EMREX and EWP offering complementary digital services in the higher education area

Janina Mincer-Daszkiewicz (jmd@mimuw.edu.pl), Faculty of Mathematics, Informatics, and Mechanics, University of Warsaw, Banacha 2, 02-097 Warszawa, Poland

1.   ABSTRACT

EMREX (*Field trial on the impact of enabling easy mobility on recognition of external studies*) [1, 3] and **EWP** (*Erasmus Without Paper*) [2, 4] are two European projects funded by the *Erasmus+ Programme, Key Action 3*, running almost in parallel (2015-2017) and having some partners in common. EMREX is part of *Prospective Initiatives — European Policy Experimentations,* EWP part of *Prospective Initiatives — Forward Looking Cooperation Projects*.

For those looking at them from the outside their goals seem to be similar — the electronic exchange of student data among higher education institutions (HEIs). Both projects are very active in the *European Higher Education Area*, offering the digitalization of services which are now handled on paper, searching for solutions to problems of data availability, data privacy, and secure data transfer, looking for new partners (also from outside Europe), and planning to apply for extension in the new Erasmus+ call (March 2017).

If you are a higher education institution, interested in the digitalization of data exchange and the improvement of mobility processes, which of the two projects should you join? Is the effort involved doubled? Extending the IT services of your institution is a tempting but usually expensive decision to make. You should have good arguments to convince your superiors. Also, if you are to gain from digital data exchange, your partners in mobility should make the same decision. Should you join the pioneers or rather wait for the others to go first and eventually follow? Can you believe that the results of the projects will last longer than the end of 2017, at this moment the official end of Erasmus+ funding for both projects? Can you trust that what EMREX and EWP have to offer will make a real change in the digitalization of services in the higher education area in Europe and beyond?

In this paper we ask some provocative questions and offer guidelines for higher education institutions who look for realistic answers. In particular, the paper contains the thorough comparison of the aims, approaches and challenges of both projects and concludes with some practical advice on their dissemination and sustainability.

2.   INTRODUCTION

The rapid development of digital technologies is changing the ways universities conduct research, provide teaching, and — last but not least — carry out their administrative tasks.

The internationalization of higher education results in increased mobility and cross-border cooperation — a target has been set by European higher education ministers to increase the number of students completing a period of study or training abroad to at least 20% by 2020. According **to** the 2011 EU Agenda for the modernization of Europe's higher education systems, sectoral priorities should involve "*improving the recognition of diplomas and credits or portability of grants through comparable and consistent use of ECTS and the Diploma Supplement, and linking qualifications to the European Qualifications Framework*". Students acquire education in the global education market and expect that the obtained diplomas and credits will be recognized everywhere.

EMREX and EWP are IT projects which incorporate digital technologies into services supporting internationalization and student mobility.

EWP and EMREX evolved from the early initiatives of the RS3G (*Rome Student Systems and Standards Group*) — an international group of higher education implementers focusing on data exchange standards (https://www.usos.edu.pl/Mobility/).

EMREX's main focus is on a student as the owner of the data and the main beneficiary of a smooth and easy recognition. EWP's focus is on the administrative officers in HEIs who every day bear the burden of making internationalization a reality in practice. Both projects implement services to exchange data electronically and deliver it on time where it is needed.

System integration may be achieved in different ways. There are well-developed technologies and tools supporting electronic data transfers. But up to now, there have not been many successful examples of integration in the higher education area. Both projects are pioneering in the integration — on a global scale — of **Student Information Systems** used in higher education to handle student data.

In the next chapter we describe in detail how EMREX and EWP integrate Student Information Systems of higher education institutions by building a common electronic platform offering digital services.

3. DIGITALIZATION OF SERVICES BY EMREX AND BY EWP

The EMREX project started on January 1st 2015 and lasts for three years. The project is coordinated by CSC Finland, there are 8 full partners. The EWP project started on November 1st 2015 and lasts for two years. The project is coordinated by Ghent University and there are 11 full partners and 11 associate partners (from all over Europe, and the US). There are four partners which take part in both projects.

Both projects aim at the digitalization of data exchange. Let us have a closer look at what that means exactly.

3.1. EMREX business scenarios

EMREX is based on the observation that a student is the owner of his study records. Data exchange is thus initiated by the student. The first implication of this student-centered approach is that the student has to use some web interface and also that the student should be recognized and authorized, i.e. have an active account in the system from which the data is taken. In the EMREX field trial, one finding was that in some countries it is, however, quite common that institutions invalidate student accounts shortly after they finish their studies. Accounts may last a couple of months after leaving, but are rarely valid indefinitely. The problem is even more significant in case of students coming to institutions for short term studies. A move towards more electronic services for mobile students will thus require a change in culture in the way HEIs regard the students and lifelong learning, or another way of identifying a person within the EU. Projects like **eID** (*electronic identity*) or **ESC** (*European Student Card*) may help to solve this but changing the culture can sometimes be a long process even if the technical solution is ready. The issue should be raised wherever and whenever possible to influence the changes.

The basic scenario tested in the EMREX field trial is the following. A student finishes his short term studies in a receiving institution and returns to a sending institution. The student wants to transfer achievements — logs into the local SIS (*Student Information System*) or student portal, chooses the receiving institution from the presented list (the local SIS obtains it from the **EMREX registry**, see Figure 1, which stores all the necessary binding information), is redirected to the system of the receiving institution, logs in again with the credentials from the receiving country. After approving data for export, the student is redirected back to the SIS of the sending institution.
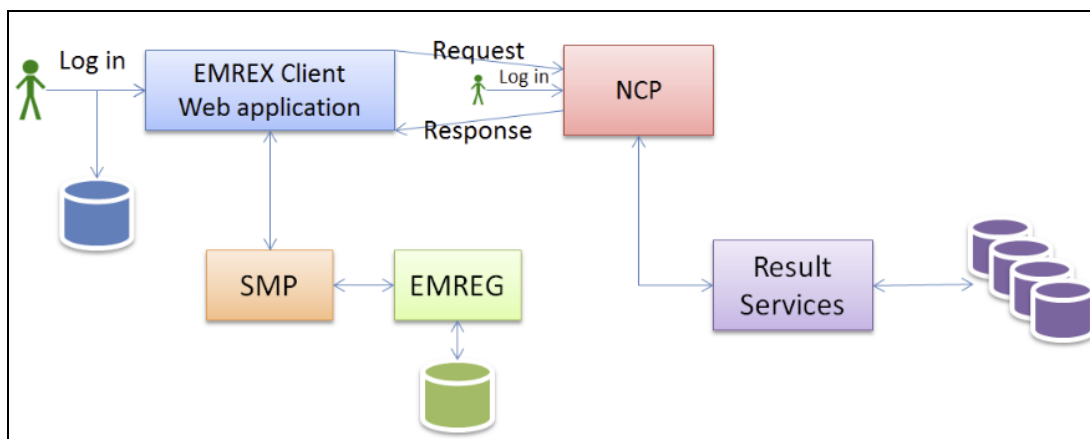
Figure 1 Main components of the EMREX network (from resources of the EMREX project)

There is one very important aspect of this scenario. Privacy is not an issue since it is the owner of the data — the student himself — who initiates the transfer and thus the receiving HEI or national data warehouse can freely give the data without any need for formal agreements between the HEIs or countries. The data is securely delivered to the local system/administration as it would be delivered on paper but is already available in an electronic form. It is the decision of the sending HEI based on the local recognition process, if the data needs to be further approved by the administration (staff of the student office) or be automatically incorporated into student records and recognized as official achievements.

Automatic recognition seems to be an attractive option but there are many open issues. Currently automatic recognition can most easily be used for national cross-studies, or in the case when courses from another institution are directly recognized during the process. A key issue is again the cultural background as in some HEIs it is part of the academic tradition that the final decision on recognition belongs to the local professors who base it on their subjective judgment. There is also an issue of grade conversion. It could be based on the *European Grade Conversion System* (**Egracons**) or on the course grade distributions calculated separately for each course and sent with the student achievements. Some HEIs offer such information in their transcript of records. Unless grade conversion is fully integrated with the data transfer, it cannot be the basis for automatic recognition, which in many cases makes it non-practical. This issue at the moment is beyond the scope of the EMREX data transfer scenario.

For the Erasmus exchanges, if the data transferred is a student's transcript of records, then in order to be fully recognized it should first be matched with the learning agreement which was signed before the short term mobility took place. This may be difficult if the courses from the receiving institution are not uniquely identified in the Student Information System of the sending institution. Sharing course catalogues between partners in mobility may help to solve this problem but needs more tightly coupled cooperation.

EMREX transfers data in an XML format with PDF included. XML gives access to structured data which may be further processed by the local system, whereas PDF provides a visual representation consistent with other documents issued by the same institution, to be displayed and printed. XML is signed with the system certificate.

It has not yet been decided if/how PDF should be signed. Also in this area there are differences in local regulations and requirements in different countries. What type of digital signature is legally valid? In Poland it should be a qualified certificate of a staff member who would otherwise sign a paper version of the document. Such signature cannot be obtained in real-time. A student might request such a document, but he would be required to wait until the qualified user signs it. Only then the data can be obtained. PDF signed with the qualified certificate is legally equivalent to the paper version signed by hand so it can replace it in any further process. The student can store it on a local computer and send it where needed. The digital signature is available for inspection in many common tools, like Acrobat Reader. To further enhance digital services for students also this area would benefit from common agreements.

Data is transferred through secure channels on its way from one place to the other so they cannot be tampered with. There is, however, one weak point from the security point of view. In our basic use case a student is supposed to log into the system from which the data is taken and also again into the system the data is transferred to. How can we be sure that in both cases this is the same student as the student will most likely have been given another local identity in the receiving country? Currently systems check some of the data, such as student's name, surname, date of birth. If the data do not match it is up to the local system to decide on the action to be carried out. In an extreme case the data can be rejected, on a less extreme level the local system can tag the data as needing further verification, e.g. a manual check. The local system should then present the data to a person authorized to approve them. In such a case full automation is not possible. The EU's eIDAS Regulation (Electronic Identification and Signature) and ESC might help in the future in this area.

EMREX uses the EMREX ELMO 1.1 data format (https://github.com/emrex-eu/elmo-schemas). ELMO has a hierarchical structure and focuses on learning outcomes which consist of other learning outcomes. Currently recognizable learning opportunities are degree programs, modules, courses, but others are also possible. That means that EMREX may also be used to transfer information about degree programs. That scenario is already carried out in Norway as part of the admission process. There is a plan to run a pilot with DUO in the Netherlands for sending data from a repository of diplomas stored by DUO for Dutch students to wherever those diplomas are needed to verify student credentials. In this scenario again a student should initiate the data transfer.

Diplomas and diploma supplements are also of interest when students apply for jobs. A student may transfer information about his achievements from the repository of diplomas, i.e. the home institution or some national repository, to the job portal.

A joint, multiple or double degree is a degree including courses where students have followed a joint program and done their studies in two or more institutions in two or more countries. A joint degree means the participating institutions divide the courses needed for a degree. In the case of double degree or dual degree the institutions provide an opportunity to get two degrees in a streamlined way so that the time needed is less than getting the degrees separately. In all these cases the degree certificate or diploma supplement must present all courses that are included in the degree and help to fulfill the degree requirements. As of today many countries manage this process manually and signed originals are often a must as a basis for transfer. The process for the student to receive the transcript and to deliver it to the home institution and the process for the administrator to register the results in the local study documentation system are both time consuming.

EMREX may facilitate the administrative processes around issuing joint, multiple or double degrees.

On a student's demand EMREX can transfer all data available from the original transcript digitally to the home institution where it can be downloaded directly into a certificate or diploma supplement. The secure verification process means that no original papers will be of use and the administration can be fast and minimized.

Last but not least, data on student achievements are most probably taken from the system where student records are stored — being it a Student Information System of the institution(s) where the student carried out part of his studies (like in Norway, Denmark or Sweden) or some aggregated data repository which stores data obtained from various higher education institutions (like in Finland). On the one hand having a national repository should help to implement data delivery, on the other such repositories may lack some required data. For example in Finland the VIRTA national database contains the achievement records but at the moment e.g. lacks data on course enrollment, course description, or diplomas, which could be needed for some other mobility processes. Also, a student needs to have the national identification number (Hetu) to have his data transferred to VIRTA (which is not always available for foreign students). There is also a question of data availability. Data is first stored in the SIS then transferred to the central repository. Depending on the process, that may have an impact on timely data availability.

To sum up, EMREX may be in use whenever students decide to transfer information about their learning outcomes from the institution where these have been achieved as long as they are stored in a digital form. They can then be sent to the institution or another system/process where they are needed — also in a digital form — to validate student credentials. Whatever is later done with the data in a target system is not part of EMREX. In particular the administration is not directly involved in the EMREX-supported scenarios.

3.2. EWP business scenarios

EWP is mainly focused on supporting the HEI administration for student exchanges (through Erasmus or in another way). Data handled by the administration is gathered in the database of the Student Information System. The mobility data is either stored in the same system in the so-called mobility module or in the stand-alone mobility application (which may involve commercial software). The main stakeholders of the basic EWP scenario developed for the pilot, are staff members of the International Relations Offices responsible for the Erasmus+ program and/or other exchange opportunities. The scenario starts with signing interinstitutional agreements between institutions of higher education. The agreements specify the number of mobilities (for students, lecturers, researchers), the types of mobilities (study, internship, lectures, research) and much more. These data need to be stored in both institutions to be used to control the mobility process.

Institutions exchange fact sheets which contain basic information on the institution or a specific organizational unit for people coming from abroad (or just considering arrival), e.g. e-mail addresses and internet contacts, language requirements, ECTS requirements, grading system, support related to visa and insurance. Data embedded in fact sheets can have a structured form which enables further electronic processing or be combined in one PDF document which can be posted on the partner institution's web page without further processing.

Every semester students are nominated for an outgoing mobility period. Nominations are prepared by the sending institution but need approval from the side of the receiving institution. In particular the number of nominees cannot exceed the value agreed in the interinstitutional agreement. The receiving institution can either accept or reject the list of nominations.

The nominated students should negotiate a study program with the receiving and sending mobility coordinators and then sign a learning agreement (LA). Access to the course catalogue is needed for this process. It is quite common that the learning agreements change before and during the mobility (which is already reflected in the official format of the LA document) so supporting the automatic change notifications helps to govern the process and lower the involved administrative burden.

The receiving institution should send a transcript of records with the student's achievements to the sending institution after the study period. This process, even if started by the receiving institution, may on the technical level be carried out in the same way as in the EMREX scenario. The ELMO file contains information on courses, credits, grades and grade distributions. The PDF version of the document included in the XML file may be signed with the personal qualified certificate of the person triggering the data transfer from the SIS of the receiving institution.

Student stipends are calculated on the basis of the length of the study period which is calculated from the arrival and departure dates to/from the receiving institution. These dates are sent on demand from the receiving to the sending institution.

EWP is based on APIs (*Application Programming Interfaces*) — a set of clearly defined methods of communication between various software components used to build applications. The API describes the expected behavior and may have multiple implementations. There are many APIs supporting the EWP business model:

- Primary Network APIs (Discovery Manifest, Echo, Registry),
- General Purpose APIs (Institutions, Organizational Units, Courses),
- Erasmus Mobility APIs (Interinstitutional Agreements, Outgoing Mobilities, Outgoing Mobility Change Notification Requests, Nominations Approval, Mobility Arrival and Departure, Transcripts of Records).

The specifications of the APIs are publicly available in GitHub (https://github.com/erasmus-without-paper). The page https://developers.erasmuswithoutpaper.eu/ is a guide for developers and should be visited first.

EMREX is implemented as one API.

The EWP business scenario is much more complex than the EMREX business scenario since it covers the whole Erasmus+ mobility process from the start to the end. There are many APIs, but each of them is relatively simple and can be implemented separately from the others. This is an important

observation since it means that APIs may be implemented one by one gradually building support for the whole process.

EWP may need some user interface to start processes in one institution but the APIs invoked may be handled automatically on the other side without human intervention although most often at some moment the workflow will involve humans.

Both partners — the sending institution and the receiving institution — may start the process. There are APIs for sending (pushing) data and for requesting (pulling) data in response to change notifications. In theory, it is possible to handle EWP data exchange fully automatically by subscribing to notifications and firing triggers when they come.

For example the institution which changes data incorporated in the institutional fact sheet might broadcast the change notification to all subscribers — partner institutions which subscribed to this particular change notification. The obtained new version might be accepted automatically, stored in place of the old one, and displayed on the local web pages.

Integration of the EWP APIs in local processes needs careful analysis and taking into account local regulations and the cultural context. However, the detailed scenario for processing the transferred data in the local system is outside the scope of EWP. An exchange of ideas and best practices can help in choosing the best options. EWP — like EMREX — focuses on building the platform for the exchange of data. In the case of EMREX it means a static registry and one API, in the case of EWP a dynamic registry and the set of APIs (see Figure 2).
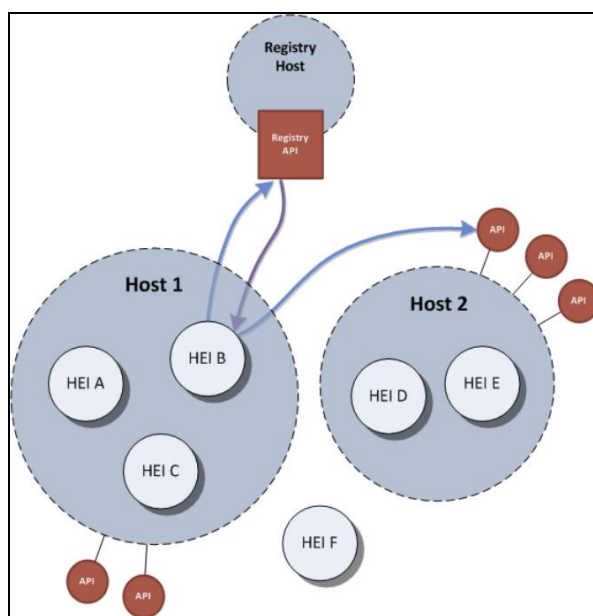

Figure 2 Main components of the EWP Network (from resources of the EWP project)

Although EWP, like EMREX, limits itself during the pilot to the most basic scenario, the designed architecture offers support for other scenarios. Along with the closed set of APIs for the exchange of mobility data, institutions may also offer open services, like common dictionaries (with e.g. countries, cities, institutions, postal codes, languages, Erasmus codes, PICs, ISCED codes etc.) as well as global statistics for some universally recognized and accepted ranking providers. The set of supported APIs may grow steadily, while the platform matures. By implementing new APIs the institution extends the set of offered digital services.

The data covered by the EWP data model is much more diverse than in the EMREX model. EMREX ELMO 1.1 is used for the part of the data covering learning agreements and the transcripts of records.

Privacy issues are solved in a different way than in EMREX. The student is the ultimate owner of his data but by applying for the mobility he authorizes both the sending and receiving institutions for

data access, processing and exchange. In some countries (e.g. Norway) he should still in some way be involved in the process, for others (e.g. Poland) initial agreement at the start of the mobility is a sufficient condition. The **Groningen Declaration Network** (http://www.groningendeclaration.org) has a *Privacy Task Force* that is looking into the issue of how student data can legally be exchanged between HEIs

But also in the EWP model it is possible for the student to authorize the institution explicitly to exchange data on his behalf. In Poland there is a central registry of the results of the maturity exams. The maturity exams are carried out by so-called Regional Examination Commissions. Each high school student may authorize its Regional Examination Commission to send his maturity results to the central database called KReM. Then the high school student may authorize the admission system of the HEI to get the data from KReM on his behalf. The student cannot do it by himself since (for many reasons) KReM does not keep accounts for students, only for the administrators from Regional Examination Commissions and HEIs. Admission systems exchange data with KReM via a set of APIs. This scenario is in line with the EWP model of data exchange.

EWP supports the idea of one central API directory — central binding list for all applications which want to talk to each other using the commonly agreed protocol. We started building this directory by delivering APIs for the EWP user scenarios. The next step may be to add to it the EMREX use case, and eventually all APIs implementing digital services for the higher education area. Even if institutions do not have the mobility module or have to postpone building their own connector to the EWP platform, they may still benefit by using the binding service of the EWP registry.

In Poland there are over 50 HEIs using the same Student Information System. This SIS consists of a portfolio of web applications. We are considering using the EWP registry for the dissemination of information on the active installations of these web applications.

4.   SUMMARY

Let's sum up the most important issues.

Both EMREX and EWP are platforms for the electronic exchange of data belonging to the business domain of the higher education institutions.

The EMREX platform is open in that respect because the institutions do not need to register to get data via EMREX. In fact it is the student who gets the data. EMREX just helps the student to transfer them in a secure and trustful way to the other system. The student uses a web interface (the EMREX client), which gets the URL of the National Contact Point (NCP) from the registry and redirects the student there. The student logs into the NCP as he would do going there directly. The registry which stores URLs of all NCPs solves the binding problem. It has to be based on trust, however — only trusted data sources can be added to the registry. Some governance policy is needed for admitting parties to the EMREX network.

EWP is open in another way — by offering a number of public APIs which can be invoked by any institution. Other APIs, in particular those supporting Erasmus+ mobility, need authorization. EWP, like EMREX, has to be based on trust and therefore needs a policy for accepting the new partners. It is up to the client to decide if the services offered by the EWP server are trustable and it is up to the server to decide if it is willing to offer services to a particular EWP client.

EMREX as of 2017 supports a simple scenario that has been tested in a live field trial. The findings of the trial can be used to elaborate practical issues which have emerged. In particular those findings may be of use for other projects involving data exchange. For example as part of EMREX the developers had to solve the problem of mapping local achievement data into the common ELMO data model and in particular agree on the data types, mandatory/optional fields and global identifiers. This provided EWP with a ready solution for the API responsible for transferring the transcript of records. This is a good example of how projects can benefit from each other.

The development work needed to benefit from the existing set of NCPs may be small. In particular any system where the data owner has an active account, like admission systems or portals with job offers, might connect to the registry and redirect the student to the NCP to get the data.

EWP as of early 2017 is under development with the aim to deliver a pilot solution at the end of the project. The pilot version will support all scenarios of the Erasmus+ mobility, which need to be integrated with the local SIS of the partner institutions. On the one hand it means more

development work but on the other it offers better support for the administration. Any system can enquire the EWP registry for available services and can incorporate supported APIs into the local processes. The more elaborated those processes are, the higher the benefits, but it also means that more development effort is needed.

Both projects base their solution on one central element — the registry. The current design of the EMREX registry is based on the manual updates of the entries which change in time. The EWP registry stores more data which may change more often so it has been designed as self-updating on the basis of the Discovery Manifest files (services) stored (offered) on (by) the EWP hosts. Remote updates are secure and fast. In fact the EWP registry might also offer information on the available EMREX NCPs. If the same trust policy would govern acceptance of the new partners for both projects, the community would benefit from one solution for both sets of digital services.

The EWP data model covers more data than the EMREX model. However, both data models are based on ELMO in the scope of courses, grades, and credits which constitute a transcript of records. It is crucial — for both projects as well as other initiatives involving data exchange — to keep the data models compatible and base it on the same data standard (ELMO in this case). If ELMO is not shared among European digitalization services it runs the risk of becoming reduced to a niche (closed) data format. Both projects should give the world a real signal that it is a good idea to base data exchange on that format and make it the de-facto standard or at least reuse naming conventions.

What is the most essential difference between the scenarios supported by both platforms? In my opinion it is the responsibility and ownership of the business process. Does this lie with the student or with the HEI administration? Who starts? Who is in charge? Is the student responsible for the timely delivery of its nomination to the partner institution? No. Is he responsible for the timely delivery of the transcript of records to the student's office? Yes or no — it depends on the regulations which are in place in the sending institution. Both EMREX and EWP may be used to transfer transcripts of records, diploma supplements, and course catalogues but in a different user scenario. EMREX will not be used — as EWP will — to transfer data on the mobility to the Mobility Tool+ of the European Commission since a student is not part of the process. EWP will not be used to send student credentials to the job portal, at least not unless authorized by the student, since this is not the task of the administration. EWP may share student data between institutions which by law are authorized for processing student data. EMREX may share student data between any institutions under the condition that the student controls the process. EMREX needs eID or an equivalent solution for the authorization problem. EWP needs a clear statement concerning privacy issues.

By implementing EMREX an institution extends the set of electronic services for a student, while by implementing EWP it supports its own administrative staff and daily routines of staff members.

5.   DISSEMINATION, SUSTAINABILITY, EXPANSION

Institutions of higher education need both platforms to diversify their offer to the community and be regarded as valuable mobility partners. However, you need two to tango. When the institution implements data exchange, it might encourage its mobility partners to do the same. The readiness for digital data exchange might be a good measure for the quality of the partnership in the mobility.

Partners in the projects will use the developed solutions in their production systems showing by example how the process can benefit from even the simplest digitalization services. This will be the best practical support for the dissemination.

Scalability can either be obtained by building central data repositories which can offer services to many institutions (centralization of the service) or by designing the local solution for one institution and deploying it in many institutions — like it is the case in e.g. Italy and Poland which have developed Student Information Systems for many higher education institutions (distributed services).

In IT projects the most important issue is sustainability. If you are going to base your SIS on some external platform or data format you have to be sure that the platform will not stop running and that the data format will be backward-compatible. Somebody should take care of the developed software solution. If it is built in-house your own development team will be responsible for the maintenance. If the system is delivered by a commercial provider you have to make sure that the provider will take care of this.

Both projects are currently funded by the European Commission, which means that common software is open-sourced. In both cases the technical results of the projects are stored in GitHub. Design decisions can be followed there, the source code can be consulted and reused. However, some sustainable support for newcomers may further ease the decision to join. Institutions might be encouraged to share the ideas and experience, scenarios and technical solutions, good practices and real life scenarios, and even the regulations which govern the data handling. In many cases supporting mobility is not a technical problem, but a problem of different regulations and processes. A competence center offering such kind of support might be a good option.

It is tempting to further expand the services but it might be more reasonable to first make it more mature and elaborated, to make them recognizable as standard services offered by the community of HEIs.

6.   FINAL CONCLUSIONS

Here are some final guidelines.

The results of both projects should be available as a common platform with a complementary set of digital services. The registry with the binding information about available digital services might be shared. Security issues should be handled in the same way.

Acceptance of the new partners might be based on the same policies. Building trust that the delivered data is of good quality and is offered by the authorized data providers is crucial.

Common dissemination events might be offered to the community and help in building such trust. A good example is the Groningen Declaration Network which since 2012 has managed to build a global network of signatories devoted to the idea of digital student data portability.

Data models for both platforms should be based on a common data format and common converters to other formats (e.g. those of PESC in the US) should be made available. ELMO should be further developed into the de-facto mobility standard and should support more types of student mobility processes.

GitHub repositories will continue to give access to the design and implementation decisions and the common code. Institutions will gradually elaborate and extend the set of offered services, depending on their priorities and technical abilities. Other digital services, resulting from the new European IT projects, can also be incorporated. The projects will then cooperate in delivering a common platform of digital services for higher education.

There may be different scenarios and workflows based on the cultural context but there should be one common platform for data exchange as there is one common network protocol.

There should be one digital EHEA for all.

7.   ACKNOWLEDGMENTS AND DISCLAIMER

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9.   AUTHOR BIOGRAPHY

Janina Mincer-Daszkiewicz graduated in computer science in the University of Warsaw, Poland, and obtained a Ph.D. degree in math from the same university. She is an associate professor in Computer Science at the Faculty of Mathematics, Informatics and Mechanics at the University of Warsaw specializing in operating systems, distributed systems, performance evaluation and software engineering. Since 1999, she leads a project for the development of a student management information system USOS, which is used in 53 Polish Higher Education Institutions, gathered in the MUCI consortium. Janina takes an active part in many nation-wide projects in Poland. She has been involved in Egracons, EMREX and Erasmus Without Paper European projects.