



**DACEM**

**Digitized Academic Catalogues for Enhanced Mobility**

WP 2. Course Catalogues mapping and technical state of the art  
at European HEIs

## **Existing Standards and Interoperability Specifications for Course Catalogues**

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## 1 Background

Work package n°2 - Course catalogues (CC) mapping and technical state of the art at Higher Education Institutions (HEIs) has two main objectives:

- **O2.1.** To map the current situation of online CC at European HEIs. This includes a description of the current CC processes by HEIs and end users covering the development, customization and deployment of the software at the HEIs own premises or as third-party services, the population and maintenance of course information by university staff and considering accessibility, completeness, consistency and timing issues.
- **O2.2.** To define a technical model to guide the design and development of the CC solution that provides guidelines regarding standardised vocabularies, taxonomies, linked data and other semantic models that can facilitate CCs information to be connected together and interpreted by machines. In addition, this technical model should also identify the APIs that need to be provided to related systems, such as the EWP and OLA tools, and machine-readable formats to import and export the information of the CC.

Accordingly, the main results of this package are:

- **R2.1.** A report mapping the current situation and requirements for online CC in the partner countries integrating the results per country, including qualitative and quantitative assessments.
- **R2.2.** A technical model for CC including specifications for data (standardised vocabularies, taxonomies, linked data specifications), and interoperability (APIs, and machine-readable formats). This includes best practices from partners' experiences regarding the management of CC and integration with related systems, such as EWP and OLA tools.

In this work package, activity 2.4 corresponded to the identification of existing data standards and interoperability specifications for CCs and, therefore, it contributes specifically towards objective O2.2. and result R2.2. This activity involved desktop research to identify existing data standards and interoperability specifications that could be useful for the definition and design of the DACEM CC, considering vocabularies, taxonomies, linked data and other semantic approaches that can facilitate the connection and interpretation of CC information. This desk research also included the identification of related APIs and machine-readable formats.

This document reports the result of this activity and corresponds to deliverable R2.2.

## 2 Introduction

As educational institutions increasingly rely on digital platforms to manage and share information, establishing consistent interoperability standards for seamless data exchange and integration is essential. This general consideration also applies to Course Catalogues (CCs), as they are foundational for managing and sharing academic programmes information. Up to date, CCs have been considered mainly to provide information for humans' consumption only. As a result, they often lack standardized data structures and interoperability mechanisms that allow seamless data exchange between different systems (Caeiro-Rodríguez et al., 2024). Nevertheless, as the processes involved in the management of students mobilities are being digitized or more situations are considered where it is needed to share or compare academic programmes from different institutions, the need for shared data models and solutions that facilitate the machine access to the data is more evident.

Interoperability needs are especially pertinent in contexts where students and faculty engage in cross-institutional activities, such as exchanges, joint degrees, and international collaborations. For example, in the case of European University Alliances (EUAs), joint course displays are becoming an urgent need (Berger et al., 2023). A joint course display provides visibility to the alliances and their work on bringing together student offerings in the individual organizations. Currently, various EUAs have set up joint course displays to include courses offered at each alliance's HEI as part of the regular curricula as well as courses specially developed by the alliance for the purpose of the cooperation, as example: the University Alliance Ruhr<sup>1</sup> and the eduXchange<sup>2</sup> joint CCs.

Despite scarce, there are some specifications available about CCs' shared data model and interoperability specifications that can support the creation and enhancement of a CC information system. This report presents the findings of a desktop research study conducted to identify existing data standards and interoperability specifications. The goal is to identify the similarities and differences among the available specifications, considering the entities proposed and their data specifications (e.g. vocabularies, taxonomies). In addition, it is also a goal to check if some key information elements could be missed in the current specifications. This review is intended to offer foundational insights and recommendations for designing a robust, interoperable data infrastructure that supports efficient information flow and maximizes the utility of CCs. This way, it will also contribute to a unified educational data ecosystem, promoting cross-institutional collaboration and enriching the student experience.

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<sup>1</sup> <https://slapps4.ruhr-uni-bochum.de/uahrhvz/>

<sup>2</sup> <https://eduxchange.nl/>

Co-financed by the European Union. The opinions and views expressed are however those of the author(s) and do not necessarily reflect those of the European Union nor those of the Spanish Service for the Internationalization of Education (SEPIE). Neither the European Union nor the granting authority can be held responsible for them.



### 3 Interoperability Initiatives for CCs

As more institutions adopt digital solutions to manage educational content, they encounter challenges when trying to synchronize or share course catalogue data due to disparate formats, proprietary systems, and varying data standards. These inconsistencies can lead to inefficiencies, as data must be manually reformatted or otherwise processed before it can be utilized in different systems. Moreover, the lack of interoperability hinders students' ability to find and compare courses across institutions, complicates the transfer of academic credits, and limits the potential for collaborative academic planning.

Recognizing these challenges, several initiatives have emerged, each designed to support the structured, interoperable sharing of CC data. Among the most prominent are the following ones:

- **European Credit Transfer and Accumulation System (ECTS) Course Catalogue**<sup>3</sup>, a standardized model for representing course information and credit values to facilitate credit transfer across European institutions.
- **Open Course Catalogue API (OCCAPI)**<sup>4</sup>, an interoperability specification designed to enable the standardized sharing and integration of course catalogue data across various educational platforms and institutions.
- **Open Education API (OOAPI)**<sup>5</sup>, a national Dutch specification that goes beyond the information usually maintained in a CC. It also involves information related to the management of courses in institutions, such as the schedule.
- **Postsecondary Electronic Standards Council (PESC)**<sup>6</sup>, a non-profit organization dedicated to improving data exchange and interoperability within the education sector
- **IMS Edu-API**<sup>7</sup>, an interoperability standard developed by the IMS Global Learning Consortium to support seamless integration of educational systems.
- **eXchanging Course Related Information – Course Advertising Profile (XCRI-CAP)**<sup>8</sup> is the UK standard for describing course marketing information. It provides a structured format for course data, defining and naming data components and specifying the types of data permitted within each component.

These standards not only streamline data exchange within institutions but also facilitate student mobility, course comparison, and academic recognition processes on an international scale.

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<sup>3</sup><https://education.ec.europa.eu/education-levels/higher-education/inclusive-and-connected-higher-education/european-credit-transfer-and-accumulation-system>

<sup>4</sup> <https://occapi.uni-foundation.eu/>

<sup>5</sup> <https://openonderwijsapi.nl/>

<sup>6</sup> <https://pesc.org/about/>

<sup>7</sup> <https://www.imsglobal.org/edu-api>

<sup>8</sup> <https://www.xcri.co.uk/what-is-xcri-cap/>

### 3.1 European Credit Transfer System (ECTS)

The **European Credit Transfer and Accumulation System (ECTS)** is a standardized framework developed by the European Union to promote transparency, comparability, and academic mobility within European higher education. ECTS was introduced as part of the Bologna Process, a collaborative effort aimed at harmonizing educational systems across Europe to support student mobility, academic recognition, and lifelong learning. In particular, the ECTS CC component is a structured format for presenting course-related information in a consistent and accessible manner, facilitating cross-institutional understanding of course content, requirements, and credit values. This allows students, faculty, and institutions to understand and compare academic offerings across borders. By offering detailed and comparable information on courses, programs, and degrees, the ECTS CC aids students in making informed decisions regarding their education, particularly when studying abroad. This structure supports academic mobility by ensuring that credits earned at one institution can be recognized at another, allowing students to transfer their achievements seamlessly. Moreover, the catalogue helps academic advisors and administrators to assess foreign qualifications and recognize credits, which is essential for cross-border educational partnerships and exchanges.

The ECTS CC includes standardized information for each course, typically covering the following elements:

- **Course Title and Code:** Unique identifiers for each course, which help both students and institutions easily locate and reference the course.
- **Course Level and Type:** Specifies the academic level (e.g., undergraduate or postgraduate) and type (e.g., mandatory, elective) of the course, which informs students about its positioning within a program.
- **Course Credits (ECTS Credits):** Indicates the credit value assigned to the course, based on the expected student workload (usually, 1 ECTS credit equates to 25-30 hours of work). This allows easy comparison and accumulation of credits across institutions.
- **Learning Outcomes and Skills Acquired:** Provides a clear statement of what students are expected to learn and be able to do upon completing the course. This section aids in determining equivalency and transferability of credits.
- **Course Content:** A brief description of the course's scope and topics covered which helps students understand the academic focus of the course.
- **Teaching Methods and Assessment Criteria:** Outlines the teaching formats (lectures, seminars, labs) and evaluation methods (exams, projects, presentations) used in the course.
- **Prerequisites and Recommended Knowledge:** Lists any required prior knowledge or courses needed to enrol, ensuring that students understand the preparation needed for success.
- **Language of Instruction:** States the language in which the course is taught, which is especially useful for international students.

In 2014, when the Erasmus+ programme was launched, the ECTS CC received a prominent place in the Erasmus Charter for Higher Education (ECHE). By signing the ECHE, HEIs agree to comply with the requirements regarding the ECTS CC.



Some general instructions from the “ECTS Users’ Guide 2015” (p. 54) regarding CCs are:

- The CC should be published in the institution’s website.
- The CC should be published sufficiently in advance for prospective students to make their choices.
- Language. The general information about an institution and the information about study programmes and individual educational components should be available in a widely-spoken language (e.g. English) and the language of instruction.
- The institution is free to decide the format of the CC, as well as the sequencing of the information, but the four information entities previously described should be included. This is nowadays a focus of great confusion, as long as many people think that CCs should only include information on programmes and individual educational components.

As the guidelines included in the “ECTS Users’ Guide” 2015 may be found “a little too general or vague”, some initiatives have been published to provide further clarification, such as the one published by a Dutch team of Bologna experts (Broekman et al., n.d.).

### 3.2 Open Course Catalogue API (OCCAPI)

The **Open Course Catalogue API (OCCAPI)** is an interoperability specification developed to enable educational institutions to standardize the publication and exchange of CC data across platforms. With OCCAPI, institutions can present structured, accessible, and up-to-date course information that is easily shareable with other educational institutions, partners, and external applications. OCCAPI offers a solution to the complex, often inconsistent data structures of traditional CC by providing a unified API framework compatible with web-based systems. This standardization is crucial in educational ecosystems where multiple systems must interact seamlessly to serve students, faculty, and institutional administrators effectively. OCCAPI enables institutions to structure course data in a consistent way, facilitating integration with other platforms, supporting transparency, and enhancing course discoverability.

In particular, OCCAPI is valuable for institutions that participate in international exchanges and student mobility programs, where understanding and comparing course offerings across institutions is vital. The API’s standardized structure allows for clear and comparable representations of course data, supporting initiatives like Erasmus+ and other exchange programs where course compatibility and credit recognition are key factors.

OCCAPI is designed as a RESTful API, using standard HTTP GET methods to allow institutions to exchange CC data in a structured and platform-independent manner. The API supports JSON as the data format, which is widely compatible with modern web technologies, ensuring easy integration with different institutional systems and student information platforms. Key components of the OCCAPI structure include:

- **Course Metadata:** OCCAPI provides standardized fields for basic course metadata, including course title, description, and subject areas. This information helps students and partner institutions understand what each course entails.

- **Credits and Workload:** The API includes fields to specify course credits and workload, allowing for alignment with systems like the European Credit Transfer and Accumulation System (ECTS). This standardization is essential for credit recognition and helps students gauge the academic effort required.
- **Prerequisites and Learning Outcomes:** OCCAPI enables institutions to outline prerequisites and expected learning outcomes for each course, giving students a clearer picture of the knowledge and skills they will gain.
- **Schedule and Mode of Delivery:** Details such as the course schedule (e.g., semester dates) and mode of delivery (e.g., online, in-person, hybrid) provide essential logistical information for prospective students, particularly those studying abroad.

OCCAPI's structure and interoperability make it suitable for a range of use cases in higher education:

- **Student Mobility Programs:** OCCAPI facilitates data exchange for institutions involved in programs like Erasmus+, allowing students to browse and select courses at partner institutions. By providing a standardized course description, prerequisites, and credit details, OCCAPI ensures that students have access to relevant and comparable information when choosing courses abroad.
- **Multi-Institutional Programs:** Institutions offering joint degrees or collaborative academic programs can use OCCAPI to integrate CCs across participating universities, providing students with a unified view of available courses and ensuring consistency in course information across institutions.
- **Public Course Portals and Aggregators:** OCCAPI can be used to centralize and publish CCs from multiple institutions on public-facing platforms, enabling students to explore courses offered across various universities in one place. This can be particularly beneficial for prospective students looking to compare programs and courses.
- **Internal Systems Integration:** OCCAPI also simplifies data sharing within institutions, connecting Student Information Systems (SIS), Learning Management Systems (LMS), and other internal academic systems to ensure that all departments have access to accurate and current course data.

OCCAPI is designed to be compatible with other educational standards and initiatives, enhancing its usability and interoperability, such as:

- **European Credit Transfer and Accumulation System (ECTS):** OCCAPI supports fields for credit and workload alignment with ECTS, making it an ideal tool for institutions that require consistent credit recognition for international students.
- **Postsecondary Electronic Standards Council (PESC).**

### 3.3 Open Education API (OOAPI)

The **Open Education API (OOAPI)** is a national Dutch specification that goes beyond the information elements usually provided by CCs. It is aimed at providing information related to student activities

and the information needed by students in general. For example, it keeps information about student groups, classroom calendars, buildings and rooms. Therefore, it includes the information maintained in CCs, but also other such the one referred to the student management.

OOAPI is currently also implemented in contexts outside of the Netherlands, notably in the EuroTeQ alliance.

### 3.4 Postsecondary Electronic Standards Council (PESC)

The Postsecondary Electronic Standards Council (PESC) is a non-profit, community-based organization that develops and promotes open, standardized data exchange solutions for the education sector (Postsecondary E.S.C., 2009). PESC aims to improve the interoperability and integration of educational data systems by creating standards that facilitate efficient data exchange between educational institutions, government agencies, and technology providers. PESC standards are widely used in North America, and their initiatives have had a significant impact on student information systems (SIS), admissions, financial aid, and academic records management. With the increasing demand for cross-institutional data sharing—particularly for student mobility and multi-institutional programs—PESC's standards play a crucial role in ensuring that institutions can efficiently manage and transfer data in a secure, consistent, and cost-effective way.

PESC has developed numerous standards to support various functions within the education sector, including:

- **Course Inventory (Catalogue):** This is a standard format in XML for the Education Course Inventory. It is intended for use by postsecondary educational institutions, by software vendors, and by state and federal education agencies. The course inventory (catalog) is used by educational institutions to transmit current and historical records of course information at the sending institutions. When a student transfers (or intends to transfer) from one college or university to another, it is essential that the receiving institution can evaluate the course credit and transferability as quickly as possible so that a possible decision can be made about the admissibility of the student to the new school. In addition, the course information assists the new institution in advising the student as to how his/her prior academic record will be used to satisfy course requirements at the new school for the student's program objective there. The course inventory contains current and historical course information, including course descriptions and other data that provide information for determining the level and content of the courses.
- **College Transcript Standard:** This standard provides a structured data model for the exchange of official student transcripts between institutions. It includes fields for course titles, credits, grades, and cumulative GPA, ensuring consistent and complete academic records during transfers or applications to graduate programs.
- **High School Transcript Standard:** Similar to the college transcript standard, this specification enables the transfer of high school academic records between secondary schools and postsecondary institutions. This standard supports fields for student demographics, academic

performance, and extracurricular involvement, providing a comprehensive overview of a student's high school history.

- **Admissions Application Standard:** This standardizes data for admissions applications, allowing institutions to receive application data from multiple sources in a consistent format. This specification includes fields for applicant information, educational background, standardized test scores, and supporting documents, simplifying the application review process and reducing processing time.
- **Data Transport Standards:** PESC also develops standards for data transport, including XML schemas, that enable secure data transfer across systems. These standards provide secure mechanisms for institutions and agencies to share sensitive student information without compromising data privacy.

PESC standards are designed to integrate with other educational data standards and systems, allowing for seamless data sharing across various platforms. For example, PESC standards are often used alongside Learning Management Systems (LMS), Student Information Systems (SIS), and other administrative tools to support a unified data infrastructure. By aligning with open standards such as IMS Global, PESC ensures that its specifications remain flexible and adaptable to the evolving needs of modern educational technology.

### 3.5 IMS Edu-API

The IMS Edu-API is an interoperability standard developed by the IMS Global Learning Consortium to support seamless integration of educational systems, with a focus on managing student information, courses, and academic programs across institutional boundaries. As a modern API specification, IMS Edu-API provides a consistent framework for sharing and managing academic data in a standardized, secure, and scalable manner. This specification is particularly valuable for educational institutions aiming to create unified digital ecosystems and enhance data-driven decision-making. In the European context there have been some attempts to use this specification for making data from Student Information Systems (SIS) available for other uses (Ljungkrona et al., 2021).

IMS Edu-API leverages RESTful web services and supports widely adopted formats such as JSON and XML. Its modular architecture ensures flexibility, enabling institutions to adopt components relevant to their specific use cases while maintaining compliance with global interoperability standards. The key components of IMS Edu-API are:

- **Student Information Management:** IMS Edu-API provides standardized endpoints for managing student records, including personal information, enrollment details, grades, and transcripts. This ensures consistent and secure handling of student data across platforms.
- **Course and Program Structures:** The API enables institutions to represent course and program details, such as descriptions, schedules, prerequisites, credit values, and learning outcomes, in a structured and interoperable format.

- **Academic Records and Credentials:** IMS Edu-API supports the exchange of academic achievements, including course completions, certifications, and degrees, facilitating the portability and verification of credentials.
- **Integration with Learning Management Systems (LMS):** The API enhances LMS interoperability by enabling seamless communication between student information systems (SIS) and teaching and learning platforms, supporting automated updates and streamlined processes.
- **Alignment with Educational Standards:** IMS Edu-API aligns with global frameworks like the European Credit Transfer and Accumulation System (ECTS) and complements tools such as Erasmus Without Paper (EWP), ensuring broad applicability across different educational contexts.

Use Cases for IMS Edu-API:

- **Cross-Institutional Student Mobility:** By standardizing the exchange of student records and course information, IMS Edu-API simplifies administrative processes for student mobility programs, such as Erasmus+.
- **Multi-Campus Collaboration:** Institutions with multiple campuses or partnerships can use IMS Edu-API to unify data management and provide a cohesive experience for students and staff.
- **Credential Portability:** The API supports the digital exchange of academic credentials, ensuring that students' qualifications are portable and easily verifiable across institutions and employers.
- **Enhanced Data Analytics:** IMS Edu-API facilitates the collection and analysis of educational data, enabling institutions to make informed decisions to improve academic outcomes and operational efficiency.

### 3.6 eXchanging Course Related Information – Course Advertising Profile (XCRI-CAP)

XCRI-CAP is a UK-based standard designed to facilitate the sharing and publication of course catalog information. Originally developed to standardize the structure and format of course data for educational institutions in the UK, XCRI-CAP helps institutions efficiently advertise courses by making course information easily accessible to external platforms and aggregators. Through a structured data model, XCRI-CAP ensures that CCs are clear, comparable, and up-to-date across various channels, supporting institutions, students, and third-party course aggregators. Before XCRI-CAP institutions often shared course information in diverse formats, making it difficult for students to compare offerings across institutions and creating barriers for online aggregators and search engines to publish accurate course data. XCRI-CAP standardizes this information, enabling educational institutions to deliver structured data to multiple platforms, enhancing course visibility and accessibility for prospective students (Dafoulas et al., 2012). The standard is particularly useful for adult and continuing education courses, where students often need comprehensive information on course duration, credits, prerequisites, and delivery modes. By providing a consistent format, XCRI-CAP improves the discoverability of courses and supports informed decision-making among prospective students.

XCRI-CAP is built as an XML schema that defines a set of standardized elements and structures for course-related information. The main components of XCRI-CAP include:

- **Course Instance:** This is the core unit of XCRI-CAP and represents an individual instance of a course. It includes details like course title, description, provider, and study mode (e.g., full-time, part-time).
- **Presentation:** Each course instance includes one or more presentations, which specify the details of the course offering, such as location, delivery format (in-person, online, hybrid), and start date.
- **Admission Requirements:** XCRI-CAP allows institutions to define admission requirements for each course, including prerequisite knowledge or qualifications, enabling students to assess whether they meet the entry criteria.
- **Credit and Award Information:** This component provides details on the credit value of the course (aligned with systems like ECTS or UK credit frameworks) and the type of award earned upon completion (e.g., certificate, diploma, degree).
- **Course Content and Learning Outcomes:** XCRI-CAP supports course descriptions that outline the content covered, as well as the skills and competencies that students will gain upon completion, giving students insight into the academic and professional value of the course.
- **Provider Information:** Information about the institution offering the course, including contact details and links to the institution's website or course webpage, helping students get in touch directly.

XCRI-CAP is compatible with several other data standards and initiatives, enhancing its flexibility and reach. In particular, XCRI-CAP can include credit data aligned with ECTS, supporting credit recognition and comparability across institutions within the European Higher Education Area.



## 4 Interoperability Initiatives related to CCs

Beyond the previous initiatives focused on the information intended to be managed by CCs, there are other related initiatives that involve the management of information like the one available in CCs. These other initiatives are mainly related to the management of student information records, that usually include information about programmes and courses. Among the most prominent are the following ones:

- **Erasmus Without Paper (EWP)**<sup>9</sup>, a standardized digital infrastructure aimed at digitizing and simplifying administrative processes for Erasmus+ student mobility.
- **The European Learner Mobility Model (ELMO)**<sup>10</sup> Standard is a data specification designed to facilitate the secure and standardized exchange of learner mobility data across European higher education institutions
- **The European Learning Model (ELM)**<sup>11</sup> is a comprehensive framework developed by the European Commission to standardize the representation and exchange of educational and training data across Europe.

### 4.1 Erasmus Without Paper (EWP)

Erasmus Without Paper (EWP) is a digital infrastructure developed to simplify and standardize the administrative processes associated with Erasmus+ student exchanges (Mincer-Daszkiewicz & Rygielski, 2016; Leis & Mincer-Daszkiewicz, 2022). It is part of the broader European Student Card Initiative<sup>12</sup> aimed at creating a fully digital European higher education area, facilitating seamless mobility for students across institutions.

EWP eliminates traditional paper-based processes (see Figure 1) by enabling secure electronic data exchange, which makes Erasmus+ exchanges more efficient, transparent, and accessible. Traditionally, Erasmus+ mobility involved a substantial amount of paperwork, including Learning Agreements (LAs), Transcripts of Records (ToRs), and Inter-Institutional Agreements (IIAs), which had to be exchanged manually between institutions. This approach led to delays, errors, and a heavy administrative burden on both students and institutions. EWP transforms these processes by allowing institutions to exchange this information digitally, supporting a smoother and faster Erasmus+ experience.

<sup>9</sup> <https://erasmus-plus.ec.europa.eu/european-student-card-initiative/ewp>

<sup>10</sup> <https://github.com/emrex-eu/elmo-schemas>

<sup>11</sup> <https://europass.europa.eu/en/news/launch-european-learning-model>

<sup>12</sup> <https://erasmus-plus.ec.europa.eu/european-student-card-initiative>

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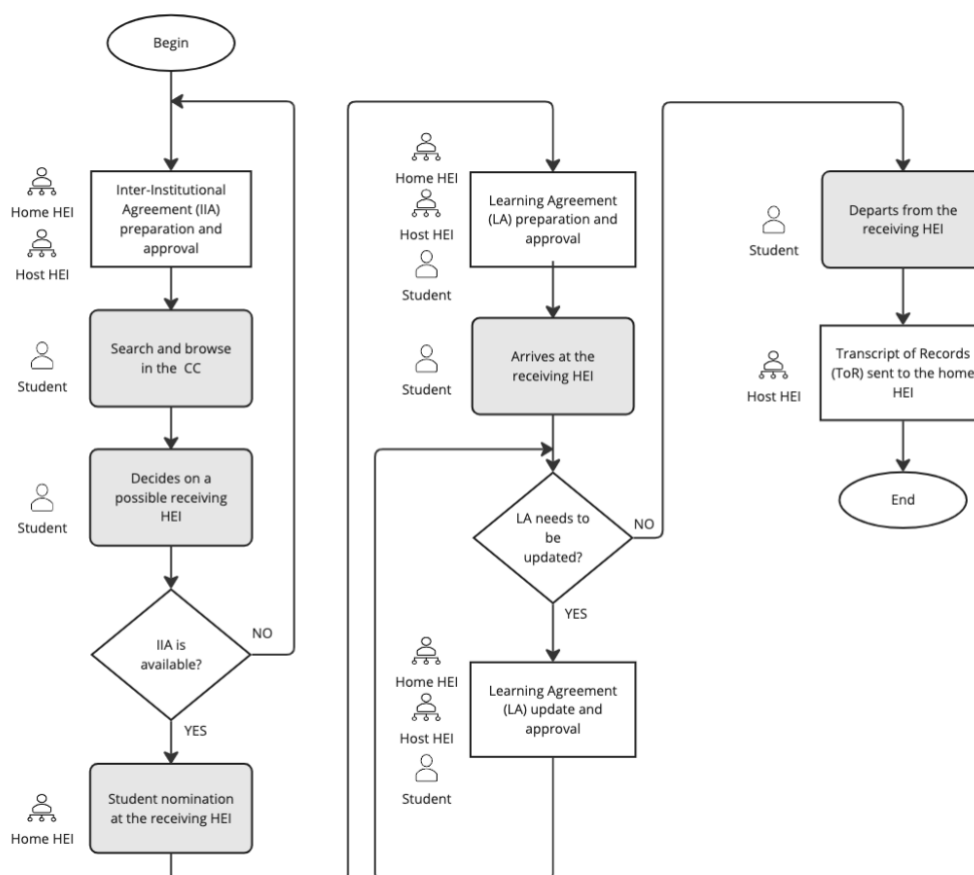


Figure 1. Main processes involved in Erasmus+ student mobility<sup>13</sup>

The EWP framework includes several key components that facilitate various aspects of Erasmus+ mobility:

- **Learning Agreements (LAs):** EWP allows LAs to be created, updated, and shared digitally between home and host institutions. These agreements outline the courses a student will take abroad, ensuring clear academic expectations and easing credit recognition processes.
- **Inter-Institutional Agreements (IIAs):** EWP supports the digital management of IIAs, which define the terms and conditions of student exchanges between partner institutions. This feature simplifies the process of setting up new partnerships and maintaining existing ones.
- **Transcript of Records (ToRs):** EWP enables the electronic exchange of Transcripts of Records, which contain students' grades and credits earned during their mobility period. This feature speeds up the credit transfer and recognition process, ensuring students receive timely recognition for their studies.

<sup>13</sup> For a more detailed view of the EWP student mobility process check <https://github.com/erasmus-without-paper/ewp-specs-mobility-flowcharts>



- **Nomination and Application:** Through EWP, institutions can manage student nominations and applications for exchange programs, improving communication and transparency between sending and receiving institutions.

By eliminating paper-based processes, EWP not only reduces the administrative workload but also promotes data consistency, accuracy, and security. For students, this digital approach simplifies the mobility experience, allowing them to manage their exchange more easily and stay informed about their academic status throughout their exchange period. For institutions, EWP's streamlined workflows free up resources that can be better allocated to supporting students and enhancing academic quality.

EWP functions as a decentralized network of connected higher education institutions across Europe, each able to securely share data through standardized APIs and protocols, see Figure 2. This network architecture enables institutions to integrate EWP with their own student information systems or third-party platforms, providing flexibility while ensuring data security and compliance with EU privacy regulations, such as the General Data Protection Regulation (GDPR). Students can also get access to the network through the Erasmus+ App. Institutions can connect to the EWP network in one of three ways:

- **Direct API Integration<sup>14</sup>:** Institutions can directly integrate EWP APIs with their student information systems, allowing for seamless data exchange without intermediary steps.
- **Third-Party Software Solutions<sup>15</sup>:** Institutions can use third-party Erasmus+ mobility software that is EWP-compatible, simplifying access for institutions that do not have the resources for custom API development.
- **EWP Dashboard<sup>16</sup>:** This is a free-to-use tool providing institutions the basic functionality needed to manage the processes of Erasmus+ student mobilities for institutions that are currently not using any digital solution.

EWP is highly compatible with other European standards and technologies, enhancing its interoperability with various institutional systems. Notably, EWP are intended to be integrated with CC by allowing institutions to publish course information in a standardized format accessible to exchange students, enabling them to make informed decisions about course selection. Additionally, EWP aligns with standards like the European Credit Transfer and Accumulation System (ECTS), which simplifies the recognition of credits earned during Erasmus exchanges.

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<sup>14</sup> At the time of writing this report there were 37 in-house solutions at <https://esci-sd.atlassian.net/wiki/spaces/EWP/pages/208633871/Technical+testing+and+validation>

<sup>15</sup> At the time of writing this report there were 20 3<sup>rd</sup> party tools at <https://esci-sd.atlassian.net/wiki/spaces/EWP/pages/208633871/Technical+testing+and+validation>

<sup>16</sup> <https://esci-sd.atlassian.net/wiki/spaces/DASH/pages/20676644/Enhanced+EWP+Dashboard>

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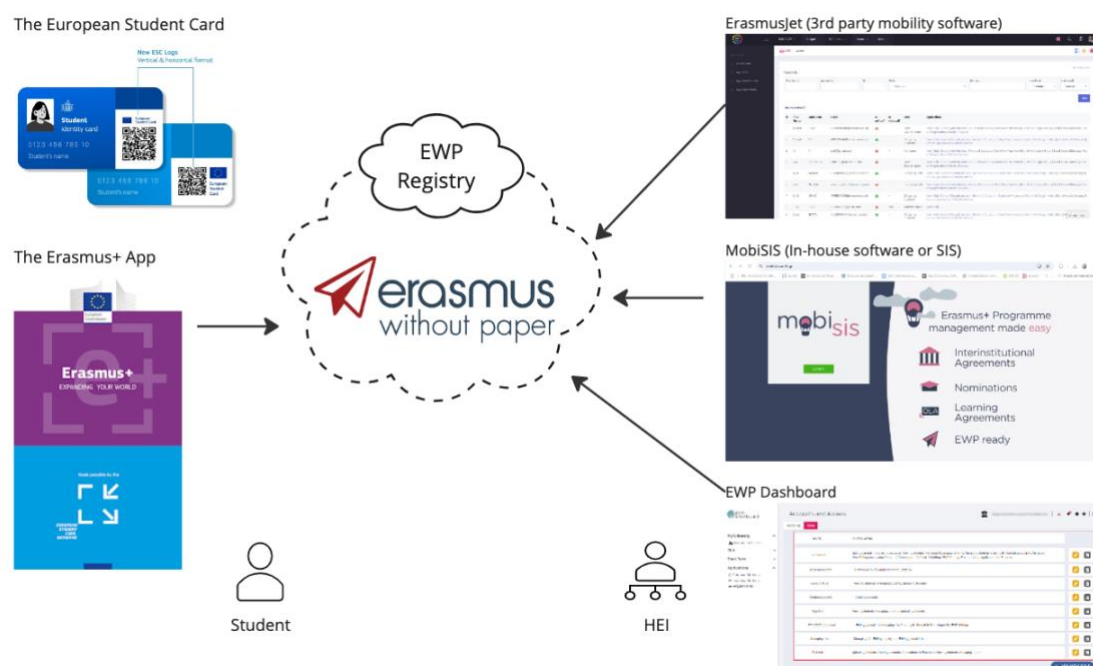


Figure 2. Representation of the EWP ecosystem

## 4.2 European Learning Mobility Model (ELMO)

The European Learning Mobility Model (ELMO) enables institutions to manage and share key academic information related to student mobility programs. ELMO is based on the CEN standard EN 15981-2011 EuroLMAI<sup>17</sup>. EuroLMAI is a data model describing assessments, primarily Diplomas, Diploma Supplements and Transcripts of Records for higher educations.

ELMO supports XML-based data structures to ensure compatibility with existing institutional systems while providing a high degree of flexibility for integration. The standard is tailored to promote transparency, reduce administrative burdens, and enhance the quality of student mobility experiences by streamlining data exchange processes. The key components of ELMO are:

- **Learning Agreements:** ELMO provides a standardized format for managing Learning Agreements, ensuring clear and consistent documentation of agreed courses, credit recognition, and academic responsibilities between sending and receiving institutions.
- **Transcripts of Records:** The standard allows for the electronic exchange of transcripts, detailing students' academic performance, earned credits, and grades during their mobility period, facilitating smooth credit recognition.
- **Inter-Institutional Agreements:** ELMO supports the digital exchange of agreements between institutions, detailing the terms and conditions for student exchanges, including course availability and administrative procedures.

<sup>17</sup> <https://interoperable-europe.ec.europa.eu/collection/european-committee-standardization-cen/solution/european-learner-mobility-achievement-information-eurolmai>

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- **Compliance with EU Standards:** The standard aligns with EU data protection regulations (e.g., GDPR) and ensures that data exchanges are secure, accurate, and compliant with European higher education policies.
- **Integration with Other Systems:** ELMO is fully compatible with the EWP network and related standards, such as the European Credit Transfer and Accumulation System (ECTS) and Open Education API(OOAPI), enhancing its interoperability.

Use Cases for ELMO:

- **Student Mobility Programs:** ELMO simplifies the exchange of critical student data, enabling institutions to manage Erasmus+ mobility processes more efficiently while improving the student experience.
- **Cross-Border Academic Collaboration:** The standard facilitates seamless collaboration between institutions across borders by standardizing data sharing practices and reducing manual administrative tasks.
- **Digital Credentialing:** ELMO enables institutions to securely share digital transcripts and Learning Agreements, ensuring portability and recognition of students' academic achievements.
- **Efficient Data Management:** The structured format of ELMO ensures consistent data quality and minimizes errors in data exchange, reducing administrative workload.

### 4.3 European Learning Model (ELM)

The European Learning Model (ELM) serves as a foundational structure to support the interoperability of various educational systems, ensuring that data about qualifications, learning achievements, and skills is consistently formatted and easily transferable. It underpins key initiatives like the Europass, the European Student Card Initiative, and the European Qualifications Framework (EQF), promoting transparency and recognition of skills and qualifications within the European Education Area.

ELM provides a set of semantic definitions and data structures to facilitate the digitalization of educational services, support lifelong learning, and enhance student mobility. By establishing a shared understanding of educational data, ELM enables institutions, employers, and learners to communicate effectively across borders and systems. The key Components of the European Learning Model are:

- **Qualifications and Credentials:** ELM defines data structures for representing qualifications and digital credentials, enabling consistent and secure documentation of academic achievements, certifications, and skills.
- **Learning Achievements:** The model supports the detailed documentation of learning outcomes and achievements, facilitating their recognition and validation across institutions and countries.
- **Interoperability with Existing Standards:** ELM integrates with and complements standards like the European Credit Transfer and Accumulation System (ECTS) and Open Education API (OOAPI), ensuring compatibility with established educational data ecosystems.

- **Support for Digital Credentialing:** ELM enables the issuance, sharing, and verification of digital credentials, streamlining processes for credential portability and verification by institutions and employers.
- **Alignment with EU Policies:** The model is aligned with broader EU initiatives such as the European Qualifications Framework (EQF), fostering consistency in the recognition of qualifications and skills across member states.

Use Cases for ELM:

- **Student Mobility:** ELM facilitates the seamless exchange of academic records, ensuring students' qualifications and achievements are recognized when transferring between institutions.
- **Lifelong Learning:** By supporting the documentation and validation of learning achievements, ELM enables individuals to maintain a comprehensive record of their skills and qualifications throughout their careers.
- **Cross-Border Collaboration:** ELM supports institutions in developing joint programs and aligning curricula by providing a standardized structure for representing educational data.
- **Digital Ecosystem Integration:** ELM serves as a foundational model for integrating various educational systems, including Learning Management Systems (LMS), Student Information Systems (SIS), and credentialing platforms.

## 5 Technical Specifications

This section describes from a technical point of view the main entities, data elements and in general specifications (vocabularies, taxonomies, etc.) proposed in the previous initiatives.

### 5.1 European Credit Transfer System Course Catalogue

The ECTS Course Catalogue provides a common structure and details what institutional, programme and course information should be available to students before entering and throughout their studies to enable them to make the right choices and use their time most efficiently. However, the ECTS CC is not a technical specification, it just indicates what elements of information should be available, but it does not constrain the digital format for that information. As such, each institution is free to decide the format of the Catalogue, the sequencing of the information and the supporting infrastructure.

The “ECTS Users’ Guide” published in 2015 gives guidelines on what an ECTS CC should contain (Users’ Guide, E.C.T.S., 2015, pp. 54-57), identifying four main information entities to be kept in CCs (see Figure 3):

- **General Information.** This is general information about the institution, as its name, address, description, academic authorities, academic calendar, admission requirements, etc.
- **Resources and Services.** This refers to offices and services available at the institution, mainly focussed on supporting students.

- **Programmes.** All degree programmes offered by the institution should be included, not only programmes that are open to international students. A particular specification is provided for Joint Programmes, that can be considered as a special case of Programme where several institutions are involved.
- **Individual Educational Components.** This is the course information, usually considered as the only information to be included in a CC.

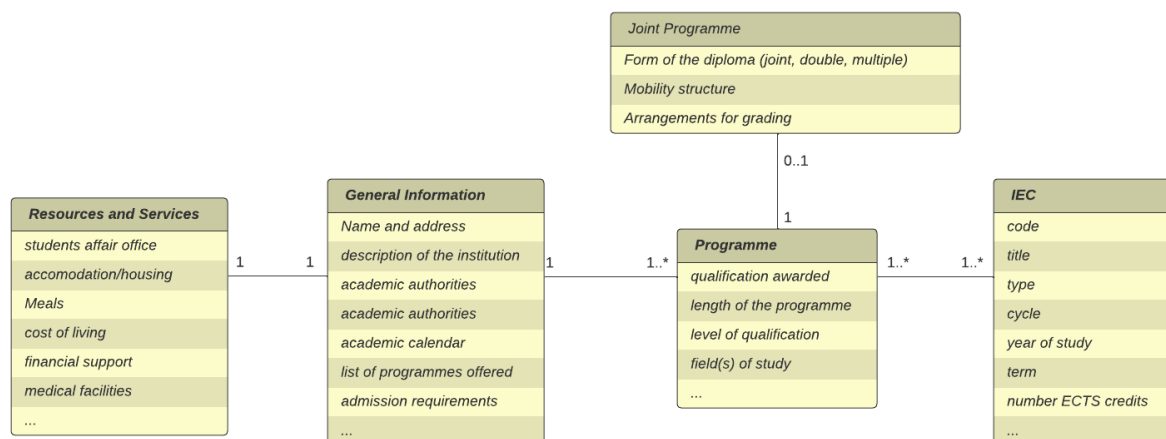


Figure 3. Recommended entities and elements for course catalogues (Users'Guide, E.C.T.S., 2015, pp. 54-57)

The recommended elements for the CC, according to the 2015 "ECTS Users' Guide", are presented in the following tables.

General Information (Institution)	
Name and address	Description of the institution (including type and status)
Academic authorities	Academic calendar
List of programmes offered	Admission requirements, including language policy, and registration procedures
Arrangements for the recognition of credit mobility and prior learning (formal, informal and non-formal)	ECTS credit allocation policy (institutional credit framework)
Arrangements for academic guidance	

Resources and services	
Student affairs offices	Accommodation/housing
Meals	Cost of living
Financial support for students	Medical facilities
Insurance	Facilities for students with disabilities and special needs
Learning facilities	International mobility possibilities

Practical information for incoming mobile students	Language courses
Work placement possibilities	Sports and leisure facilities
Student associations	

Programmes	
Qualification awarded	Length of programme
Number of credits	Level of qualification according to the National Qualification Framework and the European Qualifications Framework
Field(s) of study (e.g. ISCED-F)	Specific admission requirements (if applicable)
Specific arrangements for recognition of prior learning (formal, non-formal and informal) (if applicable)	Qualification requirements and regulations, including graduation requirements (if applicable)
Profile of the programme	Programme learning outcomes
Programme structure diagram with credits (60 ECTS per fulltime equivalent academic year)	Mode of study (full-time/parttime/e-learning etc.)
Examination regulations and grading scale	Obligatory or optional mobility windows (if applicable)
Work placement(s) (if applicable)	Work-based learning
Programme director or equivalent	Occupational profiles of graduates
Access to further studies	
Joint programmes	
Information on the form of the diploma and Diploma Supplement ( joint/double/ multiple)	Members of consortium and their role y mobility structure of the programme

Individual Educational Components	
Code	Title
Type (compulsory/optional)	Cycle (short/first/second/third)
Year of study when the component is delivered (if applicable)	Semester/trimester when the component is delivered
Number of ECTS credits allocated	Name of lecturer(s)
Learning outcomes	Mode of delivery (face-to-face/ distance learning etc.)
Prerequisites and co-requisites (if applicable)	Course content
Recommended or required reading and other learning resources/tools	Planned learning activities and teaching methods
Assessment methods and criteria	Language of instruction

## 5.2 Open Course Catalogue API (OCCAPI)

The Open Course Catalogue API (OCCAPI) specification aims to standardize the way in which HEIs expose their course catalogues in a machine-readable format.

The technical specification of OCCAPI along with a working demo for development reference is available as a GitHub project<sup>18</sup>. OCCAPI is designed to describe Courses offered by any institution in accordance with the ECTS Guidelines, while also adding flexibility with additional data points. OCCAPI also aims to reflect the structure of Degree Programmes and how Courses are organized therein. OCCAPI provides for inclusion of relevant information about the institution and the organisational unit responsible for the delivery of a Course or a Degree Programme.

OCCAPI is modelled after the JSON:API standard, relying on the concepts of Resources and Resource Collections, as well as on hypermedia links for navigation.

The resource types are (see Figure 1): Institution, Organisational Unit, Degree Programme, Course. Except the Organisational Unit, the other three ones can be matched with ECTS Users' Guide entities, coloured in yellow.

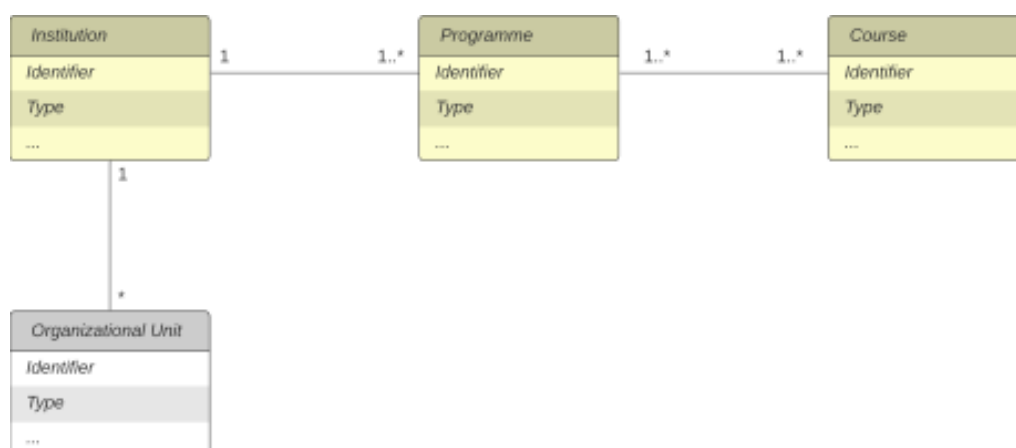


Figure 4. Main entities in the OCCAPI data model

### Institution

- title
- heild
- abbreviation
- url

### Organisational Unit

- title
- ounitld
- ounitCode
- abbreviation

<sup>18</sup> <https://github.com/EuropeanUniversityFoundation/occapi-openapi>

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- url

### Programme

- title
- code
- description
- ects
- eqfLevelProvided
- iscedCode
- languageOfInstruction
- length
- url

### Course

- title
- code
- description
- learningOutcomes
- academicTerm
- ects
- languageOfInstruction
- iscedCode
- subjectArea
- otherCategorization
- unavailableForIncomingMobility
- url
- bibliography
- courseContent
- prerequisites
- courseAvailability
- teachingMethod
- assessmentMethod
- meta

## 5.3 Open Education API (OOAPI)

OOAPI is built on RESTful principles and widely used web standards like JSON and HTTP, ensuring compatibility with modern software ecosystems. Its modular structure and standardized endpoints allow institutions to manage and share data related to courses, students, programs, and other academic entities. By offering a unified framework, OOAPI helps institutions streamline their digital infrastructure, reduce integration costs, and enhance the user experience for both students and staff.



The actual OOAPI specification is specified using the Open API Specification<sup>19</sup>, a standard that defines how to specify REST APIs. Currently it is on version v5<sup>20</sup>, supporting most operations through HTTP GET methods and providing JSON data in responses.

Key components of the OOAPI structure include (see Figure 5):

- **Organization:** referring to the academic institution.
- **Education specification:** used as an aggregation of the programs available in a institution.
- **Program:** supporting the description of programmes. The following programme types are recognised: program, minor, honours, specialization, elective, module, track, joint-degree and alliance.
- **Course:** supporting the specification of individual educational components. These can be part of a programme.
- **Component:** it is used to describe the most concrete learning activities, such as workgroups, lectures and tests.
- **ProgramOffering, CourseOffering and ComponentOffering.** They refer to a particular instance of a programme, course or component. Usually, every academic year is provided a new different instance, including specific information for such academic year such as: maximum number of students, enrolled number of students, start date, end date, etc.
- **TimelineOverrideProgram and TimelineOverrideCourse.** These entities are used to keep timeline versions of the programmes and courses.

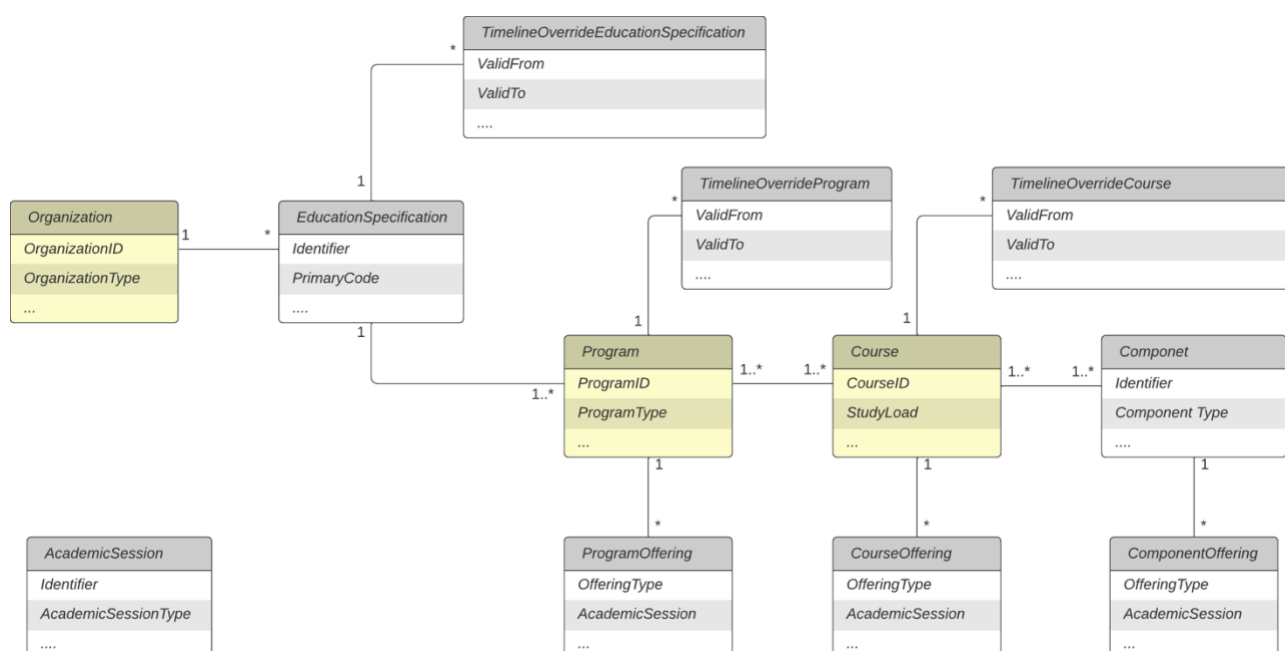


Figure 5. Main entities in the OOAPI data model

<sup>19</sup> <https://www.openapis.org/>

<sup>20</sup> <https://openonderwijsapi.nl/specification/v5/docs.html#tag/service-metadata/paths/~1/get>

### AcademicSession

- id: Unique identifier for the academic session.
- name: Name of the session (e.g., "Fall 2023").
- startDate: Start date of the session.
- endDate: End date of the session.
- description: Textual description of the session.
- termType: Classification of the session (e.g., semester, trimester).
- academicYear: Reference to the academic year this session belongs to.

### Component

- id: Unique identifier for the component.
- name: Name of the component.
- description: Detailed description.
- componentType: Type or classification of the component (e.g., lecture, lab).
- credit: Number of credits associated with the component.
- hours: Total hours required for the component.

### ComponentOffering

- id: Unique identifier for the component offering.
- componentId: Reference to the associated component.
- academicSessionId: Reference to the academic session when the offering is available.
- instructors: List of instructors teaching the component.
- schedule: Details about when and where the component is offered.
- location: Location where the component is offered.

### Course

- id: Unique identifier for the course.
- name: Name of the course.
- description: Detailed description.
- subjectArea: Subject or discipline the course belongs to.
- level: Academic level of the course (e.g., undergraduate, postgraduate).
- credit: Number of credits awarded upon completion.
- prerequisites: Courses or qualifications required before enrolling.
- outcomes: Expected learning outcomes.

### CourseOffering

- id: Unique identifier for the course offering.
- courseId: Reference to the associated course.
- academicSessionId: Reference to the academic session when the course is offered.
- instructors: List of instructors teaching the course.
- schedule: Details of time and place for the offering.
- location: Location where the course is held.

- **enrollmentLimit:** Maximum number of students allowed to enroll.

### EducationSpecification

- **id:** Unique identifier for the specification.
- **name:** Name of the specification.
- **description:** Detailed description.
- **level:** Academic level or standard (e.g., EQF level).
- **credit:** Number of credits defined by the specification.
- **outcomes:** Learning outcomes defined by the specification.
- **requirements:** Conditions or prerequisites for meeting the specification.

### Organization

- **id:** Unique identifier for the organization.
- **name:** Name of the organization.
- **description:** Textual description of the organization.
- **parentId:** Reference to a parent organization (if any).
- **contact:** Contact information (e.g., email, phone).
- **location:** Physical address of the organization.

### Program

- **id:** Unique identifier for the program.
- **name:** Name of the program.
- **description:** Detailed description.
- **level:** Academic level of the program (e.g., Bachelor's, Master's).
- **credit:** Total number of credits required to complete the program.
- **duration:** Expected duration of the program.
- **outcomes:** Learning outcomes associated with the program.
- **requirements:** Prerequisites or conditions for admission.

### ProgramOffering

- **id:** Unique identifier for the program offering.
- **programId:** Reference to the associated program.
- **academicSessionId:** Reference to the academic session for this offering.
- **locations:** List of locations where the program is offered.
- **admissionProcedure:** Description of the admission process.
- **applicationDeadline:** Application deadlines.
- **priceDetail:** Tuition or fees for the program offering.

**TimelineOverrideProgram and TimelineOverrideCourse.** These entities have the same data than Program and Course entities, but including two new data fields: **validFrom** (inclusive) and **validTo** (exclusive) indicating for which period the changed attributes are valid. They are used to keep timeline versions of the programmes and courses.

In addition to the entities in the model, OOAPI also proposes several vocabularies for specific data elements:

- EducationSpecificationType: program, privateProgram, programCluster, Course.
- LevelType: secondary vocational education, associate degree, bachelor, master, doctoral, undefined, undivided, etc.
- SectorType: secondary vocational education, higher professional education, university education.
- StudyLoadType: contacttime, ects, sbu, sp hour.
- ProgramType: program, minor, honours, specialization, elective, module, track, joint-degree, alliance
- QualificationAwardedType: BA, BSc, BBA, BSW, Bed, BMus, LLB, MA, MSc, MBA, MSW, Med, MMus, LLM, PhD, None.
- LevelOfQualificationType: 1, 2, 3, 4, 4+, 5, 6, 7, 8.
- ModeOfStudyType: full-time, part-time, dual training, self-paced
- ModelOfDeliveryType: distance-learning, on campus, online, hybrid, situated
- ComponentType: test, lecture, practical, tutorial, consultation, project, workshop, excursion, independent study, external, skills training
- OfferingType: program, course, component
- ResultValueType: pass-or-fail, US letter, UK letter, 0-100, 1-10
- CostType: STAP eligible, total costs
- RemoteState: pending, canceled, denied, associated, queued
- AssociationType: programOfferingAssociation, courseOfferingAssociation, componentOfferingAssociation
- AssociationRole: student, lecturer, teaching assistant, coordinator, guest
- State: pending, canceled, denied, associated, queued
- ResultPass: unknown, passed, failed,
- ResultState: in progress, postponed, completed, queued
- NewsItemType: calamity, general, schedule-change, announcement
- OrganizationType: root, institute, department, faculty, branch, academy, school
- RoomType: general purpose, lecture room, computer room, laboratory, office, workspace, exam location, study room, examination room, conference room
- AddressType: postal, visit, deliveries, billing, teaching
- AcademicSessionType: academicyear, semester, trimester, quarter, testing period, period

## 5.4 Postsecondary Electronic Standards Council (PESC)

The PESC Course Inventory standard is very oriented to support the transfer of data regarding courses among different institutions. It includes an XML specification with a set of entities:

**TransmissionData:** includes routing and header information (required)

- DocumentID
- CreatedDateTime

- DocumentTypeCode
- TransmissionType
- Source: organization
- Destination: organization
- DocumentProcessCode
- DocumentOfficialCode
- DocumentCompleteCode
- RequestTrackingID
- UserDefinedExtensions
- NoteMessage

**CourseInventoryInformation:** body of document. Information about individual courses and supporting data (required)

- CourseCreditUnits
- CourseCreditMaximumValue
- CourseCreditMinimumValue
- CourseAcademicGradeScale
- CourseRepeatability
- CourseCIPCode
- CourseCISCCode
- CourseNCESCode
- CoursePSISCode
- CourseSCEDCode
- CourseLevel
- CourseHonorsCode
- CourseSubjectAbbreviation
- CourseLongDepartmentName
- CourseNumber
- CourseSubID
- PreviousCourseID
- RelatedCourseID
- CourseShortID
- CourseLongTitle
- CourseDescription
- CourseEffectiveDate
- CourseExpirationDate
- CoursePrerequisite
- CourseCorequisite
- Requirement
- Licensure
- LanguageOfInstruction
- NoteMessage

- UserDefinedExtensions

These entities are not comparable to the entities contained in the previous specifications. Just the CourseInventoryInformation can be related to the Individual Educational Component or Course. In any case, it contains many specific data elements that cannot be generalized to international contexts.

## 5.5 IMS Edu-API

IMS Edu-API leverages RESTful web services and supports widely adopted formats such as JSON and XML. Its modular architecture ensures flexibility, enabling institutions to adopt components relevant to their specific use cases while maintaining compliance with global interoperability standards.

The key components of IMS Edu-API are (cf Figure 6): AcademicSession, Affiliation, CollectionOffering, CollectionTemplate, ComponentOffering, ComponentTemplate, CourseOffering, CourseTemplate, Enrollment, Organization, Person.

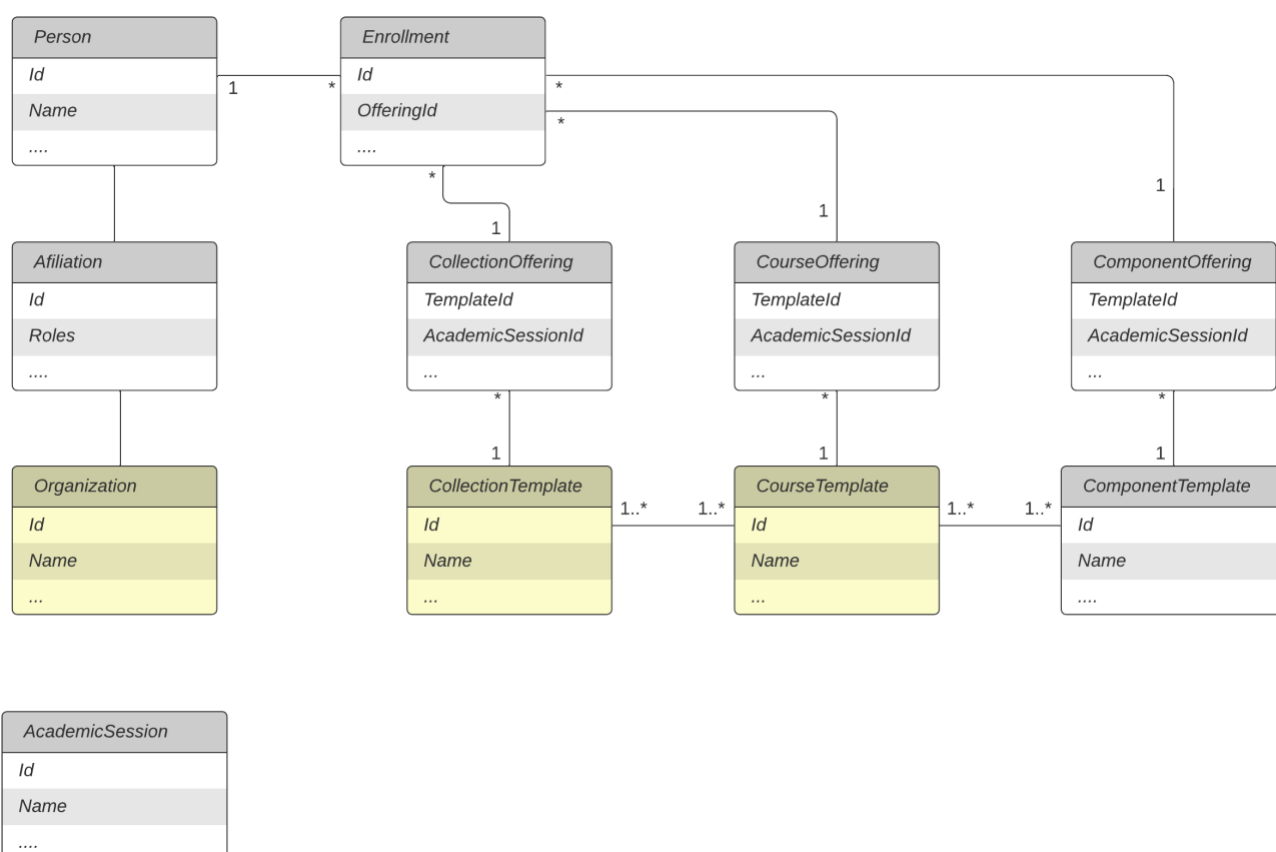


Figure 6. Main entities of the IMS Edu-API data model

### AcademicSession

- id: Unique identifier for the session.
- name: Name of the session (e.g., "Fall 2023").

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- description: Optional description of the session.
- startDate: Start date of the session.
- endDate: End date of the session.
- academicYear: Identifier for the academic year.
- termType: Classification of the session (e.g., semester, quarter).
- status: Current status (e.g., active, canceled).

### Affiliation

- id: Unique identifier for the affiliation.
- personId: Reference to the associated person.
- organizationId: Reference to the associated organization.
- roles: List of roles (e.g., student, faculty).
- startDate: Start date of the affiliation.
- endDate: End date of the affiliation (if applicable).
- status: Current status (e.g., active, inactive).

### CollectionOffering

- id: Unique identifier for the collection offering.
- templateId: Reference to the associated collection template.
- academicSessionId: Reference to the session when the collection is offered.
- schedule: Details about time and location of the offering.
- enrollmentLimit: Maximum number of enrollments allowed.
- status: Current status (e.g., active, canceled).

### CollectionTemplate

- id: Unique identifier for the collection template.
- name: Name of the collection.
- description: Detailed description of the collection.
- components: List of components included in the collection.
- credit: Total credits for the collection.
- outcomes: Expected outcomes for learners.

### ComponentOffering

- id: Unique identifier for the component offering.
- templateId: Reference to the associated component template.
- academicSessionId: Reference to the session when the component is offered.
- schedule: Schedule details (e.g., times, locations).
- instructors: List of instructors assigned to the component.
- status: Current status (e.g., active, canceled).

### ComponentTemplate

- id: Unique identifier for the component template.

- name: Name of the component.
- description: Detailed description.
- componentType: Type of the component (e.g., lecture, lab).
- credit: Number of credits associated with the component.
- prerequisites: Prerequisites for the component.

### CourseOffering

- id: Unique identifier for the course offering.
- templateId: Reference to the associated course template.
- academicSessionId: Reference to the session when the course is offered.
- schedule: Schedule details (e.g., time, location).
- instructors: List of instructors teaching the course.
- enrollmentLimit: Maximum number of enrollments allowed.
- status: Current status (e.g., active, canceled).

### CourseTemplate

- id: Unique identifier for the course template.
- name: Name of the course.
- description: Detailed description.
- subjectArea: Subject area or discipline.
- level: Academic level (e.g., undergraduate, graduate).
- credit: Total credits for the course.
- prerequisites: Prerequisites for enrollment.
- outcomes: Expected learning outcomes.

### Enrollment

- id: Unique identifier for the enrollment.
- personId: Reference to the person enrolled.
- offeringId: Reference to the offering (e.g., course, component).
- status: Current status of the enrollment (e.g., active, withdrawn).
- grade: Grade achieved (if applicable).
- dateEnrolled: Date when the enrollment occurred.

### Organization

- id: Unique identifier for the organization.
- name: Name of the organization.
- description: Description of the organization.
- type: Type of organization (e.g., faculty, department).
- parentId: Reference to the parent organization (if applicable).
- contact: Contact details for the organization.

### Person

- id: Unique identifier for the person.



- name: Full name of the person.
- email: Email address.
- phone: Phone number.
- roles: List of roles the person holds (e.g., student, instructor).
- affiliations: List of affiliations with organizations.
- status: Current status of the person (e.g., active, inactive).

## 5.6 eXchanging Course Related Information – Course Advertising Profile (XCRI-CAP)

XCRI-CAP is built as an XML schema that defines a set of standardized elements and structures for course-related information<sup>21</sup>. The main components of XCRI-CAP include, see Figure 7:

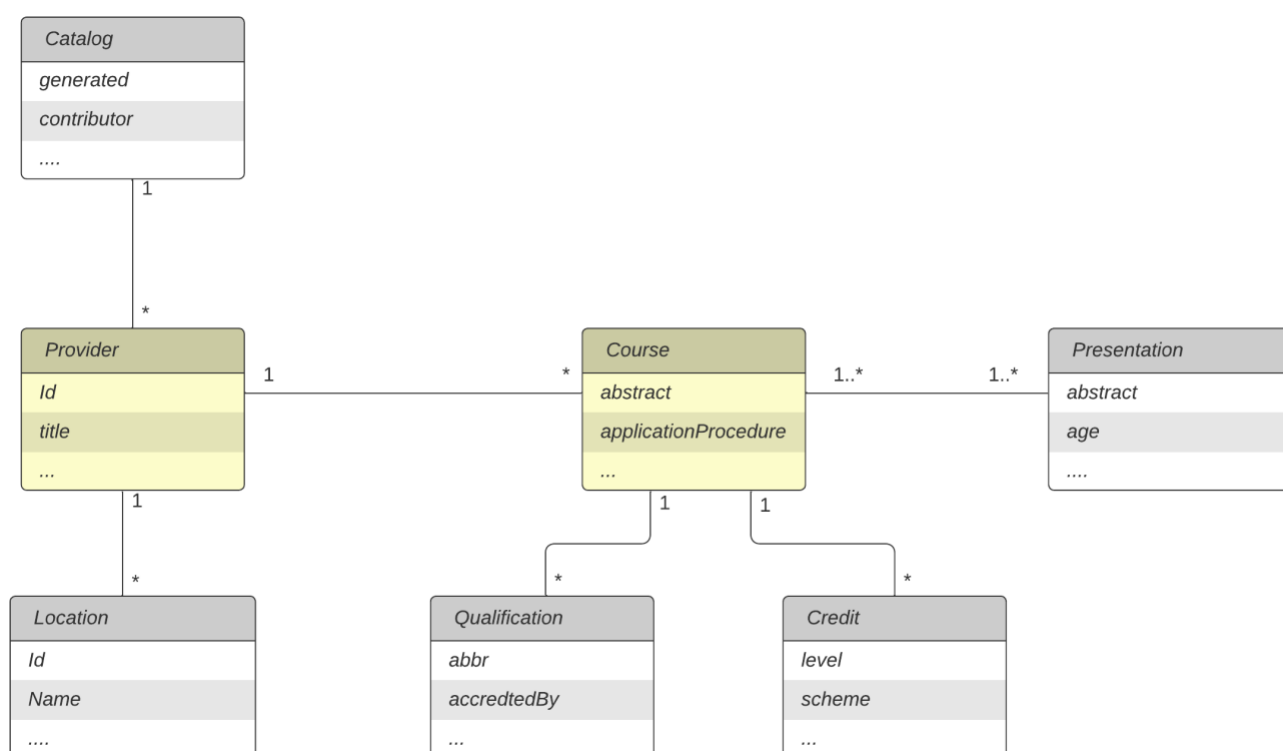


Figure 7. Main entities in the XCRI-CAP data model

**Catalog.** This entity represents the catalogue and contains metadata information about the catalogue.

- **contributor:** An organisation, group or individual responsible for making contributions to the resource.
- **description:** Descriptions of when and how courses are offered.
- **lang:** the language used for the description.
- **href:** A URL linking to general textual information about the parent element.

<sup>21</sup> <https://xcri.prospects.ac.uk/Data-Definitions-XCRI-CAP-Postgraduate-Taught-Courses-v3.2.pdf>

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**Provider.** Organization or institution offering the courses.

- **description:** General textual information about the provider and its facilities.
- **identifier:** An unambiguous reference to the provider.
- **location:** Holds information about the spatial location of the provider. It contains the official address for administrative enquiries and the geographical location of the main site of the organisation.
- **title:** Trading name of the provider.
- **url:** URL to the organization's website.

**Course.** Holds the data relating to the learning opportunity. Feeds must include all offered courses that the HEI wishes to market via their XCRI-CAP feed.

- **abstract:** A short one-sentence description for use in a course list
- **applicationProcedure:** Text describing how to apply for the learning opportunity.
- **assessment:** Text describing the broad approach to assessment used in the learning opportunity
- **learningOutcome:** Text describing the learning outcomes for a course of study.
- **objective:** Text describing aims or learning objectives of the learning opportunity.
- **prerequisite:** Textual description of the entry requirements (academic and / or non-academic, formal or informal) for entry to a learning opportunity.
- **regulations:** Textual description of the organisation's academic and administrative regulations relevant to a learning opportunity
- **description:** General summary of the course
- **identidier:** A permanent unambiguous reference to the course
- **isPartOf:** Text about relationship between the resource and a parent resource.
- **subject:** The topic of the course
- **title:** The topic of the course
- **type:** A grouping of similar courses in terms of target audience
- **url:** The URL of the course

**Presentation.** Descriptions of when and how courses are offered.

- **abstract:** A short one-sentence description
- **age:** The intended age range for which the presentation is suitable
- **applicationProcedure:**
- **applyFrom:** The date from which applications can be accepted for the presentation
- **applyTo:** A URL to further information about, or an online application system for, the presentation.
- **applyUntil:** The date after which applications cannot be accepted for the presentation of a course.
- **assessment:**
- **attendanceMode:** the type of location at which the student will undertake the presentation
- **attendancePattern:** The period in the day and/or frequency during which attendance at a venue is required (if any)

- **cost:** A textual description of the cost associated with obtaining access to the presentation, including reference to bursaries or other special arrangements for specific groups of learners
- **description:**
- **duration:** Information about how long the presentation will last
- **end:** Information about the end date and / or time of the presentation
- **identifier:** Unique identifier for the presentation.
- **languageOfAssessment:** A language in which the presentation is assessed
- **languageOfInstruction:** A language in which the presentation is available to be taught.
- **learningOutcome:**
- **objective:**
- **places:** A textual description of the number of places available for participants in the presentation.
- **prerequisite:**
- **regulations:**
- **start:** Information about the start date and / or time of the presentation.
- **studyMode:** A general expression of the overall amount of the student's time that is devoted to the learning opportunity, as defined by the provider
- **subject:** The topic of the presentation
- **title:** Name of the presentation
- **url:** The URL of the presentation
- **venue:** Holds the information relating to the main locations where a learning opportunity is presented.

**Qualification.** Information about qualifications achieved upon completion.

- **abbr:** Abbreviation used as a shortened form of the qualification awarded.
- **accreditedBy:** The common name of an organisation that accredits the qualification.
- **awardeBy:** The common name of the awarding body.
- **Description:** General summary of the nature of the qualification
- **description in qualification context:** Description of any professional standing of the qualification, including reference to specific professional bodies.
- **education level:** Information about the progression through an educational or training context represented by the qualification
- **identifier:** An unambiguous reference to the qualification
- **title:** Full official name of the qualification using standard abbreviations if used in official documentation
- **url:** The URL of the qualification

**Credit.** An account of the credits that can be obtained from completion of a course

- **level:** The point in a credit scheme or framework at which credits are awarded.
- **scheme:** The name of the credit scheme under which credits are awarded
- **value:** The number of credits awarded

In addition to the definitions for the information entities, this specification also provides some vocabularies for certain data elements:

- **StudyMode:** NK (Not known), FL (Flexible), FT (Full Time), PF (Part of a full time programme), PT (Part time).
- **Course Type:** UG (Undergraduate), PG (Postgraduate), CP (Continuous Professional Development), OT (Other).
- **AttendanceMode:** CM (Campus), DA (Distance with attendance), NC (Face-to-Face non-campus), MM (Mixed Mode), ON (Online), WB (Work-based)
- **AttendancePattern:** DT (Daytime), EV (Evening), TW (Twilight), DR (Day/Block release), WE (Weekend), CS (Customised)

## 5.7 Erasmus Without Paper (EWP)

Erasmus Without Paper (EWP) is an initiative aimed at digitalizing the Erasmus+ program administration, enabling seamless data exchange between higher education institutions (HEIs). Its design incorporates a decentralized approach, ensuring flexibility, security, and compatibility with existing systems. The technical information about the EWP is available at a Confluence site<sup>22</sup> and in a GitHub site<sup>23</sup>.

### 5.7.1 APIs

The operation of the EWP network is based on the set of APIs<sup>24</sup>. These APIs come in groups related to specific business processes, like handling inter-institutional agreements, learning agreements, nominations, etc.

The APIs follow a REST definition based on HTTP GET and POST methods. Parameters must be provided in the regular application/x-www-form-urlencoded format. Responses are described using XML schemas.

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<sup>22</sup> <https://esci-sd.atlassian.net/wiki/spaces/ITSC/pages/111706138/EWP+in+GitHub>

<sup>23</sup> <https://github.com/erasmus-without-paper>

<sup>24</sup> <https://esci-sd.atlassian.net/wiki/spaces/ITSC/pages/111509524/APIs+-+overview> (last accessed: 11/01/2024)

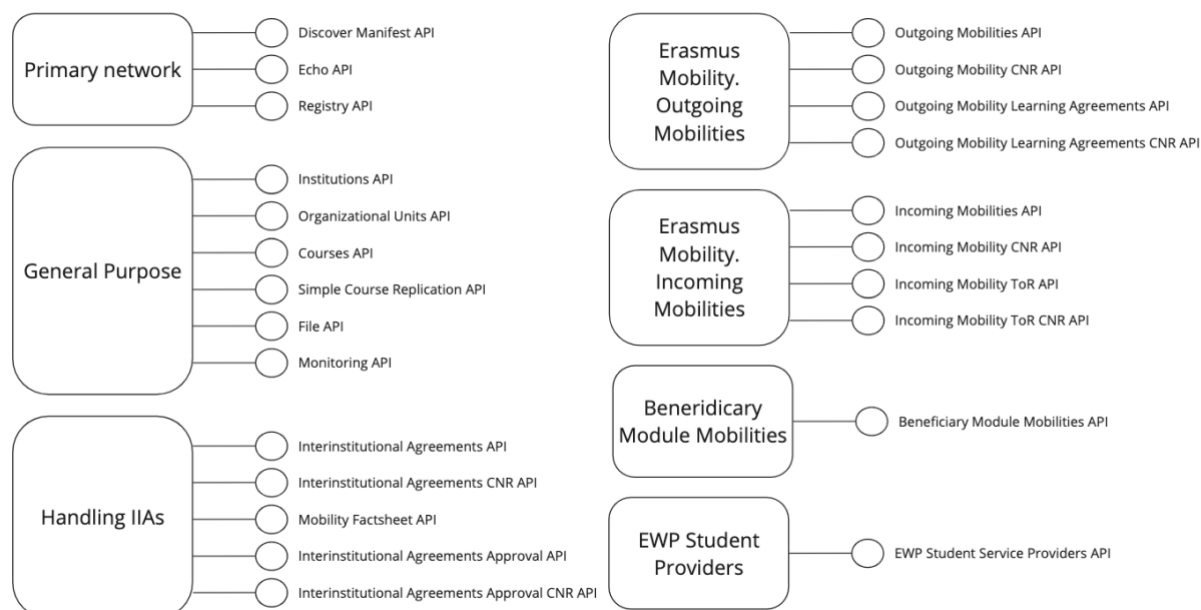


Figure 8. EWP APIs grouped by business processes

- The Primary network APIs:
  - o Discovery manifest API serve to announce which HEIs your system covers, which features (APIs) you have implemented, and which credentials your clients are going to use when fetching data from the EWP network.
  - o Echo API is used to design and test the authentication and security framework of the network.
  - o Registry API is implemented by the EWP Registry Service and it returns the catalogue file with information gathered from the manifest files<sup>25</sup>.
- General purpose APIs:
  - o Institutions API allows external clients to retrieve general information on institutions either covered, or otherwise known, by the host. The information includes things like address, logo, image and key contact persons.
  - o Organizational Units API allows external clients to retrieve general information on selected organizational units (faculties, departments, divisions, etc.) either covered, or otherwise known by the host.
  - o Courses API allows other HEIs to access information on courses and other learning opportunities conducted at a given HEI.
  - o Simple Course Replication API allows the clients to replicate the catalogue of courses conducted on this HEI. This in turn allows the clients to design rich course searching user experience.
  - o File API allows partners to share files securely.

<sup>25</sup> The following page contains the registry information: <https://registry.erasmuswithoutpaper.eu/coverage> (last accessed: 11/01/2024)

- Monitoring API allows clients in the EWP network to inform the network's administrators about any issues encountered when making requests.
- Handling IIAs:
  - Interinstitutional Agreements API. This API allows partners to compare their copies of IIA with each other.
  - Interinstitutional Agreement CNR<sup>26</sup> API. Allows HEIs to get notified whenever any IIA (related to them) is updated on the other HEI's servers.
  - Mobility Factsheet API. This allows partners to share all the information useful for incoming students in the mobility process.
  - Interinstitutional Agreements Approval API is used to approve agreements.
  - Interinstitutional Agreement Approval CNR API allows HEIs to get notified whenever any IIA approval (related to them) is updated.
- Erasmus mobility APIs. Outgoing Mobilities (Nominations and LAs)
  - Outgoing Mobilities API. This API is implemented by the sending institution. It allows the receiving HEI to read, write and enumerate mobilities stored on the sending HEI's server.
  - Outgoing Mobility CNR API. To provide notifications.
  - Outgoing Mobility Learning Agreements API. This is based on the official LA template.
  - Outgoing Mobility Learning Agreements CNR API.
- Erasmus mobility API. Incoming Mobilities (Nominations and ToRs)
  - Incoming Mobilities API. Implemented at the receiving institution.
  - Incoming Mobility CNR API.
  - Incoming Mobility ToR API. ToR stands for Transcript of Records.
  - Incoming Mobility ToR CNR API.
- Beneficiary Module Mobilities API. This API is implemented by only one host. It allows external clients to automatise reporting of individual mobilities of students to the Beneficiary Module.
- EWP Student Service Providers API. This API provides a structured overview about the available student services at the receiving institution.

The following page has information about the APIs supported by institutions around Europe: <https://registry.erasmuswithoutpaper.eu/coverage> . More updated information can be found in the EWP Stats Portal <https://stats.erasmuswithoutpaper.eu/>

## 5.7.2 Data model

<sup>26</sup> CNR stands for Change Notification Receiver. CNR APIs implement the publish-subscribe pattern. For a detailed introduction on how CNR APIs work read this page: <https://github.com/erasmus-without-paper/ewp-specs-architecture#cnr> (last accessed: 11/01/2024)

The main elements of the EWP data model are represented in Figure 9 as an entity-relationship model. As it can be seen, there are several entities directly related to the documents involved in Erasmus+ students mobilities: IIA, IIA Partner, Mobility/Learning Agreement, LA Version, Mobility Spec (Coop Condition), Component.

In addition, there are some entities more related to the information contained in CCs: Institution/Organizational Unit, Learning Opportunity Specification, Learning Opportunity Instance, Academic Term. The Contact/Fact Sheet, Person and Result Distribution entities could also be considered relevant for a CC, see Figure 10. In the case of Institution and Learning Opportunity Specification a direct match can be established with the General Information and Individual Educational Components of the ECTS Users' Guide 2015, see section 5.1. These entities have been coloured in yellow in the figure. As it can be seen there is no entity to keep Programmes information nor Resources and Services.

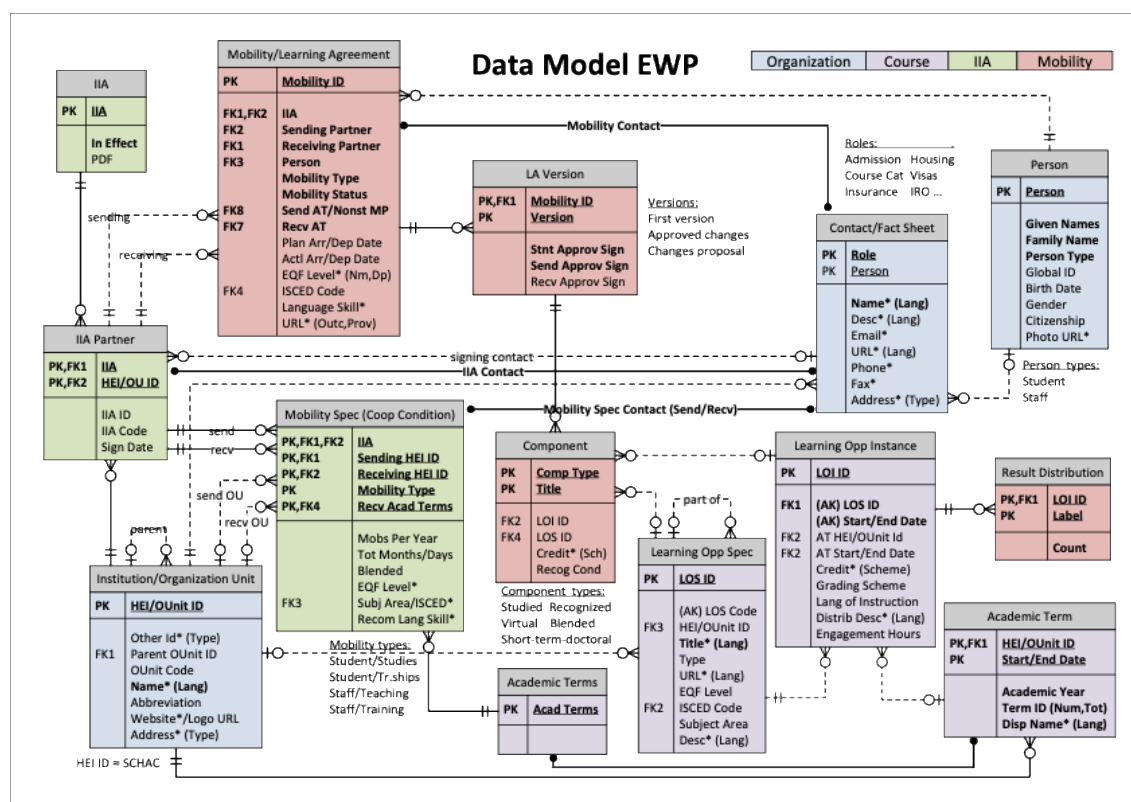


Figure 9. Original EWP Data Model<sup>27</sup>

<sup>27</sup> <https://github.com/erasmus-without-paper/ewp-mobility-data-model>



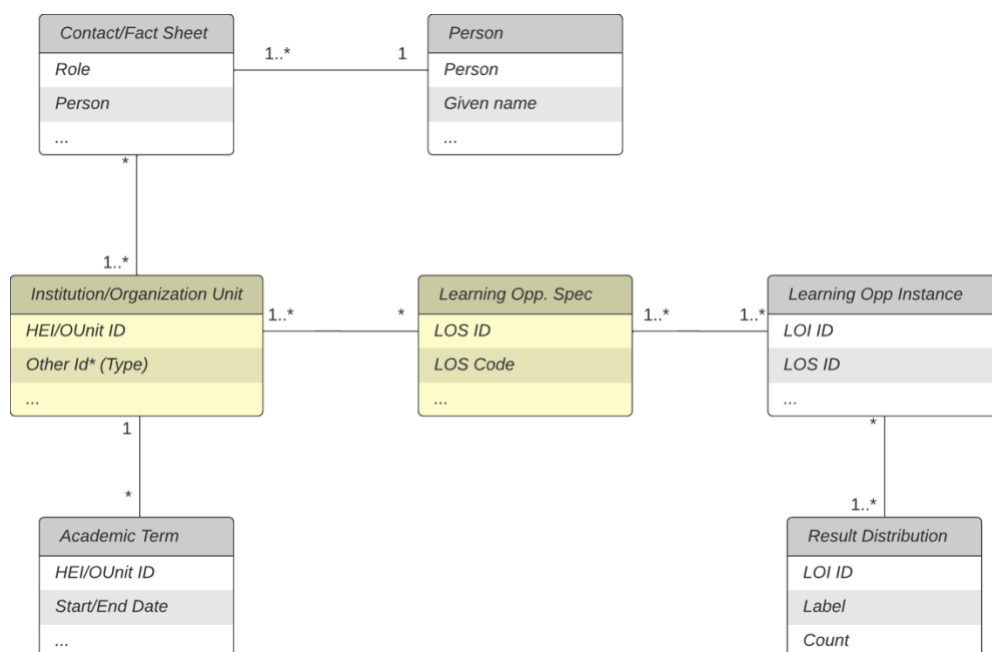


Figure 10. Entities in the EWP data model that can be related to CC information.

Next it is described the data elements of these entities according to the API schemes.

### Institutions API Response Schema

- hei: Represents a Higher Education Institution (HEI).
- hei-id: Unique identifier for the institution.
- name: Official name of the institution.
- abbreviation: Shortened name or acronym.
- other-id: Alternative identifiers (e.g., Erasmus code).
- pic: Participant Identification Code.
- ounit-id: Organizational unit identifiers within the institution.
- url: Website URL of the institution.
- logo-url: URL to the institution's logo.
- mobility-factsheet-url: URL to the mobility factsheet.
- contact: Contact details for the institution.
- other-email: Additional email addresses.
- other-fact: Other relevant information.

### Organizational Units API Response Schema

- ounit: Represents an organizational unit within an HEI.
- ounit-id: Unique identifier for the unit.
- hei-id: Identifier of the parent institution.
- name: Name of the organizational unit.
- abbreviation: Shortened name or acronym.



- other-id: Alternative identifiers.
- parent-ounit-id: Identifier of the parent organizational unit.
- url: Website URL of the unit.
- logo-url: URL to the unit's logo.
- contact: Contact details for the unit.
- other-email: Additional email addresses.
- other-fact: Other relevant information.

**Courses API Response Schema.** This API is based on the data models corresponding to **LearningOpportunitySpecification** and **LearningOpportunityInstance**.

- course: Represents a course offered by an HEI.
- course-id: Unique identifier for the course.
- institution-id: Identifier of the offering institution.
- title: Title of the course.
- description: Detailed description of the course.
- ects-credits: Number of ECTS credits awarded.
- language-of-instruction: Languages in which the course is taught.
- prerequisites: Required prior knowledge or courses.
- learning-outcomes: Expected outcomes for students.
- assessment-methods: Methods of student assessment.
- course-level: Level of the course (e.g., Bachelor, Master).
- course-mode: Mode of delivery (e.g., full-time, part-time).
- course-url: URL to the course's webpage.

### Academic Term Data Types

- AcademicYearId
- EwpAcademicTermId
  - AcademicYearId
  - TermNumber
  - NumberOfTerms
- AcademicTerm
  - academic-year-id
  - term-id
  - display-name
  - start-date
  - end-date
- TermId
  - term-number: The specific term's number within the academic year.
  - total-terms: The total number of terms in the academic year.

## 5.8 European Learner Mobility Model (ELMO)

The ELMO (Electronic Learning Model) XML Schema is designed to facilitate the exchange of student achievement information, such as diplomas, diploma supplements, and transcripts of records, primarily within higher education institutions. It is based on the CEN standard EN 15981-2011 EuroLMAI and includes the following elements:

#### **elmo**

- **generatedDate:** The date when the document was generated.
- **issuer:** Information about the institution issuing the document.
- **learner:** Details about the learner to whom the document pertains.
- **learningOpportunitySpecification:** Specifications of the learning opportunities.
- **learningOpportunityInstance:** Instances of the learning opportunities undertaken by the learner.
- **result:** Outcomes or results achieved by the learner.
- **attachment:** Additional documents or files related to the learner's achievements.
- **gradingScheme:** Descriptions of the grading schemes used.

#### **issuer**

- **title:** Name of the issuing institution.
- **identifier:** Unique identifiers for the institution (e.g., national or international codes).
- **address:** Physical address of the institution.
- **contactInfo:** Contact details, including email and phone numbers.

#### **learner**

- **identifier:** Unique identifiers for the learner (e.g., student ID, national ID).
- **givenNames:** Learner's first name(s).
- **familyName:** Learner's last name.
- **birthDate:** Date of birth.
- **placeOfBirth:** Place of birth.
- **birthName:** Name at birth, if different.
- **currentAddress:** Current residential address.
- **gender:** Gender of the learner.

#### **learningOpportunitySpecification (LOS)**

- **identifier:** Unique identifiers for the learning opportunity.
- **title:** Name of the learning opportunity.
- **iscdCode:** ISCED code representing the field of education.
- **eqfLevel:** European Qualifications Framework level.
- **credit:** Credit information, including type and value.
- **description:** Detailed description of the learning opportunity.
- **learningOutcome:** Expected outcomes upon completion.
- **prerequisite:** Requirements needed before undertaking the opportunity.
- **url:** Link to more information.

### learningOpportunityInstance (LOI)

- identifier: Unique identifiers for the instance.
- specificationId: Reference to the corresponding LOS.
- status: Current status (e.g., completed, in progress).
- startDate: Date when the instance began.
- endDate: Date when the instance ended or is expected to end.
- duration: Normal duration of the education, described in days, weeks, months, or years.
- gradingSchemeLocalId: Reference to the grading scheme used.

### result

- identifier: Unique identifiers for the result.
- loId: Reference to the associated LOI.
- grade: Grade or mark achieved.
- gradePointAverage: GPA, if applicable.
- pass: Indicates if the result is a passing grade.
- date: Date when the result was awarded.
- credit: The credits awarded for the specific result.
  - type: The type of credit system used (e.g., ECTS).
  - value: The numeric value of credits awarded.
- gradingSchemeLocalId: A reference to the grading scheme applied to this result.

### attachment

- type: The type of attachment (e.g., diploma, transcript, supplementary certificate).
- url: A link to the attachment file.
- title: A descriptive title for the attachment.
- description: Further details about the attachment.

### gradingScheme

- identifier: Unique identifier for the grading scheme.
- title: The name of the grading scheme, potentially in multiple languages.
- description: A detailed explanation of the grading system.
- grade: Lists the possible grades in the scheme.
- grade-value: The grade itself (e.g., "A", "B", "1.0").
- description: Explanation or interpretation of the grade (e.g., "Excellent", "Pass").

## 5.9 European Learning Model

The ELM allows for the record of information in a unified way. Information about learning opportunities and qualifications, including the description of qualification standards, can be used for course catalogues, training announcements and learning opportunity databases, allowing universally comprehensible data to be easily exported and described in the same way across borders.

### Courses

Co-financed by the European Union. The opinions and views expressed are however those of the author(s) and do not necessarily reflect those of the European Union nor those of the Spanish Service for the Internationalization of Education (SEPIE). Neither the European Union nor the granting authority can be held responsible for them.



Co-funded by  
the European Union

## Keys

- accreditationKey: Unique id for loq:accreditation in loq:accreditationReferences.
- agentKey: Unique id for loq:agent in loq:agentReferences.
- gradingSchemeKey: Unique id for loq:gradingScheme in loq:gradingSchemeReferences.
- groupKey: Unique id for loq:group in loq:groupReferences.
- learningAchievementSpecificationKey: Unique id for loq:learningAchievementSpecification in loq:learningAchievementSpecificationReferences.
- learningActivitySpecificationKey: Unique id for loq:learningActivitySpecification in loq:learningActivitySpecificationReferences.
- learningAssessmentSpecificationKey: Unique id for loq:learningAssessmentSpecification in loq:learningAssessmentSpecificationReferences.
- learningEntitlementSpecificationKey: Unique id for loq:learningEntitlementSpecification in loq:learningEntitlementSpecificationReferences.
- learningOpportunityKey: Unique id for loq:learningOpportunity in loq:learningOpportunityReferences.
- learningOutcomeKey: Unique id for loq:learningOutcome in loq:learningOutcomeReferences.
- organisationKey: Unique id for loq:organisation in loq:agentReferences.
- locationKey: Unique id for loq:location in loq:locationReferences.
- qualificationKey: Unique id for qualifications and qualification references in loq:learningAchievementSpecificationReferences.
- allAgentKey: Ensures uniqueness across loq:agent and loq:organisation.
- allLearningAchievementSpecificationKey: Covers loq:learningAchievementSpecification, loq:qualification, and loq:qualificationReference.

## Key References

- accreditationOrganisationKeyRef: Links an organisation to an accreditation.
- agentLocationKeyRef: Links an agent to a location.
- awardingOppLearningAchievementSpecKeyRef: Links awarding opportunities to learning achievement specifications.
- learningAchievementSpecHasPartKeyRef: Links parts of a learning achievement specification.
- learningActivitySpecSpecialisationOfKeyRef: Connects specialized activities to their original activities.

## Learning Opportunity

- identifier
- title
- description
- type

- additionalNote
- homepage
- supplementaryDocument
- temporal
- duration
- mode
- grant
- learningSchedule
- scheduleInformation
- admissionProcedure
- applicationDeadline
- priceDetail
- providedBy
- location
- learningAchievementSpecification
- learningActivitySpecification
- hasPart
- isPartOf
- bannerImage
- defaultLanguage
- status
- modified
- publisher

ELM proposes several vocabularies relevant of CC purposes:

- [ISCED-F](#) for subject areas.
- [Country Named Authority List](#) for countries
- [Currencies Named Authority List](#) for currencies
- [ESCO Occupations](#)
- [ESCO skills](#)
- [ESCO Skill Pillar concept reusability levels](#)
- [ESCO Skill Pillar concept types](#)
- [Europass Standard List of Accreditation Types](#)
- [Europass Standard List of Assessment Types](#)
- [Europass Standard List of Credential Types](#)
- [Europass Standard List of Entitlement Types](#)
- [Europass Standard List of Educational Credit Systems](#)
- [Europass Standard List of Learning Activity Types](#)
- [Europass Standard List of Learning Opportunity Types](#)
- [Europass Standard List of Learning Schedule Types](#)
- [Europass Standard List of Methods Of Supervision And Verification](#)
- [Europass Standard List of Modes Of Learning and Assessment](#)
- [Europass Standard List of Target Groups](#)

- [Europass Standard List of Verification Types](#)
- [EQF](#) and [QDR List of qualification frameworks](#) for levels of qualification
- [Language Named Authority List](#) for languages

## 6 Discussion

Table 1 shows a comparison of the main entities involved in CCs' specifications. As it can be seen, the most common entity is the Individual Educational Component, that is given different names, most of them variations of Course, but also learning offering or opportunity. The name given in the "ECTS User's Guide" (2015), Individual Educational Component, recognises the fact that some student stays may involve educational activities different than regular courses or subjects.

The second most repeated entity is referred to the Institution. This is used to describe the institution providing the courses. As it can be seen it is named in different ways: organization, provider, institution, etc. The information generally included in this entity is: identifier, name and means of contact (e.g. addresses, URLs, phone numbers). In some cases, the Organizational Units inside the institution are considered, such as faculties, departments, schools, labs, etc. The reason behind this is that in many institutions the courses are offered from such organizational units, that should be contacted in case of any question regarding the enrolment of students or the management of the studies.

The third most common entity is referred to Learning Opportunity Instance or Course Offering. This is related to the Individual Educational Component (IEC) concept, but a bit different. Maybe the clearest way to approach these two different concepts is the use of the terms specification and instance. While the specification describes an IEC in a broad way, considering the topics, objectives or effort required, the instance provides information regarding the implementation of an IEC in a specific year, such as the launch and finish dates, the teachers involved, the schedule, etc. The instance details usually change from academic year to academic year, while the specification data is kept stable along time.

The last common entity is the Programme. This makes sense as a CC should contain information about courses and courses are usually grouped into programmes. Therefore, the Programme entity refers to a programme of studies involving several courses. There are some variations regarding this entity. In the Edu-API specification the equivalent course aggregation entity is CollectionTemplate. In OOAPI there is another entity related to the Program that already appears in the table: EducationSpecification, referring to a set a set of Programs that can be provided by a certain organization. Finally, regarding programmes in some proposals it can also be observed the availability of Specification and Instance.

In addition to the previous issues, there are other topics that deserve attention also. In the case of OOAPI and IMS Edu-API, they identify an entity at a smaller level of granularity beyond course. For example, in IMS-Edu API this entity is the Course Component, as each one of the parts that made

up a course. In other way, some proposals have identified entities related to Academic Terms or Academic Sessions.

Finally, it is worth noticing in OOAPI the existence of Timeline entities which purpose is to save the different versions of the information along time. This is something that usually happens in real CCs, as the information may need to be updated for different reasons. In that scenario, the CC should keep the different versions of the information that could be accessed and used by students and staff.

*Table 1. Comparison of main entities in CC specifications*

ECTS	General Information	-	Resources and Services	Programme	Individual Educational Component	-
OCCAPI	Institution	Organisational Unit	-	Programme	Course	
OOAPI	Organization		-	Program	Course	Course Offering
IMS Edu-API	Organization			Collection Template	Course Template	Course Offering
PESC	-	-	-	-	Course Inventory Information	
XCRI-CAP	Provider		-	-	Course	
EWP	Institution/Organization Unit		-	-	Learning Opp Spec	Learning Opp Instance
ELMO	-	-	-	-	Learning Opportunity Specification	Learning Opportunity Instance
ELM	-	-	-	-	-	Learning Opportunity

## 7 Expected DACEM Interoperability Scenario

The DACEM CC is expected to act as a central repository and exchange hub for course-related information, enabling seamless interaction with various educational systems to promote interoperability, enhance student mobility, and streamline administrative processes. By adopting standardized data structures, vocabularies, and APIs, the DACEM CC ensures that course information can be accessed, shared, and utilized across multiple platforms and institutions. Its role is pivotal in fostering an integrated and efficient digital ecosystem for higher education in Europe. The key interactions with the existing systems are the following:



- **European Credit Transfer and Accumulation System (ECTS):** The DACEM CC aligns its course data structure with ECTS, including standardized credit values, learning outcomes, and workload descriptions. This ensures that courses are comparable and transferable across institutions. The expected outcome is enhanced transparency and recognition of credits, facilitating smoother academic mobility.
- **Erasmus Without Paper (EWP):** DACEM CC integrates with EWP to support the digital exchange of Learning Agreements, course data, and Transcripts of Records. It ensures that students participating in Erasmus+ mobility programs can access accurate course information for planning and credit transfer. The expected outcome are simplified mobility processes and improved data consistency for Erasmus+ exchanges.
- **European Learning Model (ELM):** DACEM CC aligns with the ELM to ensure interoperability with broader educational frameworks, supporting credential portability and lifelong learning initiatives. The expected outcome is a unified data exchange across institutions and sectors, promoting cross-border collaboration.
- **Open Course Catalog API (OCCAPI):** DACEM CC adopts the OCCAPI framework to publish and share course catalog data with other systems and platforms. It enables third-party applications, student information systems (SIS), and learning management systems (LMS) to access DACEM CC data in a standardized format. The expected outcome is an improved accessibility and discoverability of course information across platforms.
- **Postsecondary Electronic Standards Council (PESC):** DACEM CC leverages PESC standards for secure and interoperable data exchange, particularly for managing academic records and transcripts. The expected outcome is a consistent and reliable data exchange for credit recognition and transcript sharing.
- **eXchanging Course Related Information – Course Advertising Profile (XCRI-CAP):** By conforming to XCRI-CAP, DACEM CC standardizes the presentation of course marketing information, including descriptions, prerequisites, and delivery modes. The expected outcome is enhanced visibility and comparability of courses for prospective students and institutions.
- **Open Education API (OOAPI):** DACEM CC uses OOAPI to integrate with other educational data systems, ensuring compatibility with modern web-based technologies and enabling efficient data sharing. The expected outcome is a streamlined communication between DACEM CC and other digital platforms.
- **IMS Edu-API:** DACEM CC employs IMS Edu-API for managing and sharing data related to student records, course structures, and program information. The expected outcome is an enhanced integration with student information systems and support for multi-institutional academic programs.

Expected Interactions of DACEM CC with the other systems:

- **Data Exchange:** Share course information, including descriptions, prerequisites, credits, and learning outcomes, with other institutions and systems in standardized formats.
- **Integration with Mobility Tools:** Facilitate the exchange of Learning Agreements, Transcripts of Records, and inter-institutional agreements, ensuring smooth mobility processes for students.

- Cross-Institutional Collaboration: Provide a shared framework for institutions to collaborate on joint programs, ensuring consistency in course data and program structures.
- Enhanced Discoverability: Enable students to explore and compare courses across institutions through centralized platforms or public aggregators, improving decision-making and accessibility.
- Credential and Credit Recognition: Support the recognition and transfer of academic achievements by aligning with standards like ECTS, ELMO, and PESC.
- System Interoperability: Act as a bridge between different digital ecosystems, ensuring that data from DACEM CC can be utilized effectively by SIS, LMS, and other administrative systems.
- Support for Digital Credentialing: Enable the generation and verification of digital credentials and certificates through integration with systems like ELM and Europass.

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