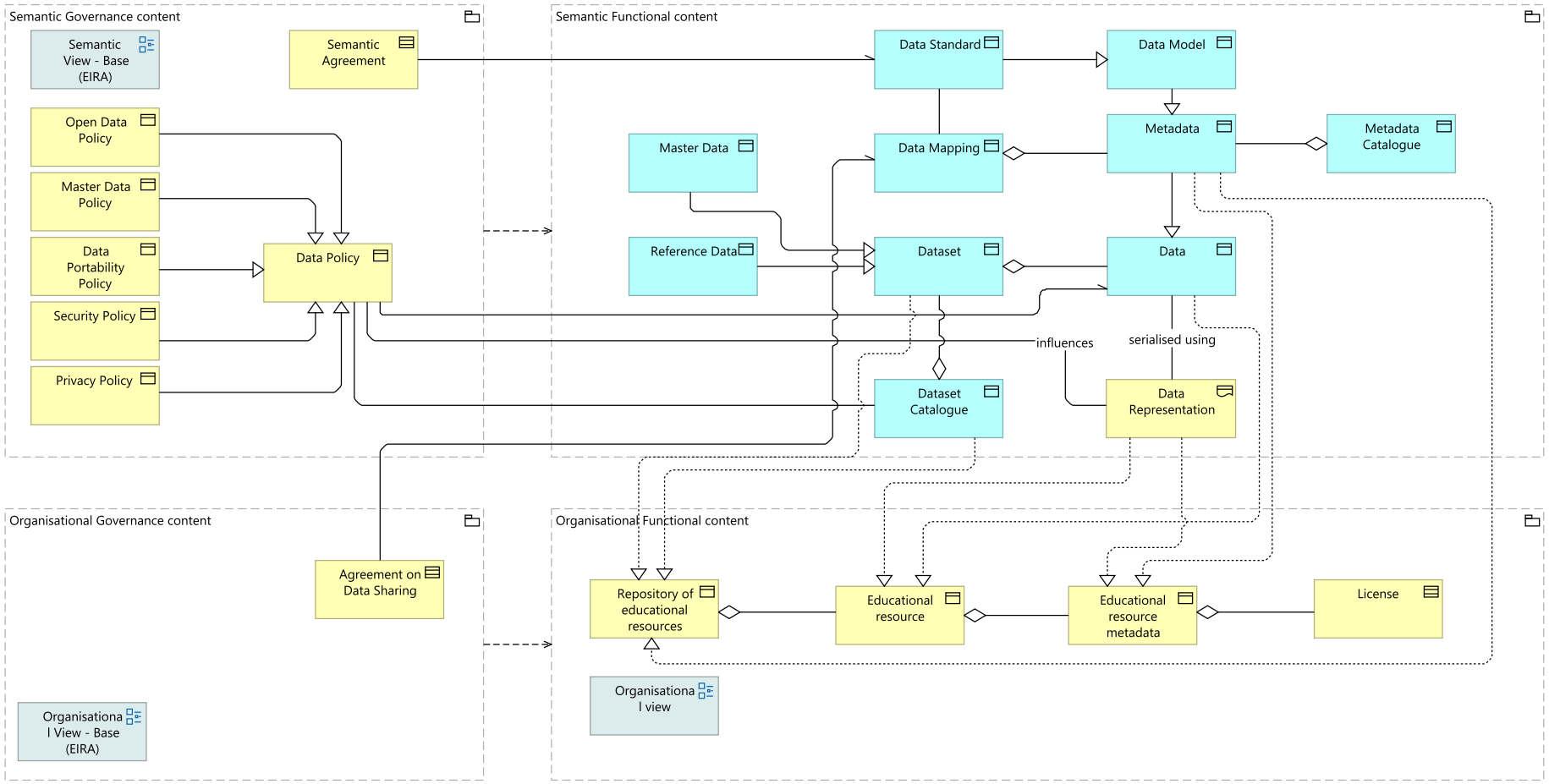



*Figure 24 - Use case 4 reference architecture semantic view.*

## Technical view

Since this use case is primarily understood as a catalogue of educational resources, the main need here is their search and usage. This is where standards and metadata play a crucial role.

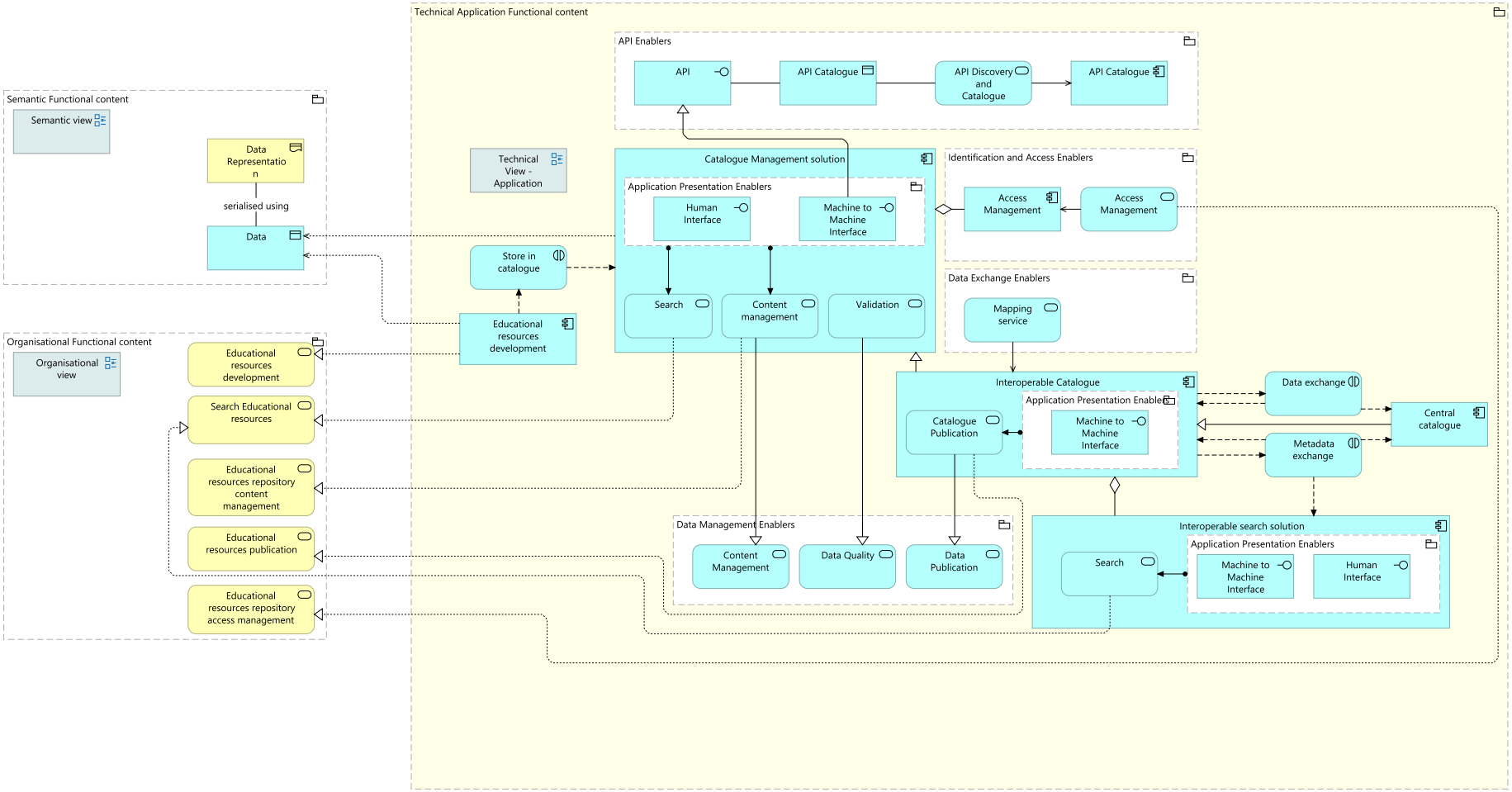



*Figure 25 - Use case 4 reference architecture technical view.*

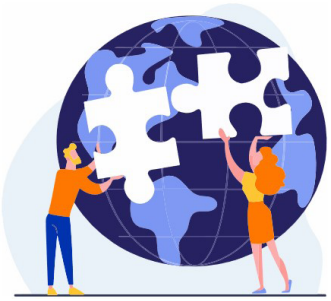
PART 5

# Use case 5 – Generate data

# Use case 5 - Generate data

USE CASE 5

## Generate data



Establishing a standardised approach for the exchange of learners' activity data to ensure a seamless integration of various virtual learning environments.

Learning Analytics

Student Analytics



This use case focuses on the learning records generated by learners, which are stored in systems such as Learning Management Systems (LMS), Student Information Systems (SIS), or Learning Record Systems (LRS). These learning records capture information about activities completed by students as well as student-specific information within an SIS. The key capability is to generate, store and exchange learner data on a more granular level than earning the credential. This use case also enables to analyse meta-data on the learner journey, and thus can help improve platforms, educational resource or even give input for the creation of a new education resource.

## Challenges

Sharing data generated by learners participating in educational activities exposes several challenges. Tools generate records using different protocols and data models, making complicated analysing and visualize learner's performance across multiple institutions. Institutions follow different data definitions, and store different records based on those definitions, making it complicated to share and compare actions performed by learners in different institutions.

## Draft architecture

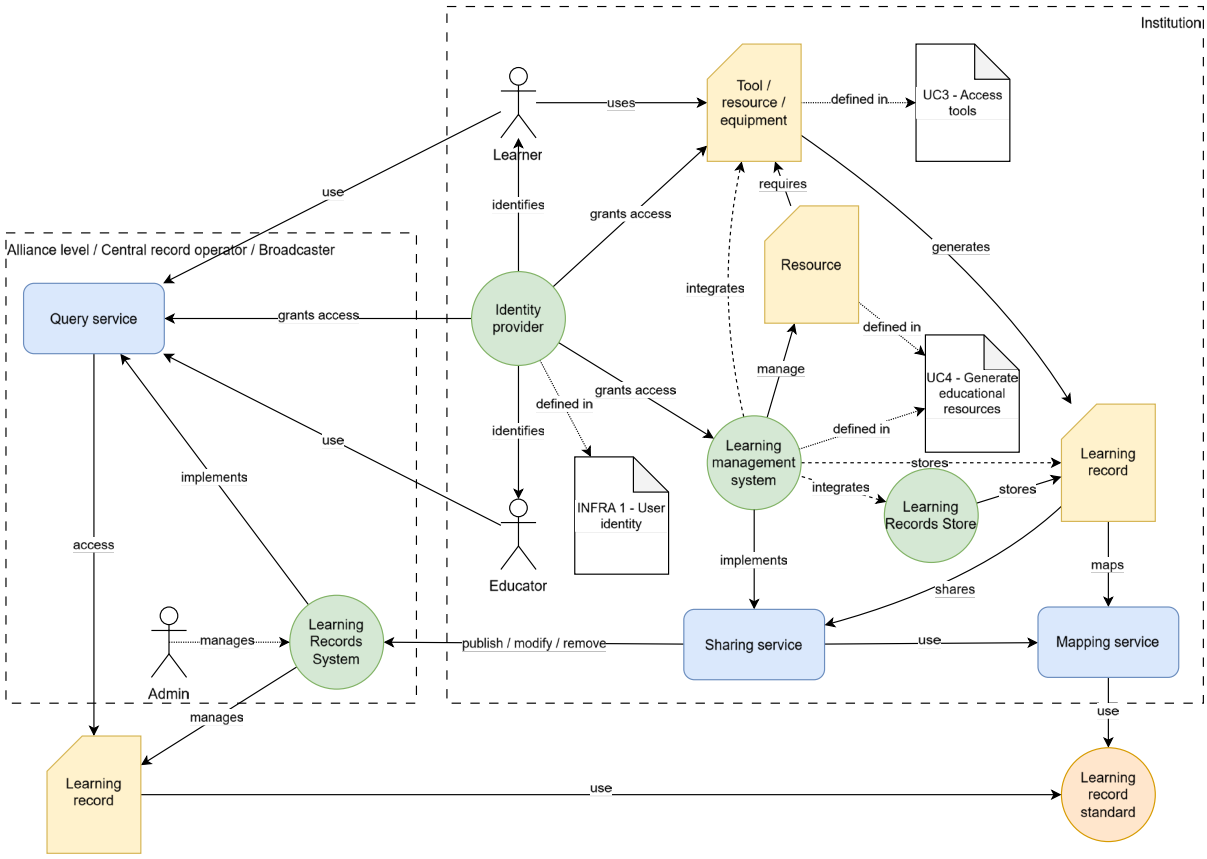



*Figure 26 - Use case 5 required building blocks and their relationships.*
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The main elements of this use case and their relationships in the management of learner-related data are shown in the schema above. This architecture is designed to support the primary high-level workflows covering the creation and sharing of learners' learning records. The key components of the draft architecture schema are outlined below.

**Business objects:**

- **Learning record:** A statement about a learning activity completed by a learner. Includes information about the actor, usually a learner, the action realized, and the result of the action.
- **Resource:** An educational resource designed as part of a learning activity. Educational resources are usually designed and created to be used with a specific tool, resource, equipment, or any other type of asset.
- **Tool:** Any type of asset available to complete a learning activity.

**Services:**

- **Sharing service** oversees sending local records to external systems. Based on the selected approach, the service will expose a reading or a publishing interface. Sharing services may rely on a mapping service to translate from the local data model to the shared **learning record standard.**
- **Query service:** Users interact with the query service to collect information about the learner's activities. Depending on the selected approach this service will be implemented differently. Either broadcasting queries to the different systems in a peer-to-peer approach, interacting with the local record system, or interacting with the central record system.

**Systems:**

- **Learning management system (LMS):** A software application for the administration and delivery of educational processes. In this particular use case, a LMS integrates information on learners' progress related to different learning activities that are part of a learning offering.
- **Learning records system (LRS):** A software application for storing and managing learning records. Learning records systems can be integrated as part of the LMS or an independent system.

# Reference architecture

## Organisational view

The next architectural schema of the organisational layer outlines the lifecycle of a student's learning records related to course activities. Key capabilities associated with learning records are addressed: Learning & Teaching Delivery, Learning Assessment, Student Record Maintenance, Student Supervision, and Student Academic Progress. From top to bottom, the different roles a citizen may assume are shown, defining their access to various services through a public digital services interface. Given that the processes for creating and managing learning records involve handling data generated by learners, there is a strong connection between these processes and multiple privacy and security frameworks.

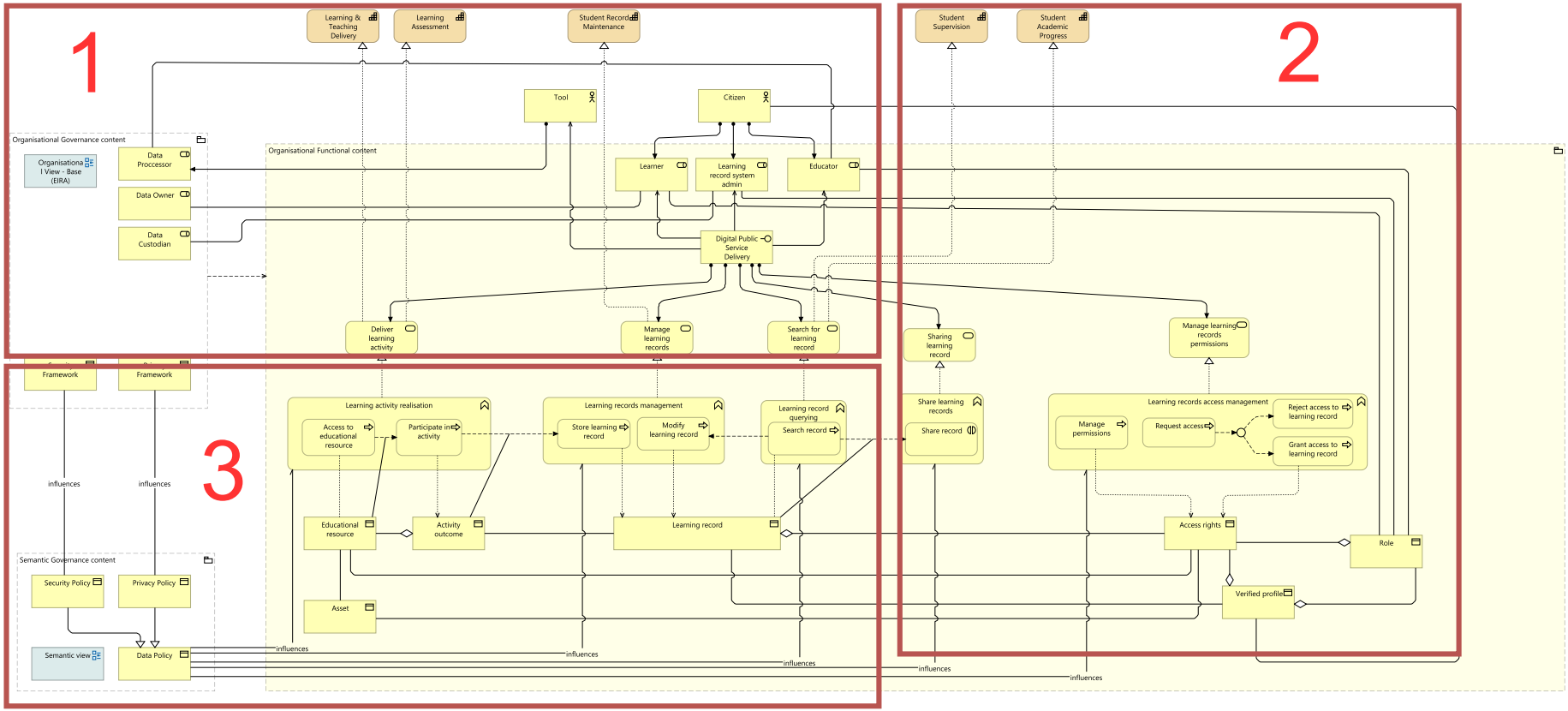


*Figure 27 - Use case 5 reference architecture organisational view.*

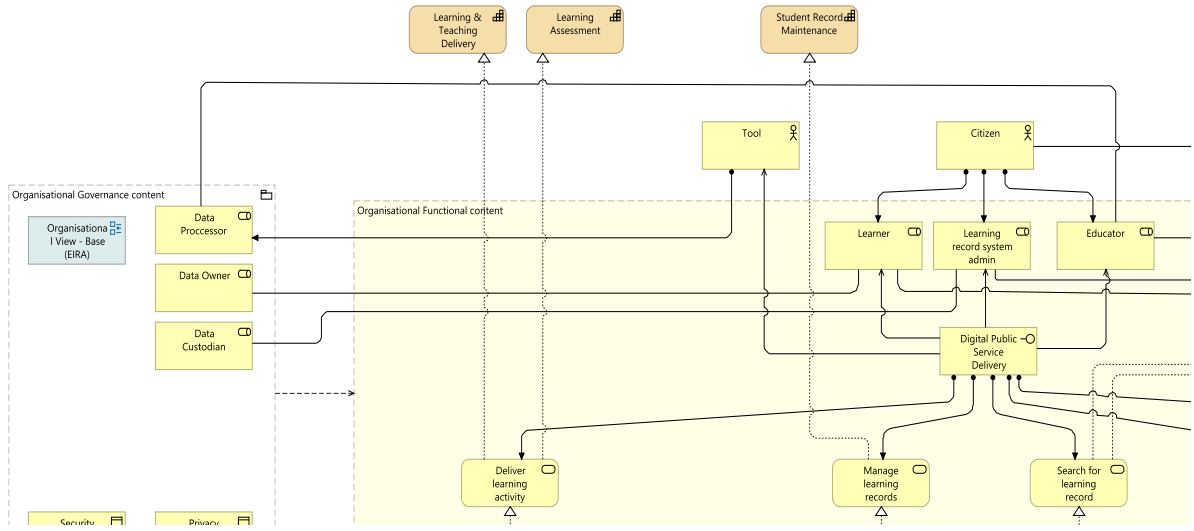


*Figure 28 - Use case 5 reference architecture organisational view - part 1.*
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This section of the reference architecture schema for use case 5 shows the organisational roles and their relationships. For example, learners act as data owners of the learning records they generate through activities, while the LRS admin fulfils the role of data custodian. All services are accessed through a digital interface, encompassing the defined capabilities.

The second part of the diagram shows the remaining services exposed by the digital interface, together with the business functions that implement these services. Here we also see some of the business objects related to managing access to learning records, such as access rights and the verified profile. The verified profile, which is related to use case 7 (user identity), contains information and attributes essential to this process, such as access rights.

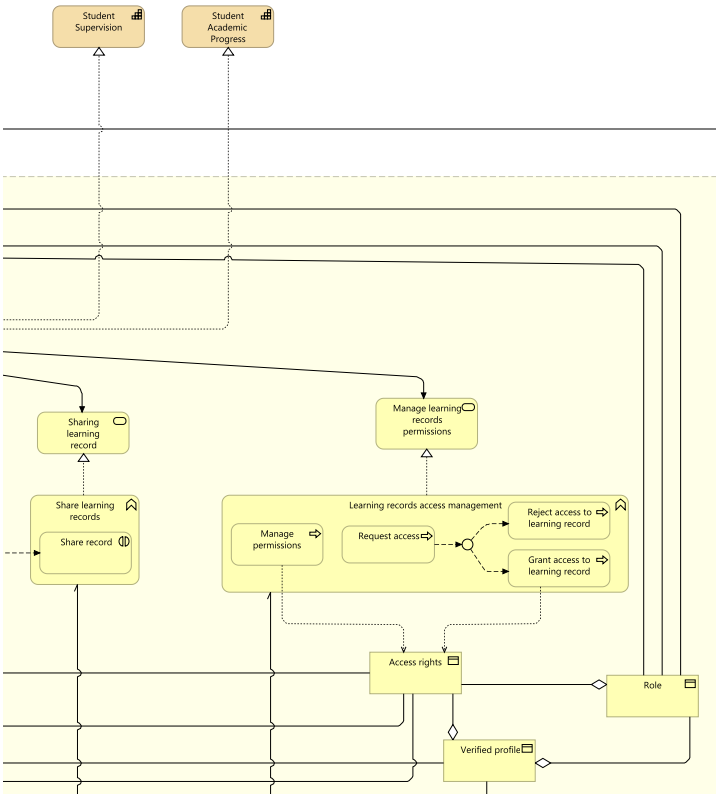


*Figure 29 - Use case 5 reference architecture organisational view - part 2.*
*© 2025 European Union*

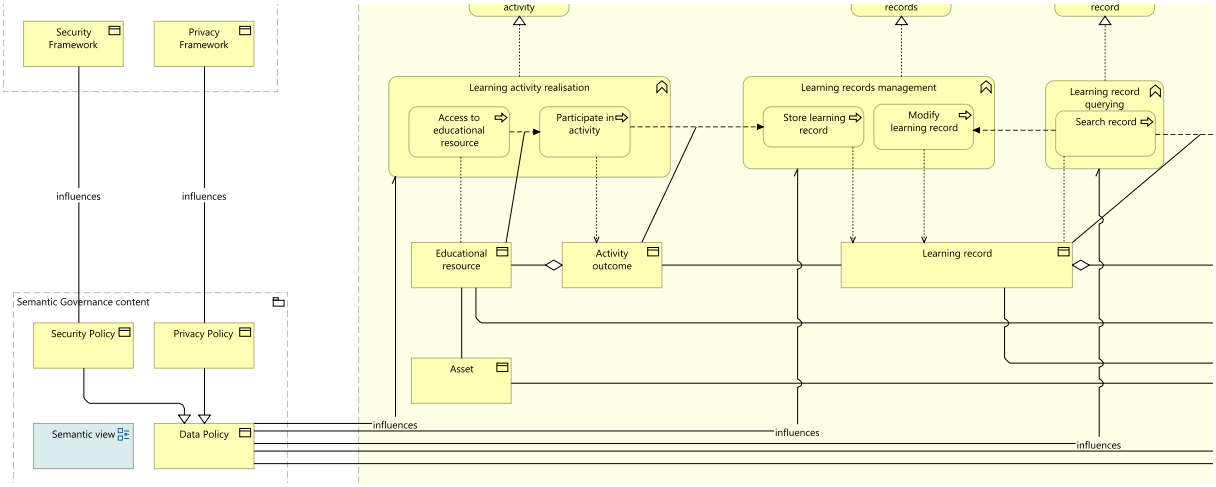


*Figure 30 - Use case 5 reference architecture organisational view -part 3.*
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The final part of the schema presents the remaining business functions, focusing on creating learning records and their subsequent handling by educators and learners. The semantic layer appears here, illustrating how the various privacy and security policies applicable to this type of data are integrated into these processes.

| Building block | Type | Description |
|---|---|---|
| **Access Rights** | Business Object | Access rights govern who has the ability to view, edit, and delete data, and proper control over access rights is essential for maintaining the confidentiality, integrity, and availability of information |
| **Access to Educational Resource** | Business Process | Access to educational resource ABB is a business process that represents a user's access to any educational resource when engaging in an educational activity. |
| **Activity Outcome** | Business Object | Outcome of an activity, either physical or virtual. |
| **Asset** | Business Object | A resource, either physically or digitally available and managed by an institution. |
| **Citizen** | Business Actor | Citizen ABB is a business actor providing and/or consuming public services. A citizen is a member of a particular country who has rights because of being born there or because of being given rights. |
| **Data Custodian** | Business Role | A natural or legal person, public authority, agency, or any other body that processes personal data on behalf of the controller. There are situations where an entity can be a data controller, or a data processor, or both. |
| **Data Owner** | Business Role | Data owner ABB is a business role being assigned to individual who creates or generates the data or entity that has legal ownership or control over the data. In other cases, a data owner might be the individual or entity responsible for managing or overseeing the use of the data. It can be mapped with data controller from the GDPR, under the European General Data Protection Regulation (GDPR), a "data controller" is defined as the entity that determines the purposes, conditions, and means of the processing of personal data. This means that the data controller is the entity that decides why and how personal data is processed. |

| | | |
|---|---|---|
| **Data Processor** | Business Role | A natural or legal person, public authority, agency, or any other body that processes personal data on behalf of the controller. There are situations in which an entity may be either a data controller or a data processor, or both. |
| **Deliver Learning Activity** | Business Service | Deliver learning activity ABB is a business service that exposes the functionality of the learning activity realisation business function. This encompasses carrying out activities through accessing and utilising related educational resources, ultimately resulting in the creation of learning records. |
| **Educational Resource** | Business Object | Educational resource ABB is a business object representing any type of resource created for educational purposes. |
| **Educator** | Business Role | Educator ABB is a business role representing the educator's position within an institution. |
| **Grant Access to Learning Record** | Business Process | This ABB represents the business process through which access is enabled for a specific user to a learning record stored within a system. |
| **Learning & Teaching Delivery** | Capability | Learning & teaching delivery conducts the learning and teaching activities specified in the institution's curricula. |
| **Learning Activity Realisation** | Business Function | Learning activity realisation ABB is a business function that aggregates the business processes of accessing an educational resource and participating in an activity. The process of participating in an activity results in a learning outcome acquired by the learner, which is subsequently recorded in a learning record. |
| **Learning Assessment** | Capability | Learning assessment assesses the student's knowledge of learning outcomes across all delivery modes including blended learning and work-based and work-integrated learning. |
| **Learning Record Querying** | Business Function | Learning record querying ABB is a business function that represents the process of searching for learning records, associated with various workflows that may require this object. This ABB is strongly influenced by the business object data policy, which encompasses the privacy and security restrictions for handling this type of data. |

| | | |
|---|---|---|
| **Learning Record System Admin** | Business Role | Learning record system admin ABB is a role that encompasses the responsibilities of managing the learning records generated by learners within a single profile. |
| **Learning Records Access Management** | Business Function | Learning records access management ABB is the business function that encompasses the processes of managing access and permissions to the learning records generated by users. |
| **Manage Learning Records** | Business Service | Manage learning records ABB is a business service that provides functionalities for managing learning records, such as storage and modification. |
| **Manage Learning Records Permissions** | Business Service | Manage learning records permissions ABB is a business service that provides functionalities related to managing access permissions for stored learning records. |
| **Manage Permissions** | Business Process | This ABB represents the business process by which an individual's access rights to a learning record are managed. |
| **Modify Learning Record** | Business Process | This ABB represents the process by which a user modifies a learning record. For example, an educator validating the outcome of an activity. |
| **Participate in Activity** | Business Process | Participate in activity ABB business process represents the learner's action of engaging in an activity, which generates an activity outcome that will later be incorporated into a learning record. |
| **Reject Access to Learning Record** | Business Process | This ABB represents the business process by which a user is denied access to a specific learning record due to insufficient permissions. |
| **Request Access** | Business Process | This ABB represents the process initiated by a user to request access to a specific learning record. |
| **Role** | Business Object | This ABB represents the business object related to a user role. |
| **Search for Learning Record** | Business Service | Search for learning record ABB is a business service that exposes the functionality to search for learning records stored in a system. |

| | | |
|---|---|---|
| **Search Record** | Business Process | Search record ABB is the business process that represents the business process of searching for learning records carried out by users. |
| **Share Learning Records** | Business Function | Share learning records ABB is the business function responsible for implementing the service of sharing learning records. This ABB is strongly influenced by the business object data policy, which encompasses the privacy and security restrictions for sharing this type of data. |
| **Share Record** | Business Interaction | Share record ABB is a business interaction related to the interaction between different systems to share learning records, either within an institution or at the alliance level. |
| **Sharing Learning Record** | Business Service | Sharing learning record is a business service that exposes the functionality related to the sharing of stored learning records. |
| **Store Learning Record** | Business Process | Store learning record ABB is the business process that represents the process by which learning records are shared between systems. This process is strongly linked to the data policies regarding security and privacy. |
| **Student Academic Progress Management** | Capability | Student academic progress management guides a student to completion of their studies. |
| **Student Supervision** | Capability | Student supervision provides supervision of a student's academic efforts, whether they be course-, dissertation-, or research-based. |
| **Tool** | Business Actor | Tool ABB is a business actor that represents the tools used by institutional staff (learners/educators), which can access educational resources and through which learning activity records of users are generated. |

## Semantic view

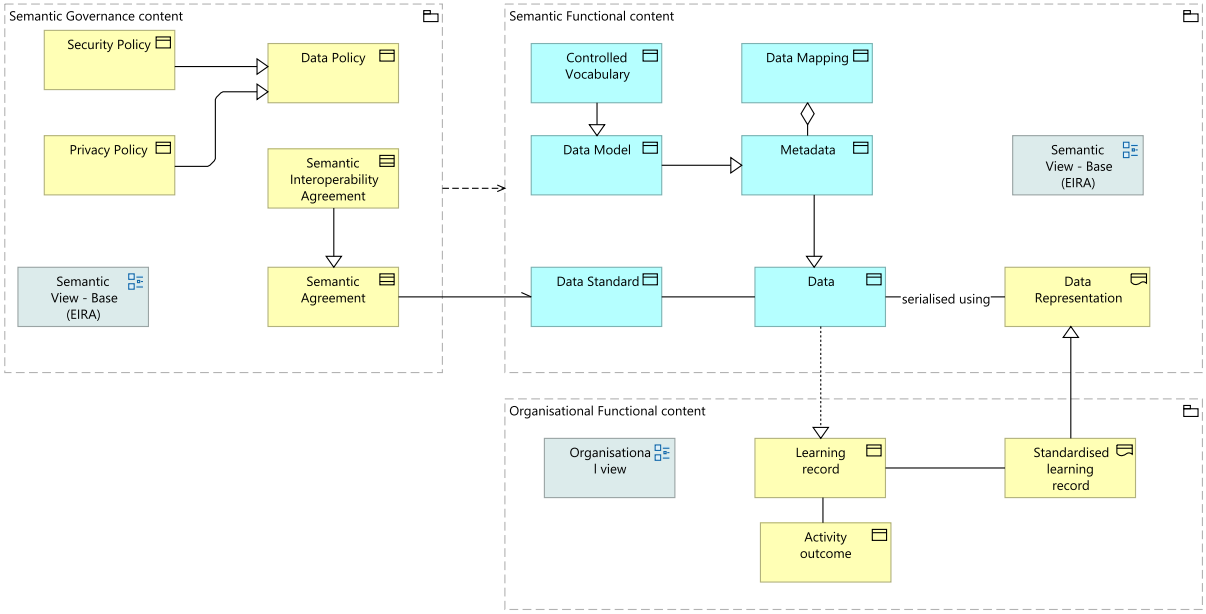


*Figure 31 - Use case 5 reference architecture semantic view.*
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For this use case, the reference architecture at the semantic level only displays the ABBs related to the current representation of the data and how they should be linked to standardised representations of the data to ensure their interoperability.

The following table describesthe most prominent building blocks.

| Building block | Type | Description |
|---|---|---|
| **Controlled Vocabulary** | Data object | Controlled vocabulary ABB is a data object that enables a carefully curated set of terms used to describe concepts or objects in a specific field or domain. It is a standardised list of terms that are used to ensure consistency and accuracy in the indexing, searching, and retrieval of information. |
| **Semantic Interoperability Agreement** | Contract | Semantic interoperability agreement ABB is a contract for-malising governance rules enabling collaboration between digital public services with ontological value. |
| **Standardised Learning Record** | Representation | Standardised learning record ABB is a representation that defines the standardised state of a learning record. |

## Technical view

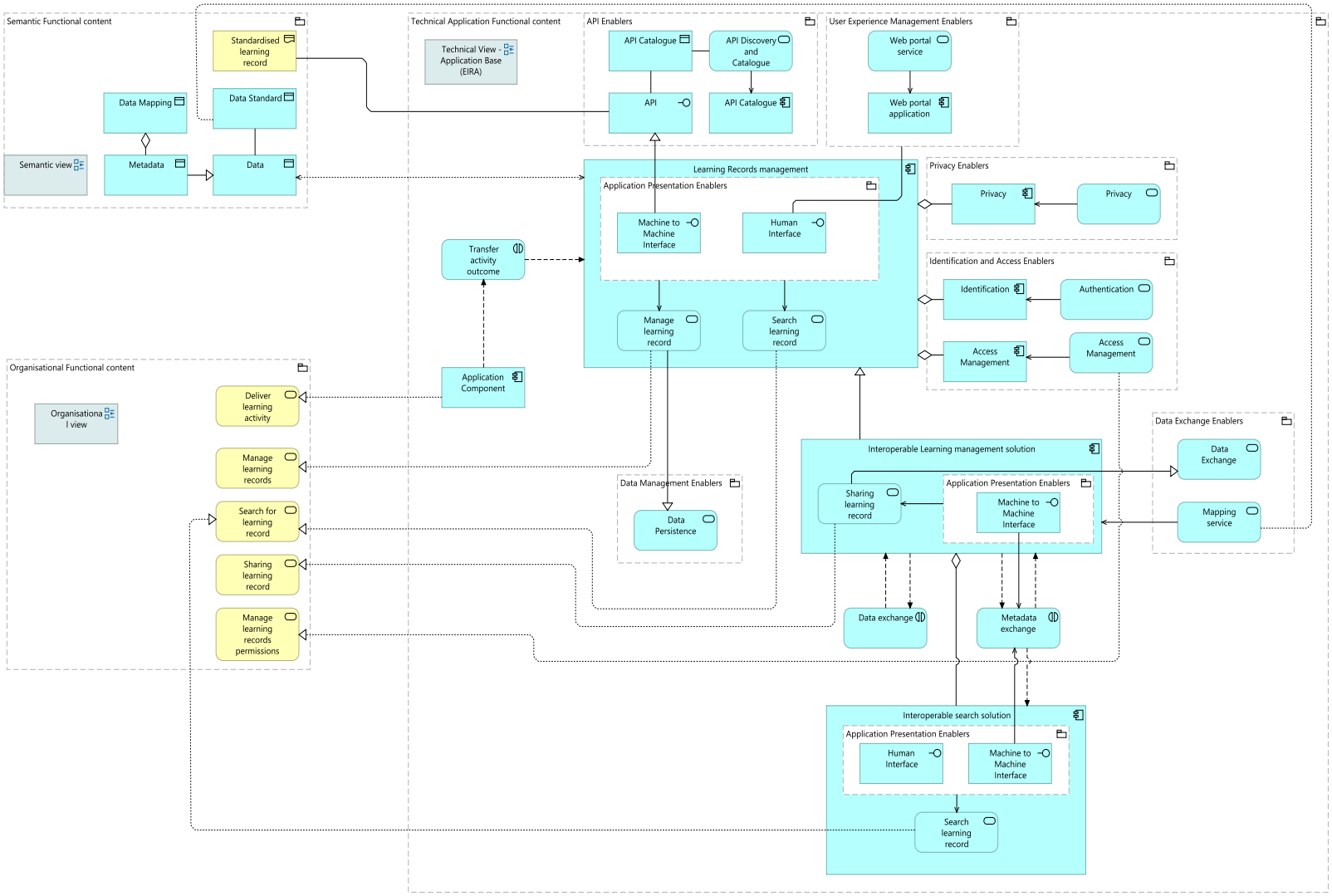


*Figure 32 - Use case 5 reference architecture technical view.*

The technical view of the reference architecture for this use case represents the current state of learning records management generated by learners. On top of this foundation, the necessary components are added to ensure interoperability for this use case. This is achieved through data exchange enablers and components that facilitate the exchange of standardised metadata and its retrieval.

The following table describes the most prominent building blocks.

| Building block | Type | Description |
|---|---|---|
| **Access Rights** | Business Object | Access rights govern who has the ability to view, edit, and delete data, and proper control over access rights is essential for maintaining the confidentiality, integrity, and availability of information |
| **Access Management** | Application Service | Access management ABB is an application service aimed to grant authorised users the right to use a service, while preventing access to non-authorized users. |
| **Access Management** | Application Component | Access management ABB is an application component implementing the process of granting rights to users and preventing access to non-authorised users. |
| **API** | Application Interface | API ABB is an application interface that enables a set of rules and specifications that allow different software components or systems to communicate and exchange data. |
| **API Catalogue** | Data Object | API catalogue ABB is a data object corresponding to a collection of (open) software interfaces that enable data consumption by a specific digital solution. |
| **API Catalogue** | Application Component | API catalogue ABB is an application component that refers to the (open) software interface functionalities that are aligned with the implementation structure of the digital services. |
| **API Discovery and Catalogue** | Application Service | API discovery and catalogue service ABB is an application service that enables the discovery and/or maintenance of the API catalogue ABB. |
| **API Enablers** | Grouping | API enablers ABB is a grouping that refers to components and frameworks that support the implementation and cataloguing of (open) software interfaces. |

| | | |
|---|---|---|
| **Application Component** | Application Component | Application component ABB is an application component that represents an application linked to a learning activity, which, once initiated by a user, results in the completion of a learning outcome. |
| **Authentication** | Application Service | Authentication ABB is an application service that enables the functionality of grating users to access the platforms or the services. |
| **Data Exchange** | Application Service | Data exchange ABB is an application service enabling the secure exchange of messages, records, forms and other kinds of data between different individuals, organisations or systems. This includes data routing, except endpoint discovery. |
| **Data Exchange** | Application Interaction | Data exchange ABB is an application interaction that represents the data exchange between interoperable applications. |
| **Data Exchange Enablers** | Grouping | Digital exchange enablers ABB is a grouping that refers to tools or components that facilitate the exchange of data between systems or applications. |
| **Data Management Enablers** | Grouping | Data management enablers ABB is a grouping that refers to components and services that support effective data management practices and procedures. |
| **Data Persistence** | Application Service | Data persistence ABB is an application service that enables the procedures that allow data to be stored and retrieved over an extended period of time. |
| **Identification** | Application Component | Identification ABB is an application component implementing the process of verifying a user's identity based on one or more authentication factors. |
| **Identification and Access Enablers** | Grouping | Identification and access enablers ABB is a Grouping that refers to components to enable the secure identification and authentication of users, systems and services into a platform. |

| | | |
|---|---|---|
| **Interoperable Learning Management Solution** | Application Component | Interoperable learning management solution ABB is an application component that specialises the learning records management ABB. This interoperable specialisation is responsible for sharing learning record data through data exchange enablers, which facilitate the mapping to standardised data and its exposure. |
| **Interoperable Search Solution** | Application Component | Interoperable search solution ABB is an application component that specialises in the search functions for learning records and is aggregated into the interoperable learning management solution ABB. |
| **Manage Learning Record** | Application Service | Manage learning record ABB is an application service responsible for implementing the operations involved in managing learning records. |
| **Mapping Service** | Application Service | Mapping service ABB is a service that enables the translation between data models, standards, or controlled vocabularies. |
| **Metadata Exchange** | Application Interaction | Metadata exchange ABB is an application interaction that represents the metadata exchange between interoperable applications. |
| **Privacy** | Application Service | Privacy ABB is an application service enabling the share of functionalities such as storing, securing, anonymising, pseudonymising, rectifying and erasing personal data. |
| **Privacy** | Application Component | Privacy ABB is an application component that enables the implementation of functionalities such as storing, securing, anonymising, pseudonymising, rectifying and erasing personal data. |
| **Privacy Enablers** | Grouping | Privacy enablers ABB is a grouping that refers to components and services that facilitate the implementation of privacy-related functionality within an application or system. |
| **Search Learning Record** | Application Service | Search learning record ABB is an application service responsible for implementing the search functionality for learning records. |
| **Transfer Activity Outcome** | Application Interaction | Transfer activity outcome ABB is an application interaction that represents the transfer of the learning record related to the outcome of the activity performed by the learner, between the application that generates it and the storage where this data will reside. |

| | | |
|---|---|---|
| **User Experience Management Enablers** | Grouping | User experience management enablers ABB is a Grouping that refers to components and services that track, measure, analyse and improve any interaction people have with the organisation. |
| **Web Portal Application** | Application Component | Web portal application ABB is an application component representing a web portal application through which access is provided to a range of services. |
| **Web Portal Service** | Application Service | Web portal service is the service responsible for exposing the services offered to the user through a human interface. |

For a more comprehensive view of this architecture, it is recommended to review the ArchiMate diagrams associated with this document.

PART 6

# Use case 6 – Earn a credential

# Use case 6 - Earn a credential

USE CASE **6**

## Earn a credential

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The digital management of educational credentials (issuance, verification, revocation), affirming the achievements from diverse learning experiences.

Micro-credentials

Portable credentials

Use case 6 is all about communication with the job market or enrolling on further learning opportunities. For the scope of this use case, credentials can be both digital and physical. The fundament of any credential is trust. The use case covers issuing the credential, sharing it, and verifying the credential with trust data[2].

## Challenges

The interoperability between HEIs to generate and manage student credentials involves several steps and the use of technologies that ensure the validity, security, and recognition of these credentials.

Secure storage of credentials is a necessity, including student and institution identity attributes and credential details. This involves elements such as data encryption, user authentication, and access control. Another challenge is preventing unauthorised changes to the stored data. In addition, identity management capabilities are required to verify the identity of users accessing the system and to ensure the correct use of stored credentials. A service that allows third parties to verify the authenticity of a credential is needed, which implies a validation of the digital signature, the integrity of the data, and the source of the credential. The system must be compatible with interoperability standards to facilitate its integration with other systems. Lastly, the system must have a detailed record of all activities related to the credentials, such as issuance, verification, validation, and revocation.

[2] A set of data that allows the authenticity and validity of a digital credential to be verified. This trusted data is issued or verified by trusted sources and helps ensure that the credential originates from a legitimate and authorised institution or entity.

## Draft architecture

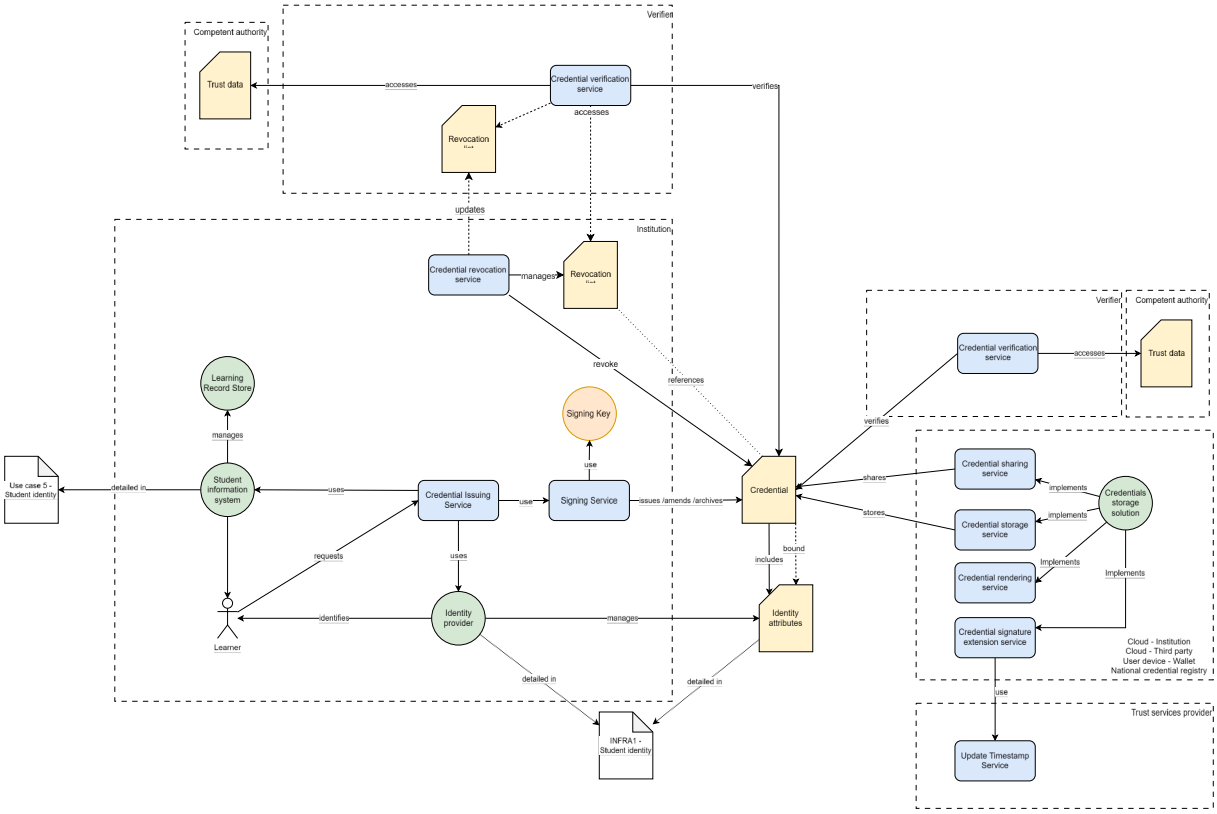


*Figure 33 - Use case 6 required building blocks and their relationships – scenario 1.*
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The diagram above illustrates the draft architecture for a scenario in which an institution is responsible for issuing a credential to a learner. This credential is signed using the institution's signing key, and the necessary identity attributes of the user are associated with it to ensure its recognition in the future. The credential is stored in a credential storage solution, defined generically to accommodate modern solutions like digital wallets, as well as more traditional options such as national repositories. This storage solution is responsible for sharing the credential, displaying it in a readable format, and, in some cases, extending its validity.

In the next diagram, the process of credential signing is adapted for a joint programme scenario. In this case, different approaches can be taken for signing the credential. For example, an agreement between the involved institutions may allow the learner's home institution to sign the credential on behalf of all

participating institutions. Alternatively, an agreement might allow the home institution to sign the credential with its signing key, as well as with the signing keys of the other institutions, resulting in a credential that is signed by all of them. Both scenarios are depicted in the diagram.

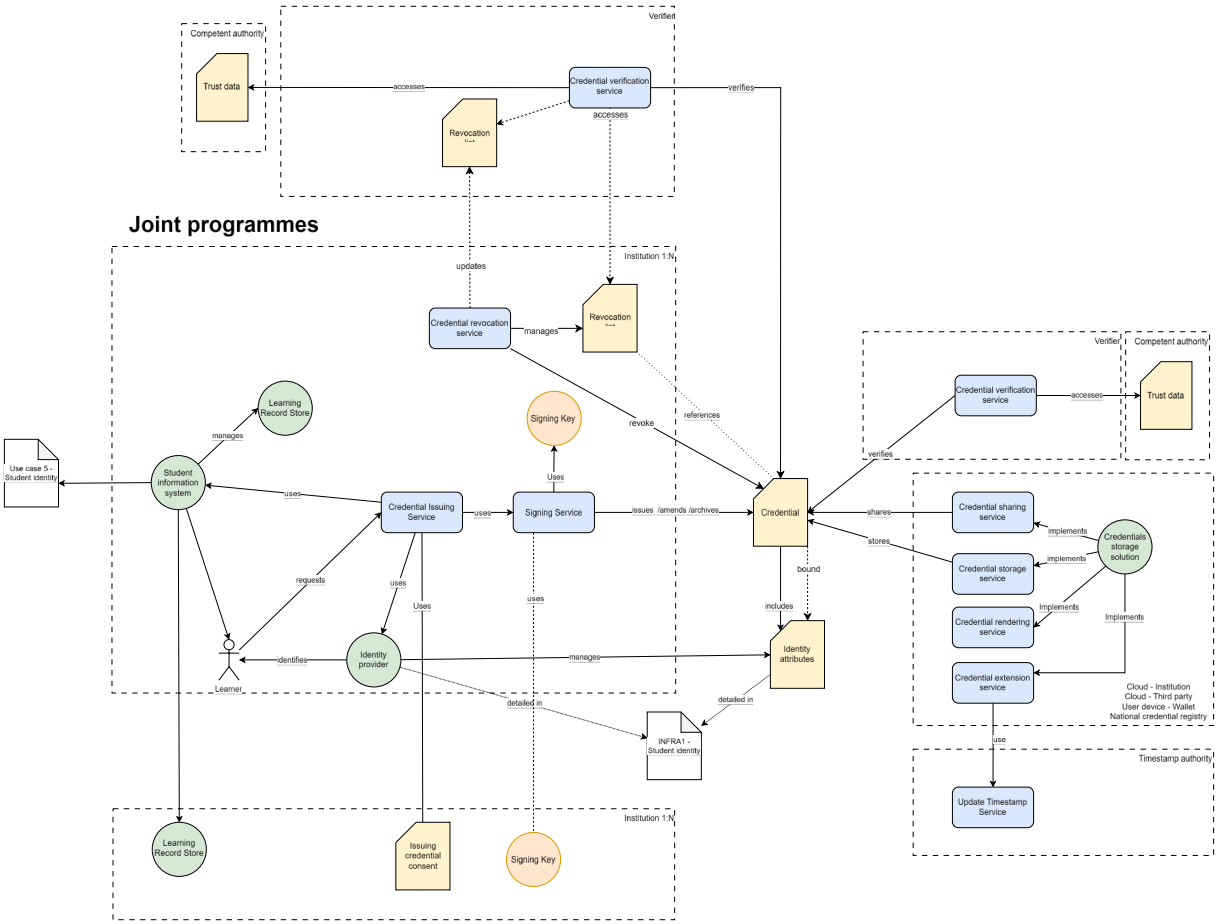


*Figure 34 - Use case 6 required building blocks and their relationships – scenario 2.*
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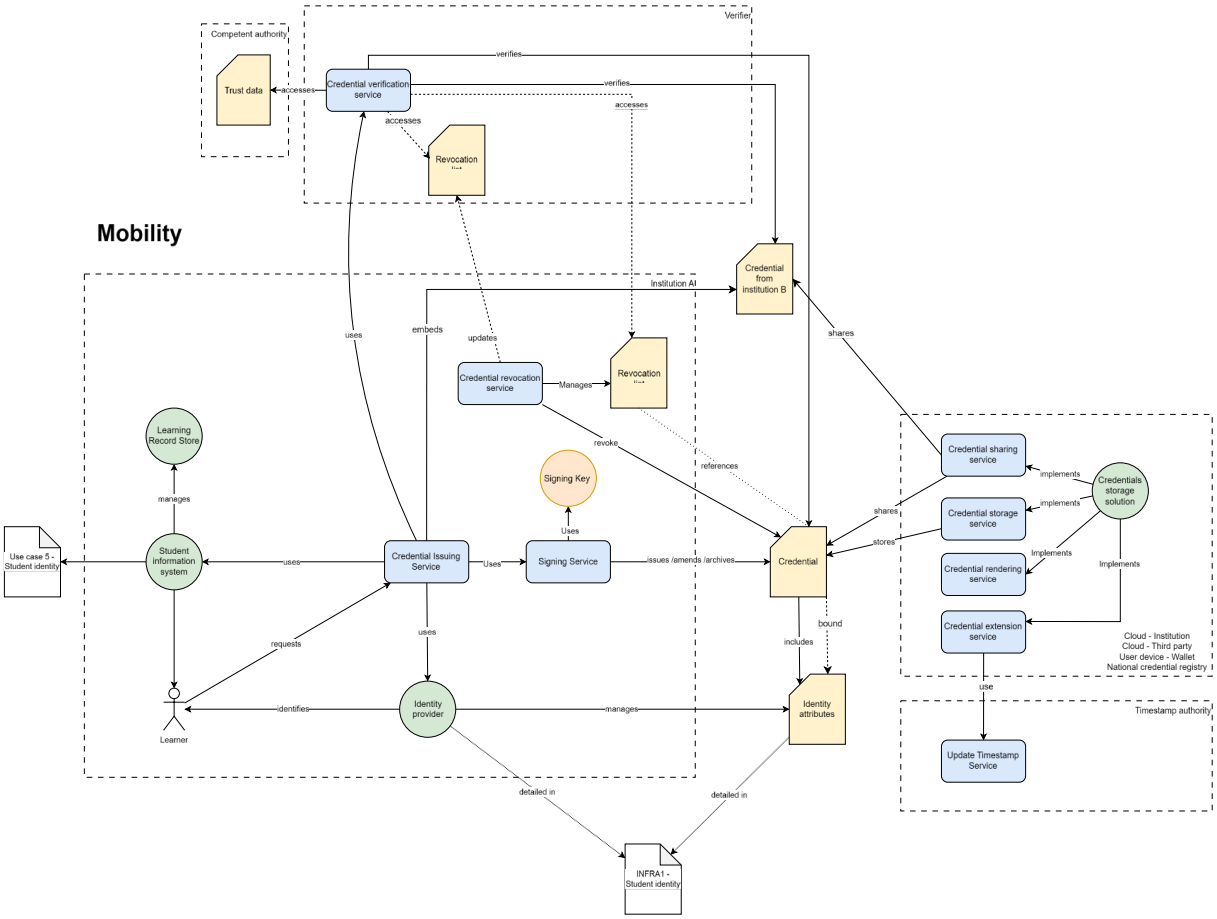


*Figure 35 - Use case 6 required building blocks and their relationships – scenario 3.*
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The above architecture diagram illustrates a mobility scenario beyond the scope of joint programmes. In this case, to obtain a common credential, during the credential creation process at the learner's home institution, credentials issued and signed by third parties are embedded within a credential signed by the home institution. This embedding of external credentials involves a sub-process of credential verification, ensuring both the validity of a credential and its association with the learner. This entire process is depicted in the architecture of this scenario.

The identified elements that make up the draft architecture are defined below:

**Business objects:**

- **Credential:** A set of one or more claims made by an issuer. The claims in a credential can be about different subjects.[3]
- **Trust data:** Data used to validate and verify a set of claims.
- **Revocation list:** This object represents a list of digital certificates that have been revoked by the issuing certificate authority.
- **Identity attributes:** A set of learner-related attributes linked to the credential issued by the institution.
- **Issuing credential consent:** Consent signed by an institution granting authority to a third party to use its signature as a certificate authority for future credentials within a joint programmes framework.

**Services:**

- **Credentials storage service:** Stores a copy of the issued certificates and a register of their status. Can be used to check the status of a previously issued certificate.
- **Credential issuing service:** Given a set of learning achievements and records, generates a certificate with a set of claims. Relies on the identity provider to attach information of the subject obtaining the certificate.
- **Credential sharing service:** Credentials storage solutions provide mechanisms to share previously stored credentials.
- **Credential revocation service:** Service in charge of revoking a credential, manages the revocation list.
- **Signing service:** Given a credential, this service is in charge of signing it with the institution signing private key.
- **Credential verification service:** Service checking the veracity of a claim. Verification processes involve getting information about the status of a claim.

**Systems:**

- **Student information system (SIS):** Manage student data, including grades and records of the student needed to issue a claim about the achievements obtained.

[3] Verifiable Credentials Data Model v2.0 (w3.org)

- **Learning record store:** Software application for storing and managing learning records. Learning records stores can be integrated as part of the LMS or be an independent system.
- **Identity provider:** An identity provider, sometimes abbreviated as IdP, is a system for creating, maintaining, and managing identity information for holders, while providing authentication services to relying party applications within a federation or distributed network[4].

**Credentials storage solution:** System to store and manage the certificates issued to the user. Is owned by the subject receiving a credential.

[4] Verifiable Credentials Data Model v2.0 (w3.org)

# Reference architecture

## Organisational view

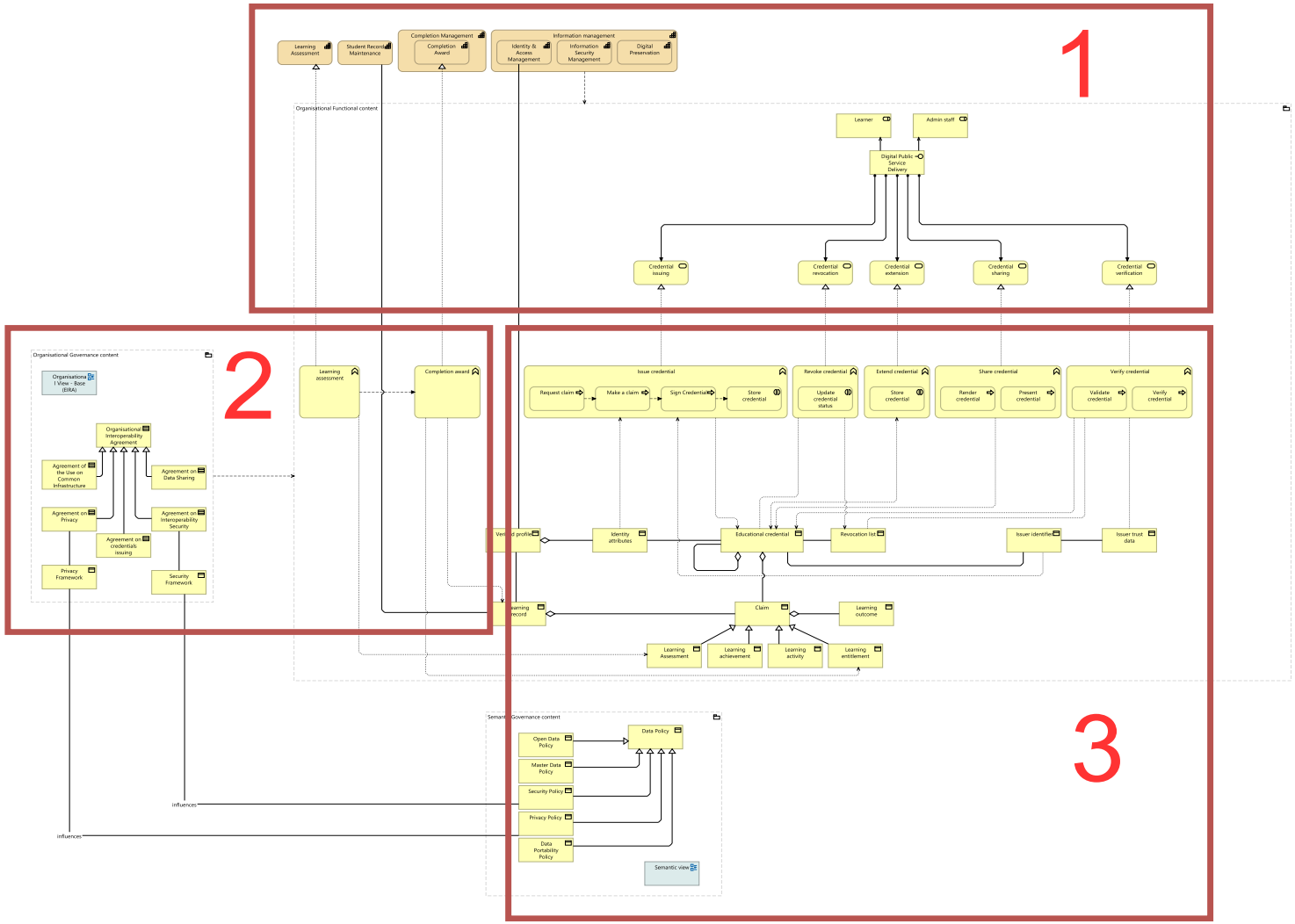


*Figure 36 - Use case 6 reference architecture organisational view.*

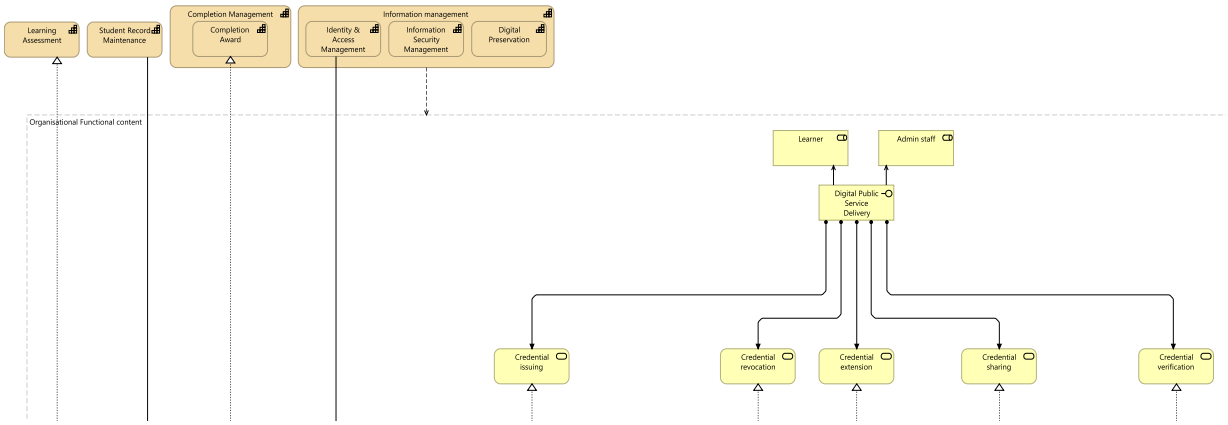


*Figure 37 - Use case 6 reference architecture organisational view - part 1.*
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In this initial view of the organisational layer, the main capabilities of the use case are presented: Learning Assessment, Student Record Maintenance, Completion Award, Identity & Access Management, Information Security Management, and Digital Preservation. These capabilities, previously defined in the base EIRA model, represent the essential process requirements that must be addressed. The digital interface exposes services that enable credential issuing, as well as the ability to revoke, extend, share, and verify issued credentials.

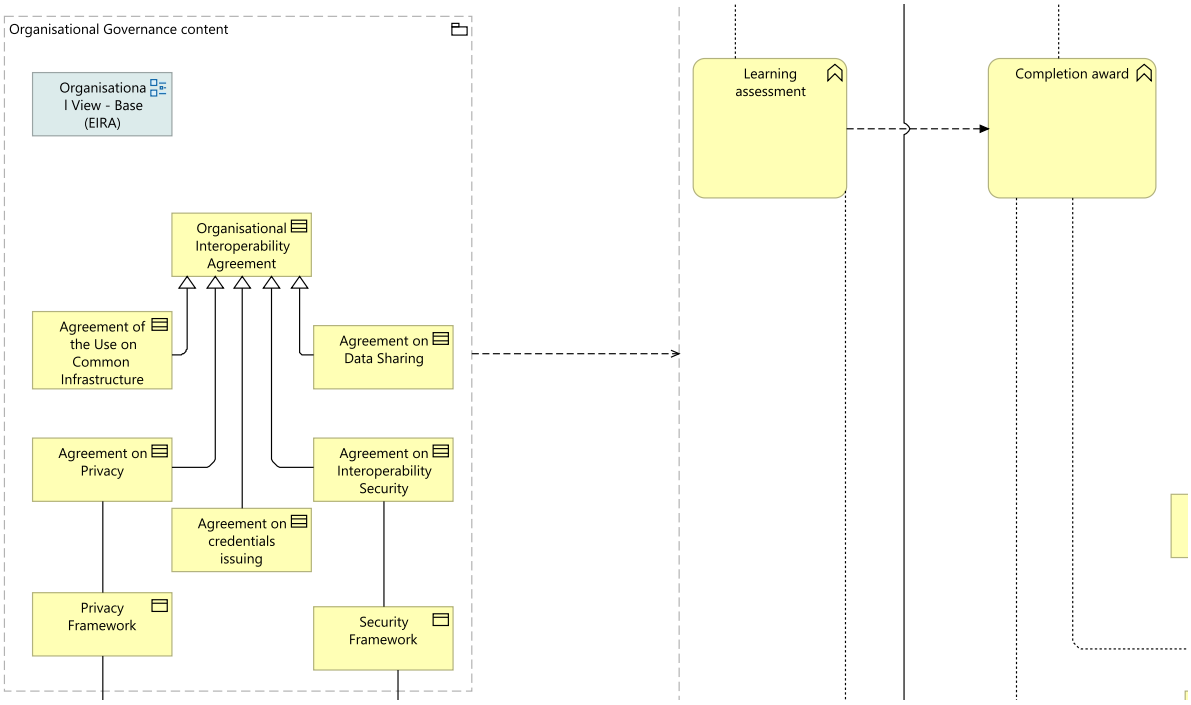


*Figure 38 - Use case 6 reference architecture organisational view - part 2.*
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This second view focuses on the contract-type ABBs that impact credential issuing flows. These contracts relate to agreements on data sharing, privacy, and security, among other aspects. These blocks are essential for ensuring a functional, interoperable ecosystem as they provide for:

- Regulatory Compliance: The organisational layer of institutions must align with regulations such as GDPR and eIDAS, which enforce strict data privacy and security standards.
- Integrity and Confidentiality Protection: Privacy and security agreements set guidelines for data handling, defining the controls and protective measures that ensure personal and sensitive information is accessible only to authorised parties.
- Interoperability Across Systems and Entities: Secure and reliable data sharing is crucial in interoperable architectures. The data-sharing building blocks establish a common framework for information exchange, enabling interoperability between systems and facilitating mutual recognition of information.

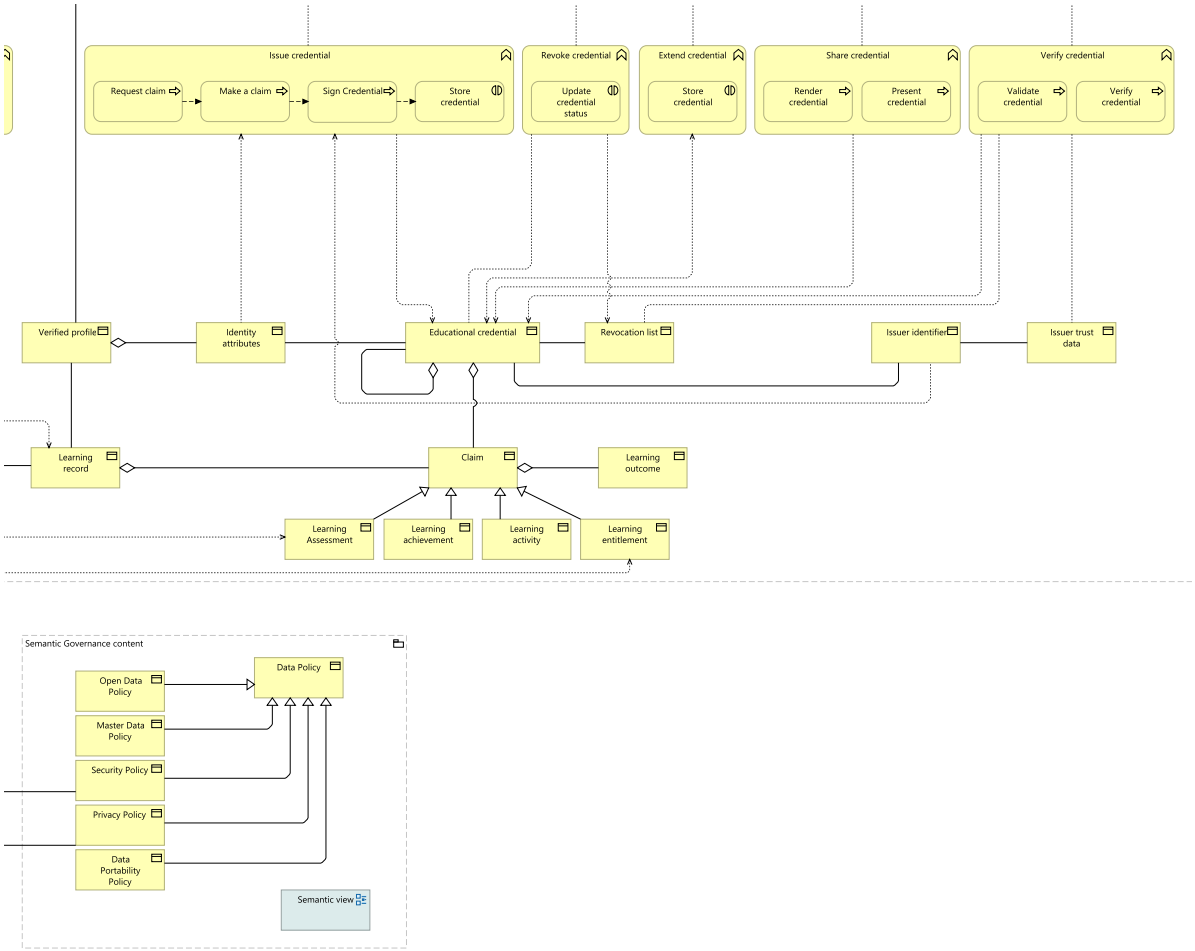


*Figure 39 - Use case 6 reference architecture organisational view - part 3.*
*© 2025 European Union*

Finally, the diagram above shows the integration of the semantic layer with the organisational layer, illustrating the various policies that constitute the ABB data policy. This data policy includes security and privacy policies, which are linked to their respective business objects and contracts within the organisational layer, as seen in the second part of this overall scheme. Next to the semantic layer reference, the business functions that implement the services exposed by the digital interface are defined, together with the corresponding business processes.

The primary business objects for this use case include claims, which, when aggregated within learning records, have different specialisations depending on the type of claim represented. These claims are also aggregated under the ABB educational credential, which represents the credential itself. Additionally, credentials have been designed to support nested structures, accommodating cases where credentials embed other credentials. This setup is particularly useful for scenarios where learners acquire partial credentials for a complete course across multiple institutions, as in various mobility processes.

The following table describes the most prominent building blocks.

| Building block | Type | Description |
|---|---|---|
| **Admin Staff** | Business Role | Admin staff ABB is a role that represents the administrative staff of the institutions. |
| **Agreement of the Use on Common Infrastructure** | Contract | Agreement of the use on common infrastructure ABB is a contract between multiple parties that outlines the terms and conditions for sharing and utilising a specific infrastructure or facility. The agreement on the use of common infrastructure typically outlines the rights and responsibilities of each party, the terms and conditions for access and usage, the payment or cost-sharing arrangements, and the procedures for resolving any disputes or issues that may arise. |
| **Agreement on Credentials Issuing Consent** | Contract | Agreement on issuing consent is a contract formalising the rules under which an institution may issue a credential on behalf of another institution. This building block is relevant in Joint Programmes scenarios where an institution may issue a diploma on behalf of the institution involved in the programme. |

| | | |
|---|---|---|
| **Agreement on Data Sharing** | Contract | Agreement on data sharing ABB is a contract formalising the information requirements, syntax bindings, protocols and semantic artefacts that must be used for the exchange of data. |
| **Agreement on Interoperability Security** | Contract | Agreement on interoperability security ABB is a contract formalising governance rules and conditions to grant the identification, authorisation, and transmission of the data, information and knowledge being exchanged between digital public services. |
| **Agreement on Privacy** | Contract | Agreement on privacy ABB is a contract that enables a set of rules for the personal data of individuals' collection, processing and transference by public administrations. |
| **Claim** | Business Object | A claim made by an issuer. |
| **Completion Award** | Business Function | Completion award ABB is a business function that manages the conferral of recognition for completion of the study. |
| **Completion Award** | Capability | Completion award manages the conferral of recognition for completion of study. |
| **Completion Management** | Capability | Completion management confirms and recognises the study completion. |
| **Credential Extension** | Business Service | Business service responsible for extending the signatures of a credential. |
| **Credential Issuing** | Business Service | Business service responsible for creating and issuing digital credentials. |
| **Credential Revocation** | Business Service | Application service responsible for invalidating issued credentials. This service plays a crucial role in maintaining the integrity and trustworthiness of the digital credential system. |
| **Credential Sharing** | Business Service | Application service that facilitates the secure and efficient sharing of digital credentials between various parties. |
| **Credential Verification** | Business Service | Application service that validates the authenticity and integrity of digital credentials. |

| | | |
|---|---|---|
| **Data Policy** | Business Object | Data policy ABB is a business object aiming to form the guiding framework in which data management can operate. |
| **Data Portability Policy** | Business Object | Data portability policy ABB is a business object that regulates data reuse and data transference between public administrations. |
| **Digital Preservation** | Capability | Digital preservation is the active and deliberate management and maintenance of digital objects (files that contain information in digital form) so that they can be accessed and used by future users. |
| **Digital Public Service Delivery** | Business Interface | Digital public service delivery ABB is a business interface representing the way in which the public sector delivers digital technologies and public services to citizens and businesses. |
| **Educational Credential** | Business Object | A credential is an attestation, evidence or proof of qualification, activities, assessments, or entitlements. |
| **Extend Credential** | Business Function | Extend credential ABB is the business function that carries out the process of extending the validity of issued credentials. |
| **Identity & Access Management** | Capability | Identity & access management manages information about people and things, instantiates and enforces organisational business rules and policy regarding entitlements to systems and services, and mediates access requests and identity verification. |
| **Identity Attributes** | Business Object | Collection of attributes to identify the subject or issuer of a claim from a credential |
| **Information Management** | Capability | Information management describes, organises, distributes, and governs information. |
| **Information Security Management** | Capability | Information security management protects information against the loss of confidentiality, integrity, and availability. |
| **Issue Credential** | Business Function | Issue credential ABB is a business function that encompasses the defined processes necessary for generating a credential. This includes the creation of the credential, its signing, and subsequent storage. |
| **Issuer Identifier** | Business Object | Issuer identifier ABB is a business object that represents the identifier used by the entity issuing the credentials, which is later used for verification purposes. |

| | | |
|---|---|---|
| **Issuer Trust Data** | Business Object | Information required by a verifier to validate that the issuer of a claim is accredited to verify the authenticity and validity of a credential. |
| **Learner** | Business Role | Learner ABB is a business role that represents the role of learners within the ecosystem of institutions and alliances. |
| **Learning Achievement** | Business Object | The acquisition of knowledge, skills or responsibility and autonomy. A recognised and/or awarded set of learning outcomes of an individual. |
| **Learning Activity** | Business Object | Any process which leads to the acquisition of knowledge, skills or responsibility and autonomy. |
| **Learning Assessment** | Business Object | The result of a process establishing the extent to which a learner has attained particular knowledge, skills and competences against criteria such as learning outcomes or standards of competence. |
| **Learning Assessment** | Capability | Learning assessment assesses the student's knowledge of learning outcomes across all delivery modes including blended learning and work-based and work-integrated learning. |
| **Learning Entitlement** | Business Object | A right, e.g., to practice a profession, take advantage of a learning opportunity or join an organisation, as a result of the acquisition of knowledge, skills, responsibility and/or autonomy. |
| **Learning Outcome** | Business Object | A statement of what a learner knows, understands and is able to do on completion of a learning process, defined in terms of knowledge, skills, responsibility and autonomy. |
| **Learning Record** | Business Object | Digital record for all learning experiences one learner has participated in. |
| **Make a Claim** | Business Process | Make a claim ABB is a business process that represents the business process by which an institution affirms the achievement of an academic accomplishment by a learner. |
| **Master Data Policy** | Business Object | Master data policy ABB is a business object that is applied to the most authoritative and accurate data available about key business entities, used to establish the context for business transactions and transactional data. |

| | | |
|---|---|---|
| **Open Data Policy** | Business Object | Open data policy ABB is a business object formalising the procedures to publish FAIR data generated by different parties. FAIR data means being aligned and compliant with FAIR principles, making data findable, accessible, interoperable, and reusable. |
| **Organisational Interoperability Agreement** | Contract | Organisational interoperability agreement ABB is a contract formalising governance rules enabling collaboration between digital public services with enabling seamless interoperability enablement value. |
| **Present Credential** | Business Process | Present credential ABB is a business process that represents the display of a stored credential. |
| **Privacy Framework** | Business Object | Privacy framework ABB is a business object that enables the confidentiality aspects of data, information and knowledge assets and organisational resources handling them. |
| **Privacy Policy** | Business Object | Privacy policy ABB is a business object that regulates the personal data of any customer, client or employee information. |
| **Render Credential** | Business Process | Render credential ABB is a business process through which the stored credential is translated into a format readable by the end user. |
| **Request Claim** | Business Process | Request claim ABB is a business process that initiates the chain of processes for issuing credentials. It represents the first step in which a student or the institution requests recognition of an academic achievement. |
| **Revocation List** | Business Object | A list of credentials that revoked by the issuing authority. |
| **Revoke Credential** | Business Function | Revoke credential ABB is the business function responsible for updating both the revocation list and the status of the credential during the process of revoking a user's credential. |
| **Security Framework** | Business Object | Security framework ABB is a business object that enables the protection of various aspects of data, information and knowledge assets and the organizational resources handling them. |
| **Security Policy** | Business Object | Security policy ABB is a business object that regulates the protection of customer or client's data. |

| | | |
|---|---|---|
| **Share Credential** | Business Function | Business function that facilitates the secure and efficient sharing of digital credentials between various parties. |
| **Sign Credential** | Business Process | Sign Credential ABB is a business process that represents the signing of credentials by an entity. |
| **Store Credential** | Business Interaction | Store credential ABB is a business interaction representing the process by which a credential is stored within a credential storage system. |
| **Student Record Maintenance** | Capability | Student record maintenance captures and manages information on each student, including permanent evidence of their attainment and attendance. |
| **Update Credential Status** | Business Interaction | Update credential status ABB is a business interaction in which a credential's status is modified, such as updating it to a "revoked" status. |
| **Validate Credential** | Business Process | Validate credential ABB is a business process representing the credential validation procedure. This process involves verifying the credential itself, the issuing entity, and the integrity of the data. |
| **Verified Profile** | Business Object | A representation of a learner, educator or administrative staff related to an institution. |
| **Verify Credential** | Business Function | The business function that validates the authenticity and integrity of digital credentials. |
| **Verify Credential** | Business Process | Business process that validates the authenticity and integrity of digital credentials. |

## Semantic view

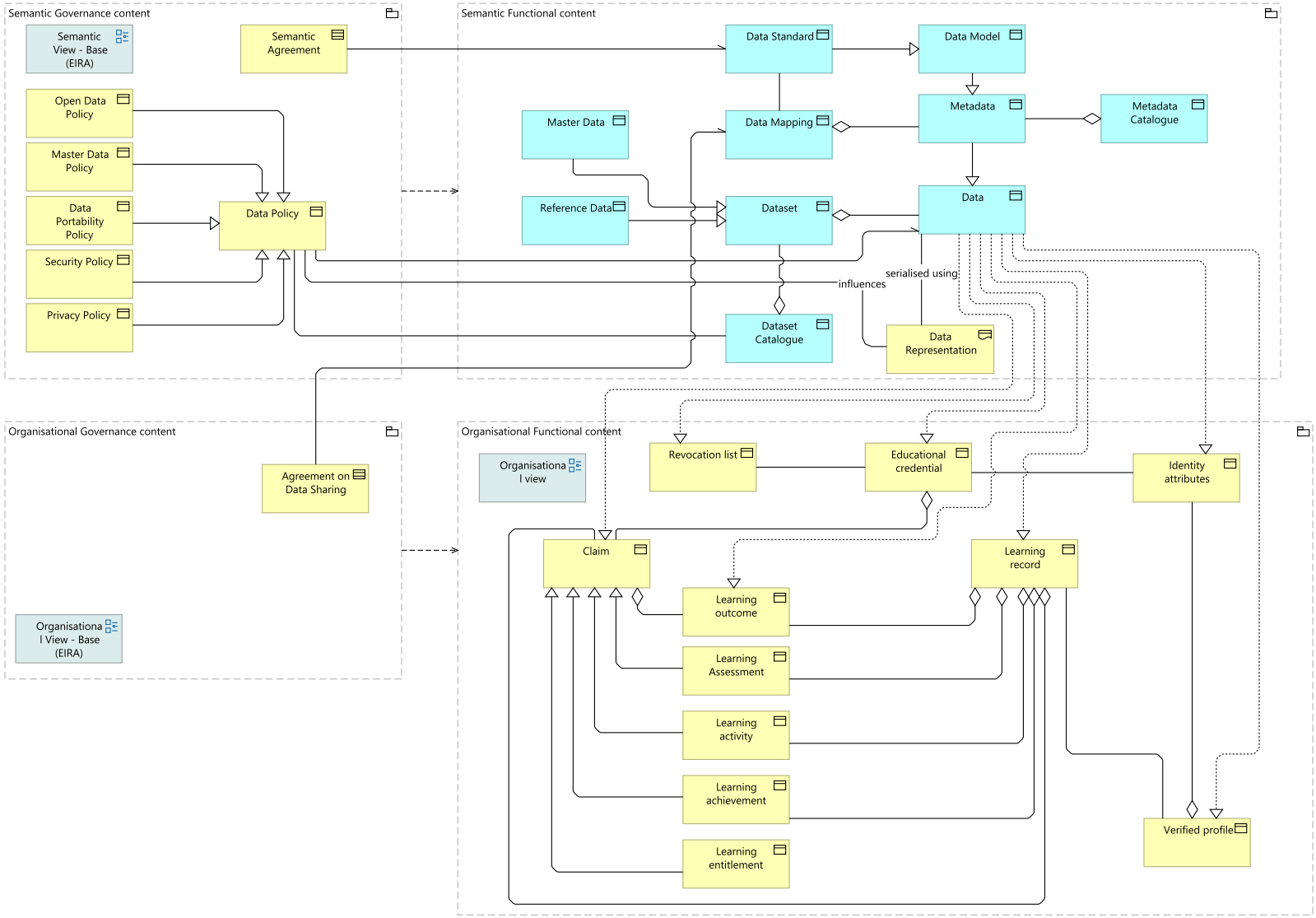


*Figure 40 - Use case 5 reference architecture semantic view.*

In the semantic view of this use case, the building blocks related to semantic agreements and data sharing are essential for interoperability, which is critical for the future recognition and sharing of credentials. Part of the organisational layer is used to define the relationships between business objects related to application objects, and how these in turn are connected by a common denominator: standards, that are directly related to the semantic agreement. An example of this type of relationship is the chain linking a Claim to a Learning outcome, which is implemented by an application object Data with associated Metadata, which in turn conforms to a Data model influenced by a Data standard. These aspects are the key components of the semantic layer. Below is the definition of the ABBs associated with this view, while those associated with the organisational layer can be found in the relevant section of this chapter.

| Building block | Type | Description |
|---|---|---|
| **Data Mapping** | Data Object | Data mapping ABB is a data object aiming to bring equivalence in a relationship between two data items with ontological value. |
| **Data Model** | Data Object | Data model ABB is a data object that aims to be a collection of entities, their properties and the relationships between them, focused on the formal representation of a domain, a concept or a real-world thing. |
| **Data Standard** | Data Object | A predefined structure that guides the organisation, integration, and management of data. It includes data models, data formats, protocols, and other technical specifications that ensure data consistency, interoperability, and efficient data exchange |
| **Dataset** | Data Object | Dataset ABB is a data object representing a collection of related data that is organised and presented in a structured format. |
| **Dataset Catalogue** | Data Object | Dataset catalogue ABB is a data object aimed at indexing a collection (inventory) of datasets in a systematic manner. |
| **Master Data** | Data Object | Master Data ABB is a data object that enables the implementation of non-transactional information to play a key role in the core business operation in public administrations and re-used for multiple purposes. |
| **Metadata** | Data Object | Metadata ABB is a data object providing information about one or more aspects of the data. |
| **Metadata Catalogue** | Data Object | Metadata catalogue ABB is a data object that represents the collection of descriptive information about data, resources or information objects related to public services. |
| **Reference Data** | Data Object | Reference data ABB is a data object that enables the definition of a set of values or codes that are used to categorise, classify, or describe data elements in a consistent and standardised way. |
| **Semantic Agreement** | Contract | Semantic agreement ABB is a contract formalising an agreement from a peer to the common ontology that is the result of a matching or mapping process that is used to resolve their semantic discrepancies. The combination matching process consists of a linguistic base and internal and external structure comparison. The result of the matching combination will be used to develop an agreement unit as a component of the agreement. |

## Technical view

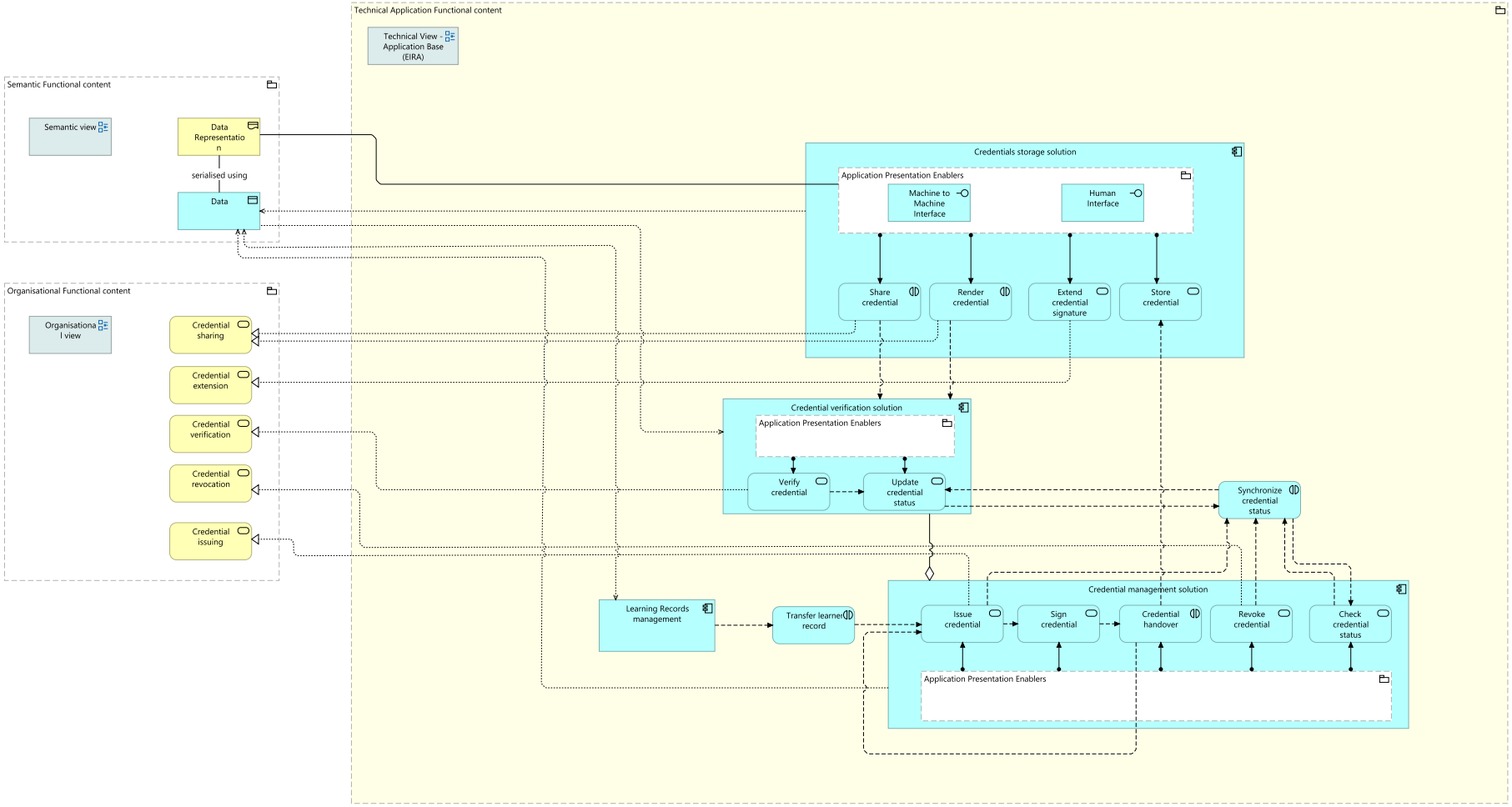


*Figure 41 - Use case 6 reference architecture technical view.*

In the technical layer, an adaptable architecture has been designed to meet the different scenarios outlined in the reference architecture. On the left-hand side, the connections of the organisational layer are shown, linking business services to the application components that will ultimately implement them. In addition, the relationship between data representations in the semantic layer and the application objects that will use this standardised representation is shown.

For application-specific elements, three main blocks are defined, representing the core groupings of technical functionalities: Credential storage solution, Credential verification solution and Credential management solution. These applications ABBs are flexible enough to support both the storage of credentials in national repositories and decentralised management options such as wallets. Although visually separate, solutions such as wallets can include at least two of these blocks, covering both credential storage and management functionality.

This adaptable architectural design enables the integration of currently existing solutions by illustrating how these established components interact with the interoperability-enabling elements, particularly in their connections to the semantic and organisational layers. Below is the definition of the ABBs associated with this view, while those associated with the organisational/semantic layer can be found in the relevant section of this chapter.

| Building block | Type | Description |
|---|---|---|
| **Check Credential Status** | Application Service | Check credential status ABB is an application service that represents the architectural component responsible for checking the status of a credential. |
| **Credential Handover** | Application Interaction | The credential handover building block enables sending a credential to a storage solution such as a wallet or to be incorporated as part of another credential issued by a collaborating institution. |
| **Credential Management Solution** | Application Component | Credential management solution ABB represents a solution that enables the management of credentials, including all the operations involved, such as issuing, signing, checking status, and revoking. |
| **Credential Verification Solution** | Application Component | Credential verification solution ABB is an application component responsible for validating and verifying credentials, as well as ensuring their integrity. |
| **Credentials Storage Solution** | Application Component | Credentials storage solution ABB is an application component that represents any existing solution for credential storage. This can be adapted to both centralised storage systems, such as national repositories, as well as others like wallets. |

| | | |
|---|---|---|
| **Extend Credential Signature** | Application Service | Extend credential signature ABB is an application service that, given a credential, is responsible for extending its validity period. |
| **Human Interface** | Application Interface | Human interface ABB is an application interface that enables the exchange of data between stakeholders (individuals, public administration or legal entities) and a service. |
| **Learning Records Management** | Application Component | Learning records management ABB is an application component that encompasses the functionalities for managing and searching learning records. |
| **Machine to Machine Interface** | Application Interface | Machine to machine interface ABB is an application interface that enables the exchange of data between a service and other services. |
| **Synchronise credential status** | Application Interaction | Synchronize credential status ABB is an application interaction that allows for synchronising the status of a credential across different application blocks. |
| **Transfer Learner Record** | Application Interaction | Transfer learner record ABB represents the interaction between applications when transferring the data of the learning records generated by users. |

PART 7

# Use case 7 – User identity

# Use case 7 - User identity

USE CASE 7

## User identity

Achieving interoperability for user identities across educational transitions, ensuring consistent identification throughout their academic journey.

Access | Federated identity | Student cards

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## Challenges

Managing user identity poses a significant challenge, particularly given the evolving nature of personal and professional identities. Throughout an individual's academic and career journey, their identity may change in various ways. For instance, a student may transition to a faculty role, requiring updates to roles, permissions, and resource access. Similarly, personal details like a user's name may change due to life events, such as marriage may occur.

These evolving details create complexities for identity management systems, which must effectively update and reflect changes without compromising data integrity or security. Interoperability across institutions becomes more challenging, as identity changes need to be recognised and validated by multiple entities while maintaining consistent records across systems. Equally important is effective role management, which requires systems to dynamically adjust user rights and permissions as roles or statuses change, both to ensure continued access to critical resources and to prevent security breaches.

Additionally, traceability and accurate recognition of credentials over time add another layer of complexity. Credentials issued under a prior name, for example, must remain linked to the user's current identity. This demands identity solutions capable of handling both permanent, unchangeable attributes as well as those that may evolve over time.

## Draft architecture

The draft architecture diagram presented in this section reflects the latest refinements made by the community and experts following the first use case 7 squad meeting. During the second meeting for this use case, the experts and community members agreed to shift the focus of the squads to other technical topics, rather than further developing this specific architecture. This decision was influenced by the fact that there are already a wide range of existing solutions for managing user identities across institutions and alliances. Rather than attempting to represent all these solutions in a single diagram - which would have compromised clarity and readability - the focus was shifted to interoperability aspects, such as defining the minimum attributes required for user identities in different scenarios, their level of assurance, and exploring future identity solutions such as decentralised identity management through wallets.

Therefore, no standalone reference architecture was developed for this use case. Instead, the technical aspects mentioned above can be found in the mapping report and interoperability framework report, both created within the project . As of the writing of this document, the latter report is pending updates to incorporate the latest changes from the squads on use case 8 and to include the most recent recommendations.

However, references to components from this use case appear within the various reference architectures of other identified use cases, as many of them require identity attributes and access and security management policies originating from this foundational use case. Thus, while it lacks a dedicated reference architecture, unique ABBs have been defined for this use case and are linked to other use cases that depend on these relationships.

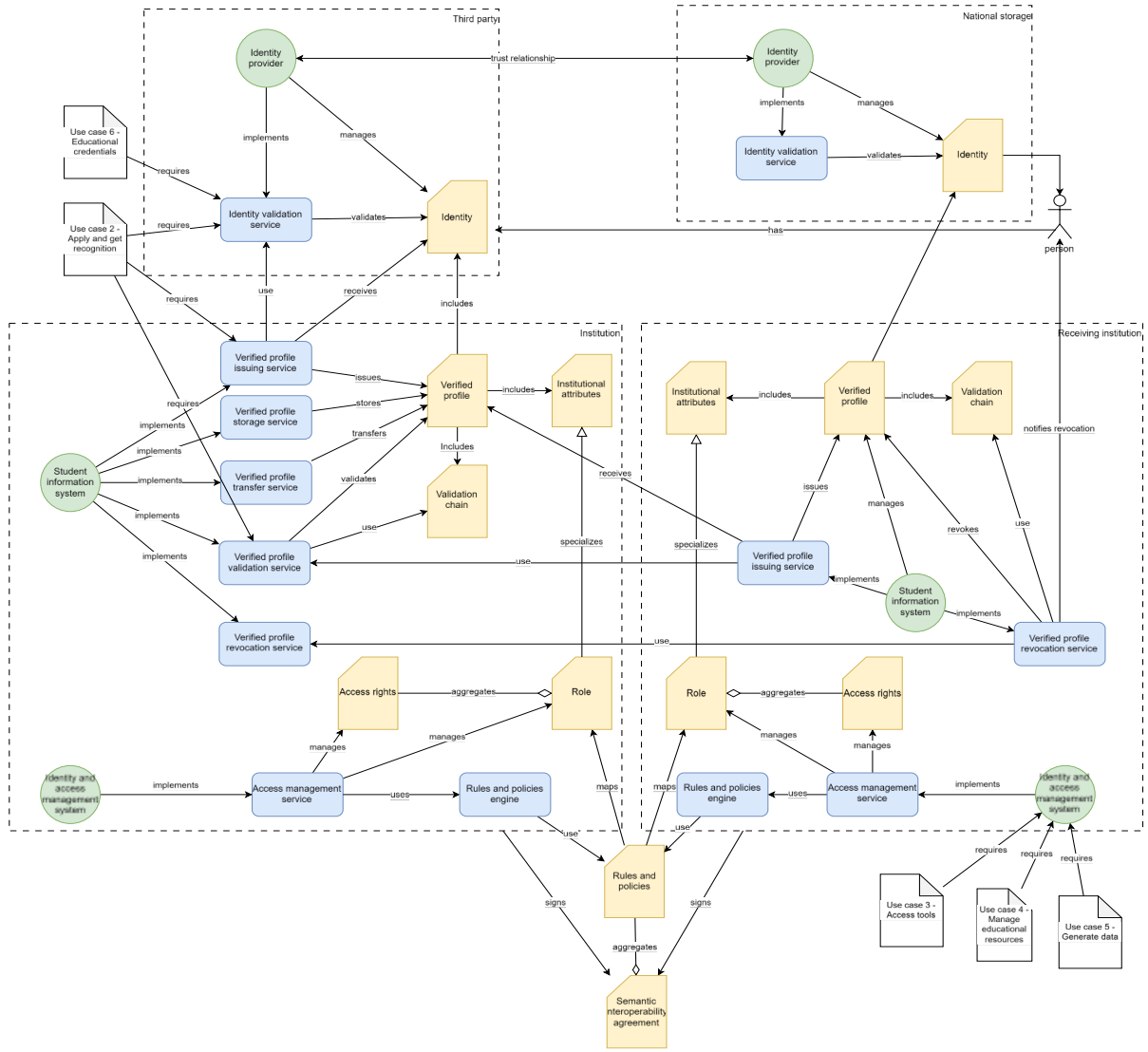


*Figure 42 - Use case 7 required building blocks and their relationships.*
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These are the most relevant building blocks of the defined reference architecture:

**Business objects:**

- **Identity:** Data object with the attributes needed to distinguish one person from others.
- **Verified profile:** Identity attributes of a person alongside institution specific attributes such as roles or access rights.
- **Validation chain:** Information of other verified profiles that have been issued based on attributes incorporated to the verified profile by that institution.

**Services:**

- **Verified profile issuing service:** Oversees creating a verified profile based either on identity attributes or attributes from an existing verified profile issued by another institution.
- **Verified profile transfer service:** This service securely shares an existing profile with another institution.
- **Verified profile validation service:** This service implements the verified profile validation process.
- **Verified profile revocation service:** This service implements the process of profile revocation.

**Systems:**

- **Student information system (SIS):** Student information systems manage student data, including but not limited to registering students in courses, managing grades, transcripts, and student test data.[5]

[5] https://library.educause.edu/topics/administrative-and-business-services/student-information-systems

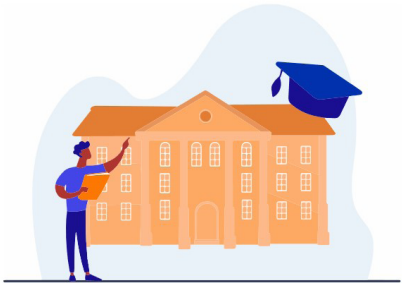
PART 8

# Use case 8 – Institutional identity

# Use case 8 - Institutional identity

USE CASE **8**

## Institutional identity



Developing a cohesive framework for trusted institutional identities, facilitating smoother collaborations and exchanges between HEIs.

Accreditation Ranking



This use case addresses the framework needed to establish trusted institutional identities, which are essential for facilitating smooth collaboration and data exchange between HEIs. For seamless data flow, HEIs need reliable methods to identify each other, even without prior contact, based on attributes such as accreditation status, rankings, enrolment, or research capacity. This systematic approach to institutional identity management is particularly necessary for exchanges that extend beyond single alliances, where institutions may not have direct knowledge of each other's credentials or accreditation status.

## Challenges

The sessions with experts and community members identified specific challenges for this use case, although fewer than for others. This can be explained by the fact that the use case is not yet considered a strategic priority for most of the alliances, a point that is analysed in more detail in the Synthesis report.

One of the key challenges is to define the minimum set of attributes that must constitute institutional

identities, a challenge similar to that observed in the area of user identities. This set of attributes is crucial to ensure interoperability and trust in the exchange of information between institutions.

Another critical aspect identified is the need to establish strong trust relationships between institutions. This challenge could be mitigated through the use of verified institutional identity records, which centralise and store relevant information about each institution, thereby promoting greater transparency and reliability.
Finally, the complexity of managing institutional identifiers was identified. Some institutions may have more than one identifier, either due to their organisational structure or the different platforms on which they operate. This poses additional challenges in consolidating a unique and consistent institutional identity.

## Draft architecture

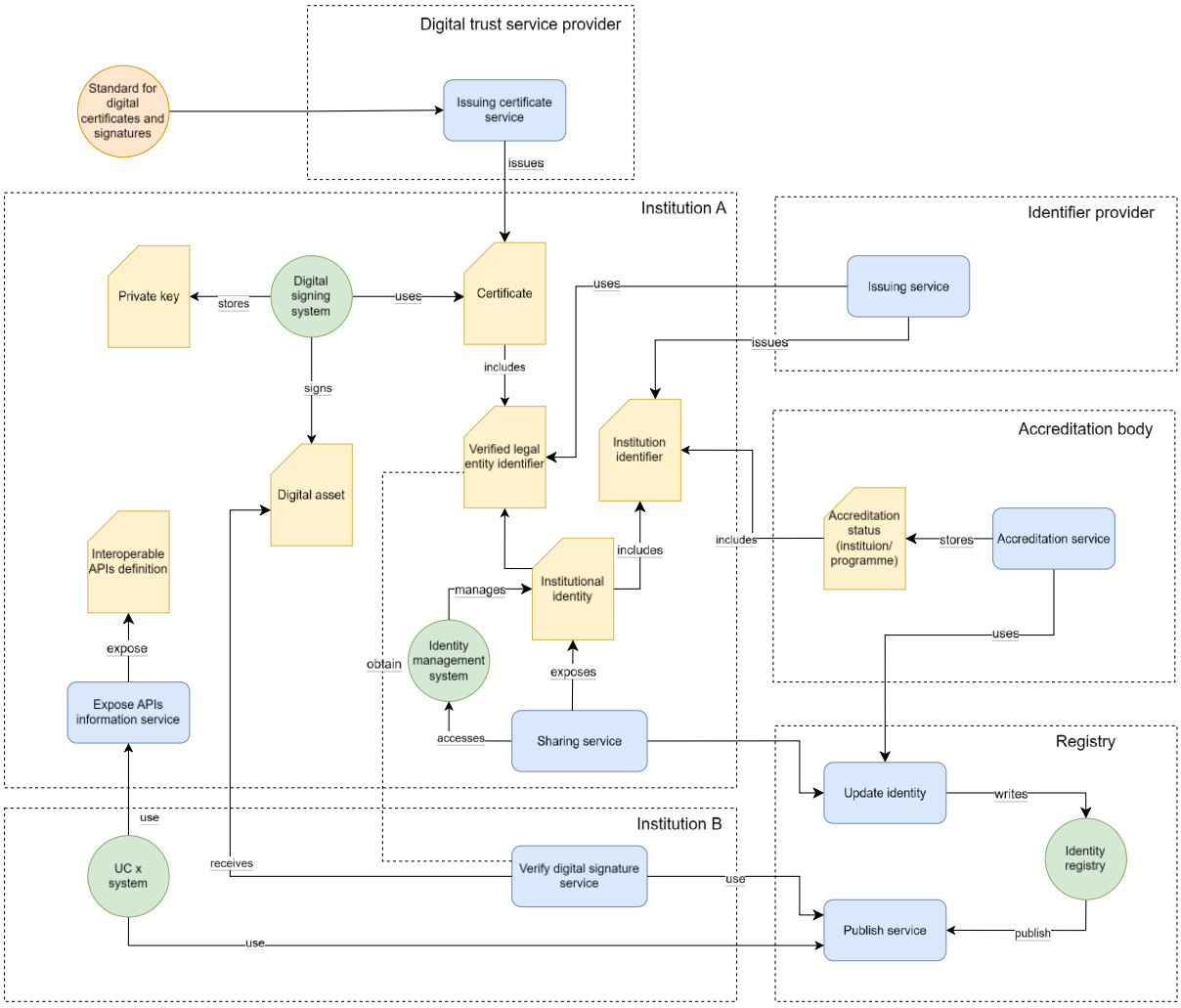



*Figure 43 - Use case 8 required building blocks and their relationships.*
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This draft architecture presents the necessary blocks to support the flows of signing, digital signature recognition linked to assets, sharing information about the institution's interoperable APIs, and sharing institutional identity. In addition to the existing blocks on the institution's side, third-party blocks appear, such as the identifier provider (responsible for providing an institution identifier based on a legal entity identifier), the accreditation body, the digital trust service provider (which provides the certificate the institution will later use to perform digital signatures), and the registry (where the aggregated institutional identity information will be stored and exposed publicly).

The following sections detail the key components of this architecture:

**Business objects:**

- **Institution identifier:** Unique identifier that distinguishes one institution from others.
- **Institutional identity:** Data object with additional information on the institution.
- **Interoperable APIs definition:** Definition of the interoperable APIs exposed by the institution to facilitate seamless integration with external institutions.

**Services:**

- **Sharing service:** Exposes identity information, possibly together with technical information required for interoperability (e.g., API endpoints of other interoperable services the institution exposes). The identity information would also be available on the institutional webpage and might be aggregated into listings of institutions such as global rankings or those provided by the ENIC-NARIC networks.
- **Verify digital signature service:** A service that validates the signature used to verify an asset from an external entity. This service uses the publication service of the identity registry to confirm the verified legal entity identifier of the institution.

**Systems:**

- **Identity management system:** Stores and manages institutional identity attributes.
- **UC X system:** This system provides a general representation of the first step required to enable other use cases. The first step is to contact the service of the institution that publishes information on interoperable APIs.

# Reference architecture

## Organisational view

The following architecture diagram depicts the organisational layer for use case 8. The required capabilities identified during sessions with the community and experts on institutional identities are defined here: Expose interoperable information, share identity, verify signed resources and digital signing. These capabilities are implemented through their corresponding services, exposed via a digital interface. Given the handling of identities and certificates, the components of this architecture are closely linked to the governance layer, particularly concerning security frameworks and the data policies that apply when sharing institutional information.

Additionally, three new actors are defined: the digital trust service provider, the accreditation body, and the registry. These actors provide key building blocks and functionalities, which are further detailed in the technical view.

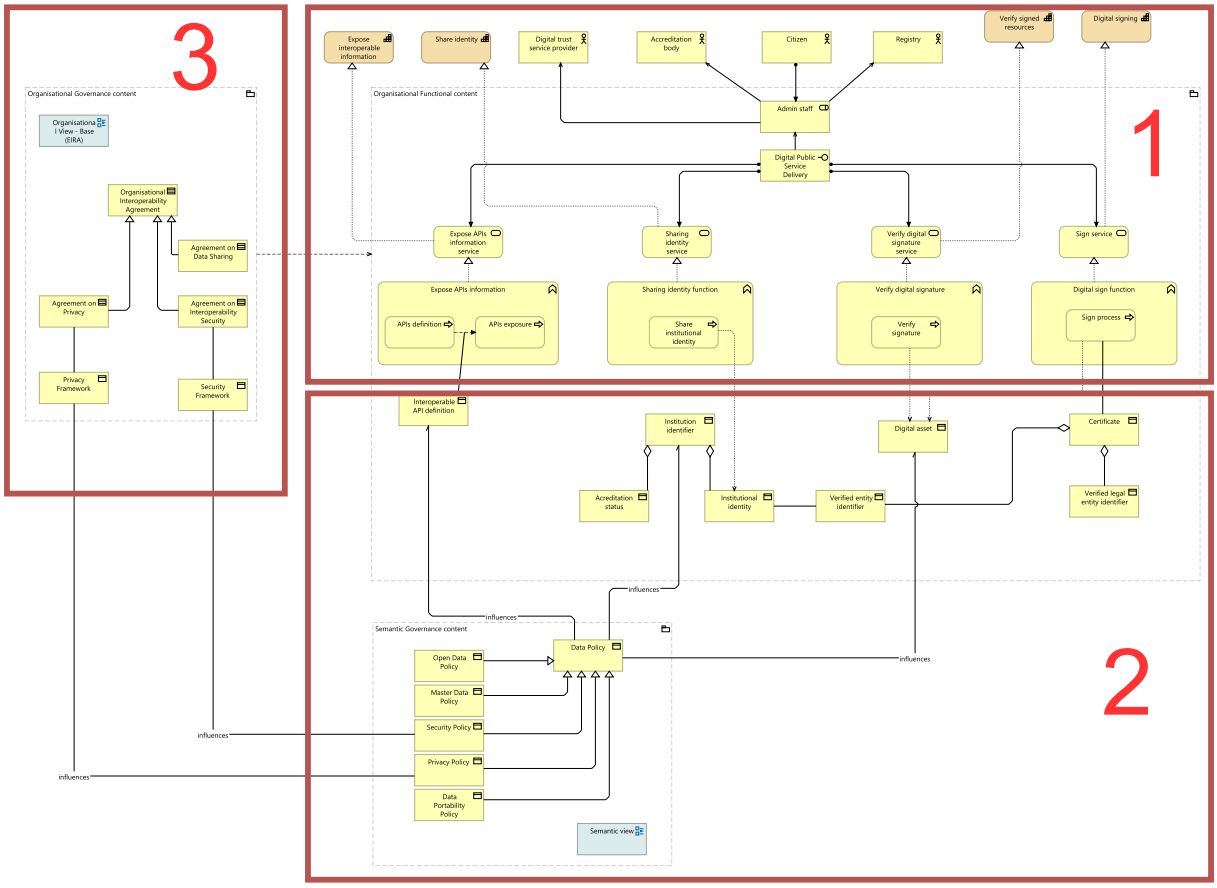


*Figure 44.1 - Use case 8 reference architecture organisational view.*
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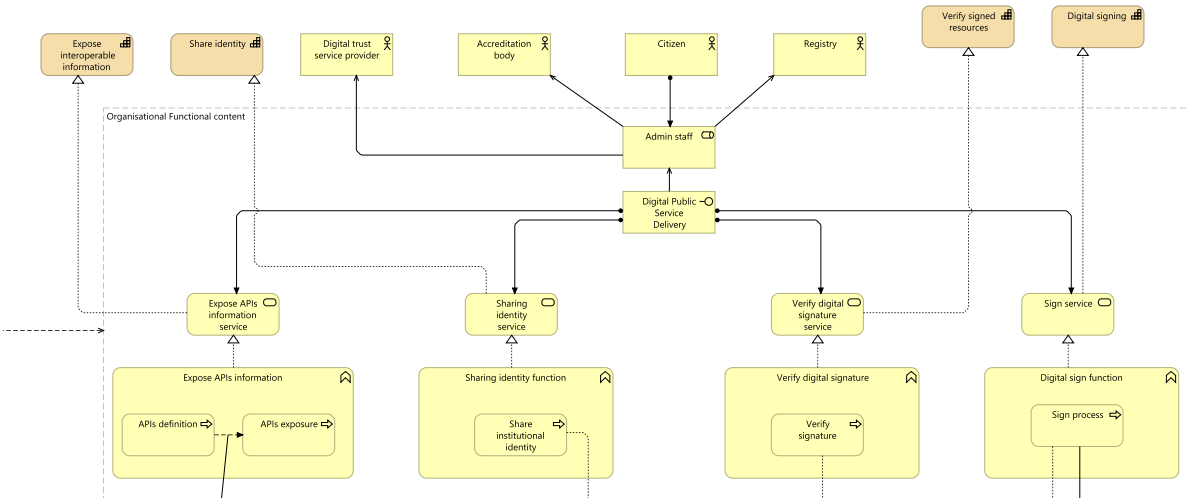


*Figure 44.2 - Use case 8 reference architecture organisational view.*
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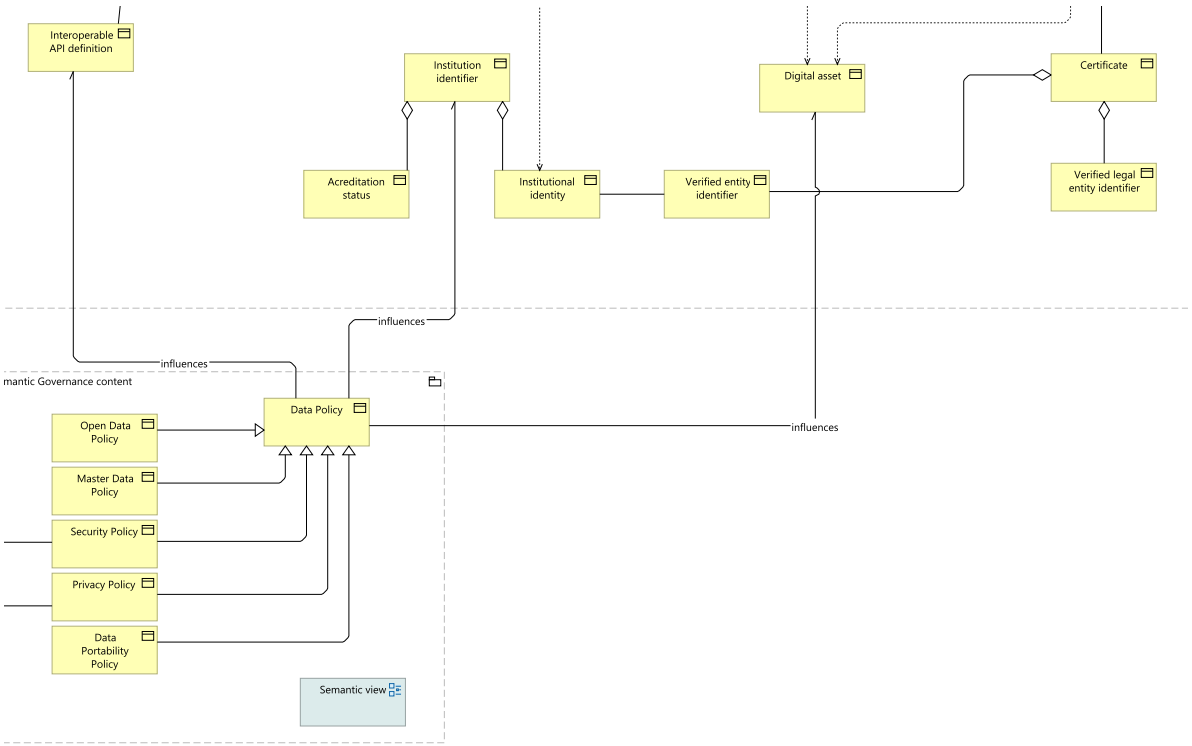


*Figure 44.3 - Use case 8 reference architecture organisational view.*
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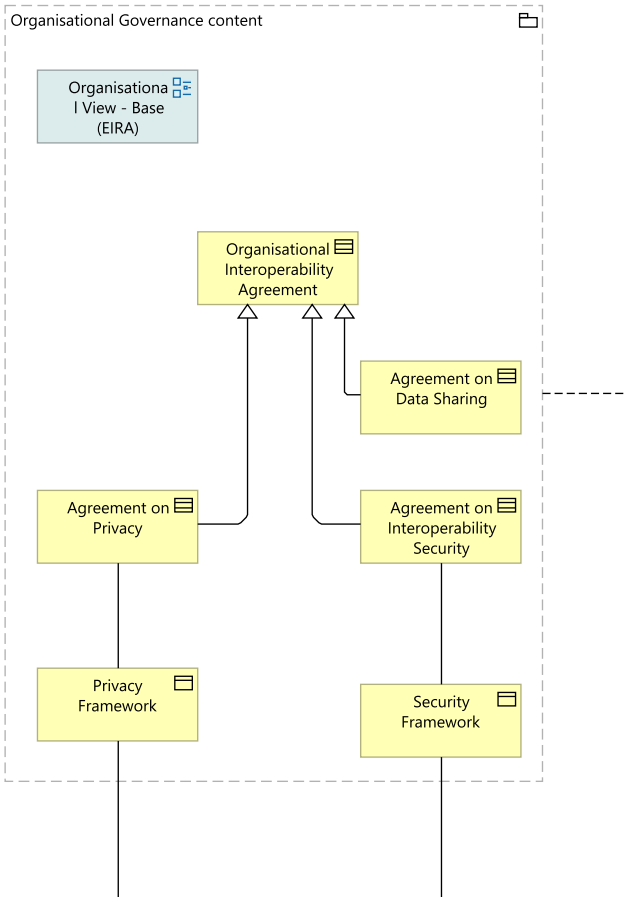


*Figure 44.3 - Use case 8 reference architecture organisational view.*
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The following table describes the most prominent building blocks.

| Building block | Type | Description |
|---|---|---|
| **Accreditation Body** | Business Actor | Accreditation body ABB is a business actor that represents the entity that oversees and validates the quality and compliance of an institution or program with established standards. |
| **Accreditation Status** | Business Object | Accreditation status ABB is a business object that indicates whether an institution or program meets the required standards set by an accreditation body. |
| **APIs Definition** | Business Process | APIs definition ABB is a business process that represent the process to create a specification that outlines the structure, functions, and methods for interfacing with a system or service. |
| **APIs Exposure** | Business Process | APIs exposure ABB is a business process that makes APIs accessible to external systems while ensuring security and interoperability. |
| **Certificate** | Business Object | Certificate ABB is a business object related to the digital document that certifies the authenticity, identity, or achievement of an institution. |
| **Digital Asset** | Business Object | Digital asset ABB is a digital representation of data or resources that can be shared or verified within the educational ecosystem. |
| **Digital Sign Function** | Business Function | Digital sign function ABB is a business function that enables the generation of a secure digital signature for electronic documents or data. |
| **Digital signing** | Capability | Digital signing capability represent the capability to use cryptographic methods to sign documents or credentials, ensuring authenticity and integrity. |
| **Digital Trust Service Provider** | Business Actor | Digital trust service provider ABB is a business actor that represents the entity that offers services like digital signatures, timestamps, and certification to ensure trusted transactions. |
| **Expose APIs Information** | Business Function | Expose APIs information ABB is a business function that publishes the details of APIs to make their functions discoverable and usable. |
| **Expose APIs Information Service** | Business Service | Expose APIs information service ABB is a service that facilitates the sharing and discovery of APIs by external systems or partners. |
| **Expose Interoperable Information** | Capability | Expose interoperable information represents the capability to share data in a standards-compliant manner, enabling seamless communication across systems. |
| **Institution Identifier** | Business Object | Institution identifier ABB is a business object that implements a unique identifier that represents an educational institution. |

| | | |
|---|---|---|
| **Institutional Identity** | Business Object | Institutional identity ABB is a business object that represents the attributes, roles, and status of an institution. |
| **Interoperable API Definition** | Business Object | Interoperable API definition ABB is a business object that ensures APIs are designed to work seamlessly across diverse systems and platforms. |
| **Registry** | Business Actor | Registry ABB is a business actor that represents a structured repository that stores and manages verified data or metadata about entities. |
| **Share Identity** | Capability | Share identity capability enables the exchange of identity information securely between systems or entities. |
| **Sharing Identity Function** | Business Function | Sharing identity function ABB provides mechanisms for securely distributing identity. |
| **Share Institutional Identity** | Business Process | Share institutional identity ABB is a business process that facilitates the exchange of an institution's verified identity with other entities. |
| **Sharing Identity Service** | Business Service | Sharing identity service ABB is a service that manages the secure distribution and verification of identity-related information. |
| **Sign Process** | Business Process | Sign process ABB is a business process that apply cryptographic techniques to create a secure digital signature for data or documents. |
| **Sign Service** | Business Service | Sign service ABB is a service that provides tools and methods for digitally signing documents or credentials. |
| **Verified Entity Identifier** | Business Object | Verified entity identifier ABB represents a unique identifier that is confirmed as authentic and corresponds to a verified entity. |
| **Verified Legal Entity Identifier** | Business Object | Verified legal entity identifier ABB is a unique identifier for a legal entity that has been authenticated and registered. |
| **Verify Digital Signature** | Business Function | Verify digital signature ABB is a business function that ensures a digital signature's validity and confirms the signer's identity. |
| **Verify Digital Signature Service** | Business Service | Verify digital signature service ABB is a service that facilitates the validation of digital signatures to ensure document authenticity. |
| **Verify Signature** | Business Process | Verify signature ABB is a business process that confirms the integrity and origin of a signed document using cryptographic techniques. |
| **Verify Signed Resources** | Capability | Verify signed resources ABB capability ensures resources are correctly signed and have not been tampered with. |

## Semantic view

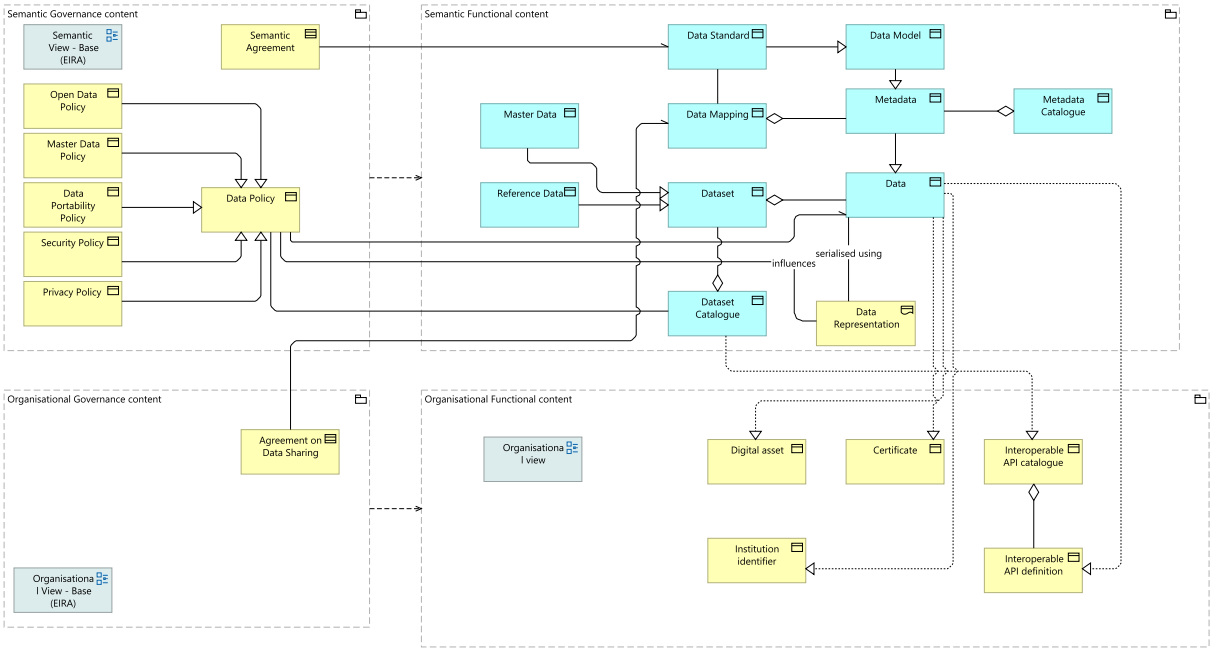


*Figure 45 - Use case 8 reference architecture semantic view.*
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Similarly, to the other use cases, this view highlights a base application object, Data, which is influenced by a Data Standard established through the Semantic Agreement. From this foundational data object, various specialised business objects are derived, each of which will have its counterparts represented in the technical view.

In the following table, the most prominent building blocks are described. The blocks common to all use cases are defined at the beginning of this document, while those specific to this use case are detailed in their respective views.

| Building block | Type | Description |
|---|---|---|
| **Interoperable API Catalogue** | Business Object | Interoperable API catalogue ABB is a business object that represents a centralised repository that lists APIs designed for seamless integration and data exchange across systems. |

## Technical view

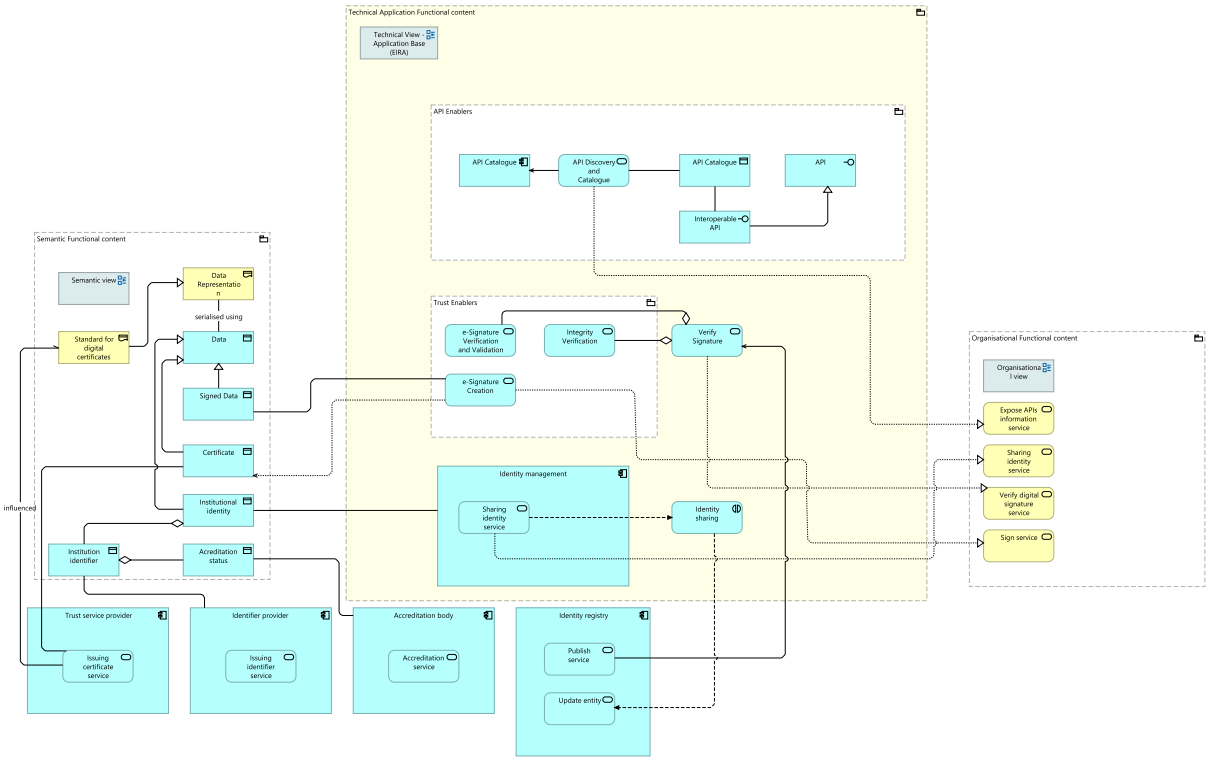


*Figure 46 - Use case 8 reference architecture technical view.*
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Finally, from a technical point of view, four different blocks are identified. The first block is the semantic functional content, which defines the application objects related to the services and applications within this layer, specialising in the base object Data. The second block includes applications related to the new actors defined in the organisational layer, focusing on external interactions such as identity storage, entity certificate creation and accreditations. The third block is the organisational functional content, which again outlines the services that implement the capabilities defined in the organisational view. Finally, the central block defines the enablers and applications that enable the institution to develop the functionalities described by the defined capabilities.

In the following table, the most prominent building blocks are described. The blocks common to all use cases are defined at the beginning of this document, while those specific to this use case are detailed in their respective views.

| Building block | Type | Description |
|---|---|---|
| **Accreditation Service** | Application Service | Accreditation service ABB is an application service that facilitates the validation and recognition of institutions or program's compliance with established quality standards. |
| **e-Signature Creation** | Application Service | e-Signature creation ABB is an application service that enables the process of signing data, in electronic form by a natural person |
| **e-Signature Verification and Validation** | Application Service | e-Signature verification and validation service ABB is an application service that enables the process of verifying and confirming that an electronic signature or a seal is valid. |
| **Identifier Provider** | Application Component | Identifier provider ABB is an application component that generates and assigns unique identifiers for institutions. |
| **Identity Management** | Application Component | Identity management ABB is an application component that governs the creation, maintenance, and use of digital identities. |
| **Identity Registry** | Application Component | Identity registry ABB is an application component that securely stores and manages identity-related data. |
| **Identity Sharing** | Application Interaction | Identity sharing ABB is an application interaction that enables the secure exchange of identity information between trusted systems or entities. |
| **Integrity Verification** | Application Service | Integrity verification ABB is an application service that enables the procedures to ensure that information has not been altered in an unauthorised manner since it was created, transmitted or stored. |
| **Interoperable API** | Application Interface | Interoperable API ABB is an application interface that enables a set of rules and specifications that allow different software components or systems to communicate and exchange interoperable data. |
| **Issuing Certificate Service** | Application Service | Issuing certificate service ABB is an application service that generates and delivers digital certificates to individuals or institutions. |
| **Issuing Identifier Service** | Application Service | Issuing identifier service ABB is an application service responsible for creating and assigning unique identifiers to entities. |
| **Publish Service** | Application Service | Publish service ABB is an application service that disseminates information, such as metadata, making it accessible to users or systems. |
| **Signed Data** | Data Object | Signed data ABB is a specialisation of data ABB. This building block enables the implementation of digitally signed information. |

| | | |
|---|---|---|
| **Standard for Digital Certificates** | Representation | Data representation ABB is a representation that refers to the method or mechanism in which data is encoded and stored in a computer system. It involves transforming data from its original form into a format that can be processed and manipulated by a computer. |
| **Trust Enablers** | Grouping | Trust enablers ABB is a grouping that refers to components and services that facilitate the establishment and maintenance of secure cross-border transactions and interactions. |
| **Trust Service Provider** | Application Component | Trust service provider ABB is an application component that offers secure services, such as digital signatures or timestamping, to ensure trusted interactions and transactions. |
| **Update Entity** | Application Service | Update entity ABB is an application service that enables the modification of existing records or attributes for entities within a system or registry. |

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