EUROPEAN UNIVERSITY OF TECHNOLOGY

Deliverable 85

6.1.2 Digital tools and data architecture

6.1.3 Best practices

Réf :

Del. Rel. No : D 6.2
WP 6

Description: Development of a template to profile the digital tools and data architecture already in use at each institution, Identification of best practices in relation to existing common tools and systems-level platforms.

Comments:

EUROPEAN UNIVERSITY OF TECHNOLOGY

Livrable 85

6.1.2 Outils numeriques et architecture de donnees

6.1.3 Meilleures pratiques

Réf :

Del. Rel. No : D 6.2
WP 6

Description: Elaboration d'un modele permettant de dresser le profil des outils numeriques et de l'architecture des donnees deja utilisees dans chaque institution, identification des meilleures pratiques en rapport avec les outils communs existants et les plateformes au niveau des systemes

Commentaires:

Table of contents

1 Purpose of the document

Task 6.1 will lay the foundation for facilitating data exchange and ultimately digital systems interoperability by profiling the digital tools and systems already in use by members of the consortium.

This task will include (but is not limited to) defining a common Academic Exchange Information Standard (AIES), identifying existing commonalities and seeking a full exploitation of cloud and mobile technologies to facilitate data alignment and exchange in compliance with GDPR, working in cooperation with existing national and international organizations (e.g., GÉANT and its national counterparts).

Communications and information-sharing mechanisms will be agreed as part of this task, and the foundations of a shared data architecture will be established.

2 Objectif du document

La tâche 6.1 jettera les bases pour faciliter l'échange de données et, en fin de compte, l'interopérabilité des systèmes numériques en dressant le profil des outils et systèmes numériques déjà utilisés par les membres du consortium.

Cette tâche comprendra (sans s'y limiter) la définition d'une norme commune d'information sur les échanges universitaires (AIES), l'identification des points communs existants et la recherche d'une exploitation complète des technologies cloud et mobiles pour faciliter l'alignement et l'échange de données en conformité avec le GDPR, en travaillant en coopération avec les organisations nationales et internationales existantes (par exemple, GÉANT et ses homologues nationaux).

Des mécanismes de communication et de partage d'informations seront convenus dans le cadre de cette tâche, et les bases d'une architecture de données partagée seront établies.

3 Workpackage context and aims

Main tasks are:

- Definition of AIES to fluidify exchange and exchange of most data, even if they are operated by different systems or if they have to be upgraded. This will include: lists and grades of teaching followed by students (transcripts), learning outcomes, logical flows for validating curricula, accounting of teaching activities, etc. (such a standard would guarantee a general compliance with GDPR, that is more difficult with various heterogenous practices and spread databases)
- Establishment of agreed communications and information-sharing mechanisms across the partners, building on the practices established during preparation of the EUt+ application.
- Development of a template to profile the digital tools and data architecture already in use at each institution, followed by a mapping exercise to outline the foundations for the eventual convergence of EUt+ information systems and the facilitation of data interchange.
- Identification of best practices in relation to existing common tools and systems-level platforms and sharing of their use across the consortium in support of the aims of EUt+.

All this must contribute to create a data structure that will then open the way to "digital twin" type tools allowing a better efficiency in the management of complex systems, as a European University will be.

2.1 Specific goals of the 6.1.2 and 6.1.3

The goal is to develop a template to profile the digital tools and data architecture already in use at each institution, and the identification of best practices in relation to existing common tools and systems-level platforms.

Thus, this document will contain a description of all mandatory data fields in a student ‘s record and an overview of the most commonly used protocols for data exchange, and recommendation of the one to be implemented by EUt+ partners.

4 Methodology

In a first part we will go back to the study of the data we have in common between the different partners and then how to manage the differences in order to create a template.

We will then compare 2 solutions already used for data sharing and which could be used as a basis for the EUt+ programme: XHEIE and Erasmus+.

The applied methods during the common work include: on-line discussions via video meetings, on-line discussions and document exchange and sharing in Whaller platform.

5 Data exchange

The most vital information related to an EUt+ student's record is identified as a template comprised of the following data:

- Type of major - bachelor/ master
- Year of enrolment - 2020, 2021 ...
- Sex
- Country
- Personal ID number
- Date of birth
- Permanent Address
  - country
  - county (area)
  - city
- Mobile phone number
- Course (year of study)
- Enrolment semester (1, 2, 3, ...)
- Background education (secondary or other university/college)
  - type of school
  - name of school
  - city
- First name
- Second name
- Surname
- Curriculum
  - subject name
  - subject semester
- Grades and certifications (certification for being present at lectures and exercises)
  - grade for each subject (course projects on a separate row)

- certification for each type of class (lecture, seminars, labs, course project) of each subject

- Health insurance related data

Not all data is available at all partners. Any missing information will be substituted by blanks.

6 EMREX

6.1 Goal of EMREX

The purpose of EMREX, with its electronic data exchange solution, is to empower individuals to control their own student data and exchange throughout lifespan, across borders for various purposes.

EMREX can be used in several ways: by mobile students who want digital transfer of their achievement records from abroad, by individuals applying for education in other countries, by individuals who want to share their achievement records with others.

6.2 Members of EMREX

The main participants are Croatia, Denmark, Finland, Germany, Greece, Italy, the Netherlands, Norway, Poland, and Sweden.

7 Technical approach of EMREX

7.1 The EMREX network

Each country has two roles in the EMREX network:

1. Provide the student with application(s) that allow them to fetch their result from another HEI, either in the same country or from abroad. This will later on be referred to as the EMREX Client and includes the functionality in the Student Mobility Plugin (SMP)
2. Provide national client(s) with functionality to fetch assessments (results from courses, qualification) from the databases containing this information. This will later on be referred to as the National Contact Point (NCP).

7.2 EMREX decentralized system

There is no major component that each country can reuse. The EMREX project does provide some modules, plugins and examples that can be used and built upon, however there are a couple of issues that cannot be solved in a general way:

1. Authenticating a student.

Each country has their own way of authenticating a student in their system. Therefore, the EMREX project cannot make a complete login module and distribute this, as each country solves this in different ways.

2. Fetching results for a student.

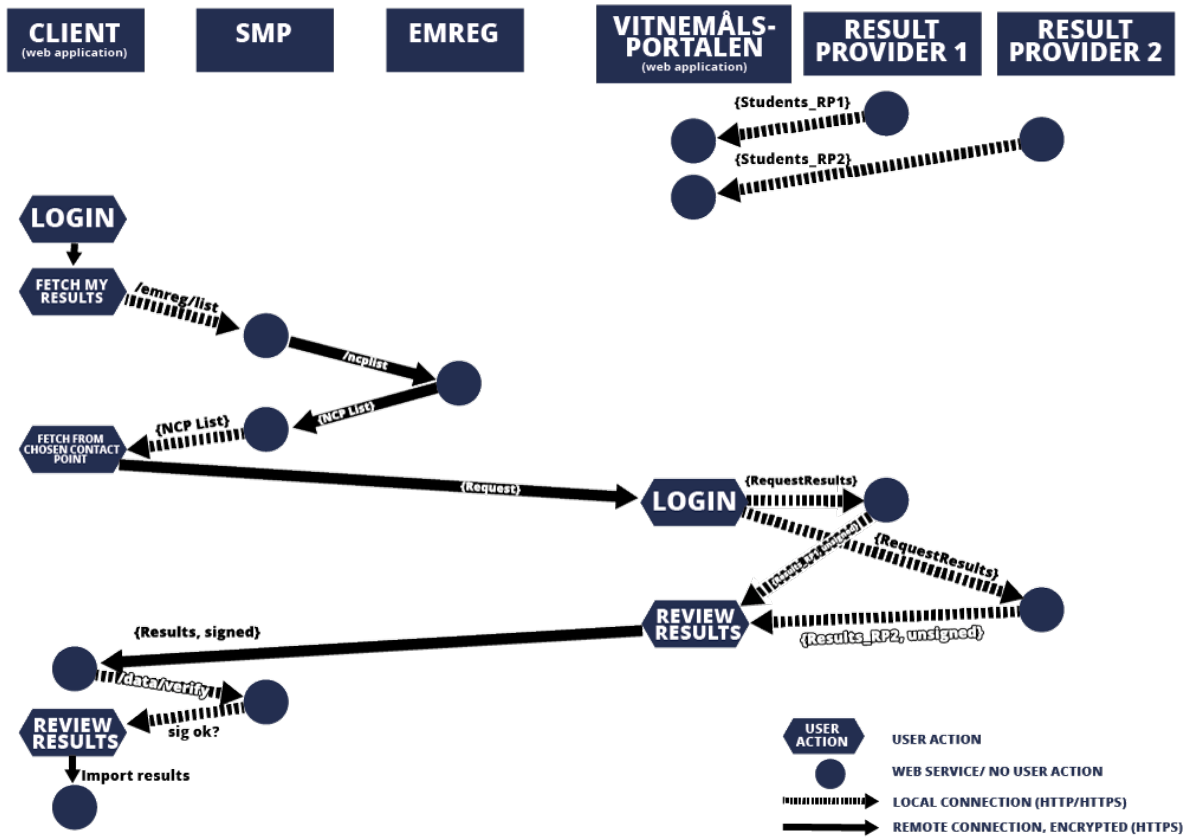
Each country/HEI has their own student information systems. The EMREX-system is dependent on connecting to an existing solution that can fetch results for a given HEI. The preferred solution is to build a REST service for each student information system involved, that provides ELMO formatted data.

3. Storing results for a student.

Each country/HEI has their own student information systems. So, there is no standard way of storing the result data the EMREX fetches into the existing student system. When the EMREX client returns a set of results for a student, these must be stored in some local system, as EMREX does not store the data in itself.

7.3 EMREX architecture

The following diagram shows in detail the data flow for a student wanting to import results from two different result providers (for instance, higher education institutions) in the same country.



Legends:

- **SMP (**Student Mobility Plugin). Client library with helpful methods that the client can use to join the EMREX network. Can also be run as a standalone application, providing you use a REST service for contacting EMREG. In addition, the library contains a method for verifying digital signatures, which can also be called as a REST service.
- **EMREG**: This is a central registry the EMREX uses to fetch the data that is needed to complete the result transfer. This is also the only centralized component in the EMREX system.
- **EMREX Client**: This is the web application that the student uses to initiate the transfer of their results from another country. (Could be integrated into the HEI SIS, i.e., work needed by the HEI)
- **NCP (National Contact Point)**. This is the point that the EMREX client contacts to fetch results.

- **Results Services**: These are the services that are used by the NCP to fetch the results for the students. If you have an existing system that handles this, the NCP can simply connect to this. However, if none exist, there may be a major job to implement this.

It is up to each implementer to decide whether the SMP will run as a standalone service or embedded into their client. The EMREX project provides a SMP library which can be used out-of-the-box as a standalone service.

The same remark applies to the result provider(s), the implementation is very much dependent on the underlying system(s).

7.4 The ELMO XML format

The ELMO XML format is the basis for the exchange of result information. Elmo is based on the CEN standard EN 15981-2011 EuroLMAI. EuroLMAI is a data model describing assessments, primarily Diplomas, Diploma Supplements and Transcripts of Records for higher educations. The schema describing the profile of the ELMO format used in EMREX is available the EMREX GitHub repository.

8 X Higher Education Institution Exchange (XHEIE)

8.1 Goal of XHEIE

XHEIE is a standardisation project of the state of Saxony-Anhalt and the Federal Ministry of Education and Research (Germany).

The goal is to standardise student data exchange in the national higher education system so that the necessary interoperability between higher education institution systems (called Campus Management Systems) can be established for the media-consistent processing of future digital administrative services. To this end, a procedure that has been tried and tested in other standardisation projects can be found here and is described as follows:

1. A standardisation strategy is developed and coordinated
2. The Standardisation requirements are formulated and submitted to the German IT Planning Council (33rd meeting)
3. Together with higher education institutions, ministries of science of the federal states, manufacturers of specialised procedures and other

stakeholders, the requirements for standardisation were collected in the project's internal ticket system.

4. The processing of the requirement is provided iteratively in the form of a publicly accessible specification with PDF documentation and machine-processable files (XSD, XML).

To improve connectivity to others, especially international systems, domestic and foreign efforts are taken into account, and information about the work of XHEIE is provided within the framework of the standardisation dependent and parallel running projects are also designed in a coordinated manner.

As a result, a specification will be drawn up to provide higher education institutions with information on how data communication between higher education institutions is regulated. The specification is in the digitisation context so that it is no longer the students but the data that runs from higher education institutions to higher education institutions.

The basis for this project is the Online Access Act (DE: Onlinezugangsgesetz) (short: OZG), which came into force in August 2017. The OZG obliges all German public authorities and higher education institutions to digitally offer their administrative services to citizens and students by the end of 2022.

8.2 XHEIE specifications example

This is an example for applicants/students' data exchange. The following data is needed for an interface (already used in Germany).

Approximately three categories of data are needed to import a student applicant. Pre-study periods are optional here.

1. Address data

Ident number or applicant number, street, co addition, country, postal code, city, telephone, e-mail

2. Request data

Applicant number, university number (destination university), request number (if necessary, several requests/subjects), subject code, degree, subject, specialization, type of study, form of study, semester of study, entrance qualification type, entrance qualification grade, entrance qualification date, entrance qualification country, entrance qualification city

3. Application data

Applicant number, semester, last name, first name, birth name, place of birth, date of birth, gender, state

Data is contained in a ZIP file consisting of text files with the following contents:

anschri.dat: Address and contact data of applicants

antr.dat: Request data of applicants

antrausl.dat: additional information for foreign applicants' data (applicants from EUt+)

bew.dat: Procedure relevant data of applicants

email.dat: E-mail addresses of applicants

phone.dat: Telephone numbers of applicants

Technically, the files are semicolon separated files and a person can have one application and several requests/subjects.

9 Erasmus+

9.1 Goal of Erasmus+

The program aims to give students, trainees, staff, and generally young people under the age of 30 with or without a degree, the opportunity to go abroad to strengthen their skills and increase their employability.

It helps organizations work in international partnerships and share innovative practices in the fields of education, training, and youth. Erasmus+ also has an important international dimension, particularly in the field of higher education. This dimension allows the program to be open to institutional cooperation activities, youth, and staff mobility, and this at the global level.

9.2 Members of Erasmus+

Erasmus+ is open to a number of countries across Europe and beyond. The following countries, including the Overseas Countries and Territories of EU Member State countries, can fully take part in all Erasmus+ actions: Austria, Belgium, Bulgaria,

Croatia, Cyprus, Czech Republic, Denmark, Finland, Germany, Greece, Hungary, Estonia, France, Ireland, Italy, Latvia, Lithuania, Malta, The Netherlands, Spain, Sweden, Poland, Portugal, United Kingdom

9.3 Erasmus Without Paper (EWP)

The EWP initiative uses the latest digital technology to digitalise the administrative framework that underpins student mobility in Europe, enabling electronic data exchange and interoperability among diverse information systems and manage mobilities of Erasmus+ more efficiently. This allows Higher Education Institutions (HEI) to exchange information in the context of student mobility swiftly and securely. In doing so EWP supports replacing paper-based workflows by digital ones.

EWP originated as a European project funded through Erasmus+ KA3 from 1/11/2015 till 30/10/2017 and again from 1/1/2018 till 31/12/19. It has now matured into an operational Network. In March 2019 the European Commission announced that the use of EWP will be made mandatory from 2021 as part of the next Multi-annual Financial Framework (MFF) i.e., the next Erasmus programme. This was confirmed and elaborated in the Erasmus goes digital webinar on 5/3/2020.

EWP consists of two chief components:

- the **EWP Network** that interconnects a multitude of student information systems (whether individual universities or third-party providers which represent multiple institutions) through the use of APIs (i.e., connectors between the Network and the users)
- the **Dashboard** that provides a web solution for exchanging student data electronically for HEIs lacking the required SIS software.

10 Erasmus Without Paper

10.1 Joining the Erasmus Without Paper

EWP allows your Higher Education Institution (HEI) to digitalise their Erasmus+ mobility management processes. The main principle behind EWP is that you keep using your existing system for managing student mobility and that this system is connected to the EWP network. Instead of printing a PDF or a paper copy of e.g., an Inter-Institutional agreement or a Learning Agreement, you will be able to sign the "documents online" and send them directly via your software system to your partner institution which will also digitally sign them.

10.2 The different scenarios and infrastructure

- Erasmus Dashboard: This is the tool developed by the EWP consortium that can be used for mobilities data and exchanging IIAs and OLAs
- Commercial mobility software: This can be commercial software or be provided by a consortium (public or private) to which your institution belongs. For example: CINECA's ESSE3 in Italy, MUCI's USOS in Poland, QS unisolution's MoveOn, SIGMA in Spain, SOP's Mobility-Online, Unit's FS in Norway
- In-house built mobility software: This is a piece of software created by (or specifically for) your own institution and entirely managed by your IT department.
- No tool: If you are using no specific software to manage your mobilities, you will need to start using one to connect to the EWP network and start exchanging Inter-institutional Agreements (and later on students' Learning Agreements) with your partner institutions.
- A combination of systems

10.3 Explanation of the general mobility process

The Erasmus+ mobility for studies entails a whole set of processes that facilitate such mobility. Oftentimes in this process communication is needed between the sending (or home) HEI and the receiving (or host) HEI. In general, one can describe the mobility flow as follows (sometimes steps are repeated/ordered somewhat differently):

- HEIs need to sign an Erasmus+ institutional agreement

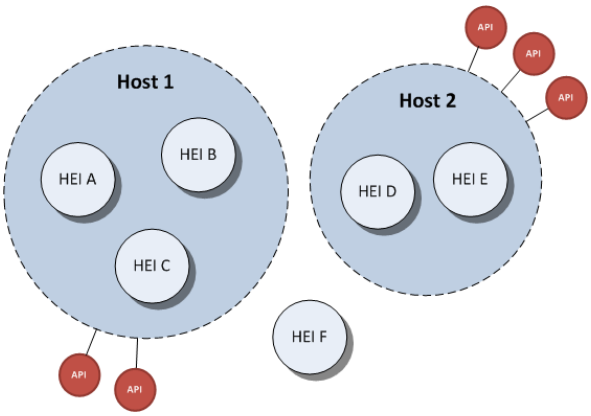
- Sending HEI nominates the student at the receiving HEI
- Learning agreement needs to be worked out and signed by three parties (student, sending HEI, receiving HEI) before departure
- Student arrives at the receiving HEI and receiving HEI needs to confirm the date of arrival
- Learning agreement might change. If so, it needs to be signed by three parties (student, sending HEI, receiving HEI)
- Student departs from the receiving HEI and receiving HEI needs to confirm the date of departure
- Receiving HEI sends TOR to sending HEI

For each of the steps that require communication (or data exchanges) between the sending HEI and the receiving HEI EWP comes into play. The processes above are translated into technical so-called APIs (Application Programming Interface) that facilitate system-to-system communication, allowing users to manage their part of the process in their own system and use the EWP network whenever confirmation/approval/signatures are needed from the partner.

11 Technical approach of EWP

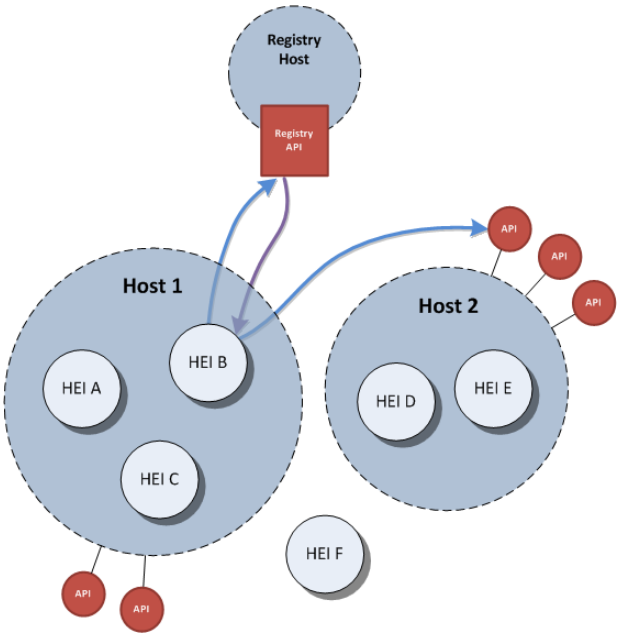
11.1 API approach

Apart from covering some HEIs, EWP Host also implements some APIs (for the HEIs it covers). EWP Hosts are not required to implement all features of the EWP Network. Each host can implement a different set of APIs. They can also expose APIs unrelated to EWP (we do not enforce any requirements on such APIs).



11.1.1 The registry service

The Registry Service is the only centralized part of the EWP architecture. It allows all EWP hosts to access the list of other EWP hosts, and to list APIs implemented by these hosts, along with the URLs these APIs are implemented at. (It MAY also be used for projects unrelated to EWP, as long as these projects have similar architectures.)



HEI B calls the EWP Registry Service. The Registry Service keeps track of all the HEIs and their APIs. Given the Registry response, HEI B is now able to determine which URL it needs to call in order to get the data. (In our simple case, this URL will be served by Host 2.)

Non-anonymous requests in the EWP Network are performed with use of client credentials. Each set of client credentials is connected with a group of HEIs.

11.2 EWP mobility process

11.2.1 Accessing information on institutions

The following APIs allow the members of the EWP Network to discover basic information on institutions and organizational units covered by other EWP partners:

- **Institutions API** - provides information about the HEI, e.g., its address, contact persons, logo image, list of organizational units, etc.
- **Organizational Units API** - provides very similar types of information as the Institutions API does, but on the department/faculty level. Quite often, organizational units will have a tree structure, with the HEI in the root of that tree.

IROs also exchange so-called fact sheets about their institutions - "business cards" in a nice, printable format. The documents should contain all information the

incoming student should know. Fact sheets may be exchanged in the EWP network in two ways:

- **Institutions API and Organizational Units API** provide a link to a current version of a fact sheet (in HTML or PDF format), stored in the information system of the institution. The partner HEI can obtain such a link and display it for their students in the local system. Each institution should keep its fact sheets up-to-date.
- **Mobility Factsheet API** delivers a fact sheet in a structured form compliant with the IIA template, prepared by the European Commission, defining requirements for Interinstitutional Agreements. In this case the partner HEI is responsible for obtaining the latest version of the fact sheet via API on demand and displaying its content in the local system.

11.2.2 Handling Interinstitutional Agreements (IIAs)

All HEIs taking part in the mobility process sign IIAs with each other. According to requirements of the EC these agreements have to be processed via the EWP network, fully electronically. Signed paper versions are neither needed nor recommended.

- **Interinstitutional Agreements API** is implemented by IIA partner HEIs. None of these HEIs is the "master" of the IIA, all HEIs are "equal". HEI A can access all IIAs related to HEI A stored on HEI B's servers. Each partner uses his own ID for the IIA, so partners will need to manually "bind" their local agreements with their remote counterparts (by storing the remote partners' IIA IDs) before they will be able to compare them. HEIs can negotiate details of the agreement outside EWP or using IIA API and IIA CNR API. These APIs enable HEIs to find possible inconsistencies in their IIAs and synchronize them. A partner can also peek on draft IIA proposals published by the other partner without actually storing them on his own server.
- **Interinstitutional Agreement CNR API** allows HEIs to get notified whenever any IIA (related to them) is updated on the other HEI's servers.

IIAs need not be formally signed with qualified electronic signatures. However, HEIs need an official partner approval of their versions of the IIAs. The approval process is supported by two other APIs:

- **Interinstitutional Agreements Approval API** is used to approve agreements sent by their partners in the Interinstitutional Agreements API. If HEI B wants

to approve agreements obtained from HEI A (more precisely: partner's copy of the agreements) should send HEI's A iia_ids of the approved agreements in this API.

- **Interinstitutional Agreement Approval CNR API** allows HEIs to get notified whenever any IIA approval (related to them) is updated on the other HEI's servers.

11.2.3 Student mobilities

Each mobility can be looked at from two different perspectives:

- **The outgoing perspective** - this is how the mobility looks like for the sending HEI. The Outgoing Mobilities API is used for serving information which we (EWP designers) chose the sending HEI to be the master of. If the receiving HEI wants to change some of this data, it needs to "ask" (e.g., via a phone call, or - if applicable - via an API call).
- **The incoming perspective** - this is how the mobility looks like for the receiving HEI. The Incoming Mobilities API is used for serving information which the receiving HEI is the master of (and the sending HEI news to "ask" to change that).
- Obviously, your own incoming mobility is your partner's outgoing one
- **Outgoing Mobility CNR API** and **Outgoing Mobility Learning Agreement CNR API** are implemented by the receiving institution and allows it to receive live updates when outgoing mobilities are changed. Partners SHOULD NOT rely on always receiving these notifications.
- **Incoming Mobility CNR API** and **Incoming Mobility ToRs CNR API** are implemented by the sending HEI and gets called by the receiving HEI when their own "master part" of the mobility gets updated.

In EWP, the sending HEI is the master of most of the student mobility data. The receiving HEI often keeps its own "slave" copy of this mobility data, but it is the sending HEI who is actually required to have it recorded.

The EWP mobility exchange file (xml format), this is not a web service. It is a file format, which can be exchanged by other means (such as email). It establishes a common format for exchanging mobility data, in a form strictly compatible with EWP Outgoing Mobility objects. Can be useful when moving mobility data from one institution to another (e.g., when migrating from other workflows to the EWP workflow). https://github.com/erasmus-without-paper/ewp-specs-fileext-ewpmobility.

11. Recommendations

Based on the above research, the working group of WP6 suggests that EWP should be implemented in EUt+ for the exchange of students' data specified by the template.