



Study to support the revision of the Diploma Supplement and analyse the feasibility of its digitalisation at European level

Final Report

EUROPEAN COMMISSION

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Abstract

The Study to support the revision of the Diploma Supplement and analyse the feasibility of its digitalisation at European level looks at the Diploma Supplement in an abstract sense, and elaborates on what it would mean to digitalise it. This custom-format study includes elements of status-quo mapping, an evaluative view on usefulness, and a feasibility analysis of future options for digitalisation of the DS at European level. This report defines and describes four technical options for the digital development of the digital Diploma Supplement which could help solve the current implementation issues across the EHEA. The study suggests that the DS be digitalised incrementally, building upon already existing and widely accepted solutions, so that EHEA countries could apply the digital DS solutions at their own pace.

Executive summary

Context of the study

During the ongoing **revision of the Europass** Decision at European level, the Bologna Process has treated the Diploma Supplement as a commitment of the European Higher Education Area. Between 2012 and 2015, the Pathfinder Group on automatic recognition (PFG) and the Structural Reforms Working Group (SRWG) recommended setting up an **Advisory Group on the Revision of the Diploma Supplement (AG4)** within the BFUG for the period 2015 to 2018. The group was mandated to assess the relevance of the Diploma Supplement for mobility, recognition of qualifications and employability. It was also tasked with exploring the potential of providing up-to-date information through the use of modern IT, including the digitalisation of the Diploma Supplement itself. The outcomes of the activities of the AG4 are intended to support the European Commission, the Council of Europe and UNESCO in reviewing the Diploma Supplement, and by providing recommendations for future developments.

In this context, the European Commission's Directorate-General for Education, Culture, Youth and Sports (DG EAC) has commissioned PPMI to analyse the Diploma Supplement in an abstract sense, to assess its implementation, and to elaborate on what it would mean to digitalise it. This custom-format study includes elements of **status-quo mapping, an evaluative view on usefulness, and a feasibility analysis (including a cost-utility analysis) of future options for the digitalisation of the document at European level**. It should be noted that the focus of the study is on suggesting digitalisation solutions for the Diploma Supplement, and not about the content of the Diploma Supplement template *per se*, although its content does of course influence the digitalisation options.

Diploma Supplement

The Diploma Supplement (DS) is a transparency instrument developed by the Council of Europe, the European Commission, and UNESCO-CEPES between 1996 and 1998. The DS forms an integral part of three important initiatives in the field of higher education internationalisation and of the recognition of qualifications across borders: the **Lisbon Recognition Convention**, the **Bologna Process**, and **Europass**. The first of the three, the Lisbon Recognition Convention (Article IX.3), calls on signatory countries to promote the Diploma Supplement or any equivalent document through national information centres or otherwise. Second, the implementation of the DS is one of the criteria used to measure the Bologna Process's progression in terms of qualification transparency. Third, the DS is one of five Europass transparency tools promoted by the European Commission.

In essence, the Diploma Supplement is a document attached to a higher education diploma. It gives **a detailed description of its holder's learning outcomes, and the nature, level, context, content and status of individual study components**. It includes several pieces of information: the name of the holder of the Supplement, the qualification and its level and function, the contents and achieved results, certification of the Supplement, information on the national higher education system under which the Supplement was issued, and other relevant information.

The Diploma Supplement **helps higher education institutions, employers, recognition centres and other stakeholders more easily understand graduates' skills and competences**. In this way, the DS aims to promote transparency and recognition in order to facilitate mobility, access to lifelong learning opportunities, and graduate employability. It therefore represents a response to the twin challenges of both higher education and labour market internationalisation.

Current status of DS implementation

During the period 2007 to 2015, the DS implementation **situation significantly improved**. Nevertheless, higher education institutions in two-thirds of EHEA countries had not yet followed all of the four Bologna requirements (providing Diploma Supplements automatically, free of charge, to all graduates, and in a widely spoken European language). Overall, there was **a lack of DS implementation monitoring efforts** at both European and national levels. While the formal criteria were usually followed, there was little information available on the usefulness of the document or about the main implementation challenges.

Implementation of the DS was most successful in countries which had **strong government support** of the document, along with, at the micro level, **deep interest from higher education institutions (HEIs)**. Around 30 countries across the EHEA had made the DS compulsory for higher education institutions; although this push proved to be fruitful, a number of HEIs still expressed concerns about the increased costs and lack of support measures. Even without coercive legal measures making DS implementation mandatory, and in addition to government support and incentives for HEIs, **experience sharing sessions** guided by DS implementation pioneers were very successful in promoting the DS.

Higher education institutions evaluated the Diploma Supplement as **one of the most valuable tools for managing student data**, especially for recognition of qualifications in the context of admission procedures. The DS was also often used by HR/recruitment officers in businesses across EHEA countries to **acquire information on job candidates**.

Nevertheless, some **implementation issues prevented the Diploma Supplement from reaching its full potential**. Although explanatory notes were drafted to assist the HEIs in filling out the DS form, **inconsistencies in the presentation of information** were persistent, with sections on professional status, programme requirements and additional information remaining the most ambiguous. The descriptions of national educational systems and learning outcomes also varied significantly, sometimes even within the same institution.

Overall, the Diplomas Supplement format and paper medium **did not provide the flexibility needed to simultaneously meet the diverse needs and expectations of different stakeholder groups**. The DS was, on the one hand, perceived to be too long and therefore not user-friendly, but, on the other hand, it was perceived to lack some important information. Part of the issue was that the Diploma Supplement was used by **several target groups with completely different needs**. Employers expressed that the DS lacked information on mobility experiences and extracurricular activities, whereas HEIs noted that the DS lacked information regarding the content of the curriculum during internships or mobilities. At the same time, while descriptions of national educational systems were seen as important by persons working with academic recognition, they were rarely useful for employers.

The Diploma Supplement and its intended benefits were also **not very well known across its intended target groups**. For instance, students usually became aware of it only upon graduation, employers were using alternative sources of information for hiring purposes, and some HEIs only issued Diploma Supplements out of a legal obligation. The situation called for more information on the DS's existence, benefits and applicability. Well-developed **DS promotion campaigns, and closer cooperation with stakeholders** to meet their expectations and share success stories, could be used to alleviate this situation.

The perception of a **high administrative burden of issuing and handling the DS** also hindered DS implementation. Issuing the DS during the peak of graduation required significant resources from some HEIs, especially smaller institutions with

limited administrative and technical capacities. In some instances, the shortage of administrative, financial or human resources affected the quality of the prepared documents and curbed possible innovations.

Some of these issues of DS implementation could be alleviated by providing guidance, information, and support at the national level. Institutional guidance to HEIs during and after the implementation stage, combined with a positive outlook towards the DS concept, were identified as the main underlying factors for successful wide-scale implementation of the DS. In particular, providing HEIs with rewards, examples and explanations, along with experience-sharing sessions, proved to be the most useful measures.

Moreover, our analysis revealed that DS digitalisation efforts could also be a driver of DS implementation and contribute to closing the existing DS implementation gaps.

The need for digitalisation

The European digital economy has been growing several times faster than the rest of the economy in recent years; however, Europe has still been lagging behind the global digital economy growth rate. When communicating across European countries, citizens face incompatible systems, irregular connectivity, or varying charges for use. Similar issues also affect the implementation of the Diploma Supplement. While it has been widely implemented across the EHEA, **so far the DS has remained primarily a paper document with only a small margin of HEIs issuing it in a digital format**. Even in cases where the DS is digitalised, there is no systematic approach for European level interoperability and standardisation.

Digitalisation could not only bring the Diploma Supplement closer to today's technological standards, but also address some of the most common implementation issues. Digitalisation could reduce issuing and handling costs, make the DS more secure and easier to verify, and add greater flexibility towards presenting and using the DS data.

Handling and processing paper documents is more expensive than digital documents and data. Digitalising the DS could **reduce issuing and handling costs for stakeholders**. Issuing digital documents instead of paper could help to save **printing and handling costs for HEIs**. Moreover, a digital Diploma Supplement could reduce handling costs for the recognition centres and employers alike. A digital format would enable users to exchange documents faster and more reliably. **Having the DS in a machine-readable format could significantly reduce the amount of manual labour required**.

Traditional printed diplomas and associated documents (such as the DS) have been subject to relatively high levels of fraud because the security measures applicable to paper documents were quite limited. Most of the consulted stakeholders agreed that the **security and verification measures enabled by digital formatting could make the DS safer and easier to verify**. Advanced digital signatures or direct DS data exchange between HEIs, recognition authorities, and employers, could significantly reduce fraud and would allow faster and surer verification of credentials.

The current format of the DS did not provide the flexibility needed to meet the needs of different stakeholders, evident from the conflicting perceptions of the length and complexity of the DS. **Digitalising the DS could enable the presentation of the most relevant information for different stakeholders** by, for instance, presenting learning outcomes to employers, or by showing elaborate descriptions of education systems to recognition centres. **The Diploma Supplement template could serve as a basis for such a modular approach**.

Digitalisation options

The Diploma Supplement could be digitalised by **incrementally building upon already existing and widely accepted solutions**. Following this approach, this report presents a baseline option, and three intermediary digitalisation options of varying complexity. The options range from a minimum set of features for producing a version of the DS that can be considered digital, to more elaborate options that could be achieved by incrementally adding new features and functionalities on top of the basic requirements.

This approach, proposing both baseline and intermediary digitalisation options, enables a comparison of the transferability of the proposed options across the EHEA and within HEIs, that may have different pre-existing technological and conceptual solutions for issuing the Diploma Supplement.

Option 0 discusses the need for structured, machine-readable data formats for compiling the Diploma Supplement and meaningful exchange of student data. **Options 1-3** discuss the data output formats and possibilities of expanding the potential of student data exchange. It should be noted that these options could be combined for maximum effect and are not mutually exclusive. They could also be adopted by countries at their own pace – if they were building upon the baseline requirements, data exchange would be ensured regardless, and so only the presentation and utilisation of the DS data would differ.

Option 0

Digitalisation of the Diploma Supplement could be started by promoting **a common data exchange standard based on XML** (baseline **Option 0**). XML is a widely used open standard, and most of the identified practices of digital student data management and exchange already employ XML for the purposes of data exchange, storing data, or generating documents in a variety of formats. XML (eXtensible Markup Language) is a markup language defining a set of rules for encoding documents in a format that is both, **human-readable and machine-readable**.

This option would require relatively low development, dissemination, and technical/maintenance costs, especially within countries that already implement European and national projects working with the XML standard.

A standard data exchange format would form a strong basis for understanding the **DS as a set of data** described in a standardised way, demonstrating high sharing and integration potential, as opposed to a paper document. Turning from the concept of a document towards the concept of a data set opens up a plethora of possibilities to develop the Diploma Supplement as a digital artefact that is easy to generate, share, and consume. With relatively **low costs**, a common data exchange standard could offer **significant impacts on interoperability and exchange** of the DS, while ensuring **user-friendliness** and a **high level of security**.

Option 1

A digital Diploma Supplement would have to be presented in a very well-known document format to reach the general public. Accordingly, **Option 1** suggests the **PDF format**, which is widely used to present and exchange documents reliably, and independently of software, hardware, or operating systems. This option explores standard ways to secure a digital DS from internet threats and maintain a traceable origin. PDF offers a **verification functionality** which could significantly limit fraud. It also complies with **a global long-term preservation standard** (PDF/A), which is particularly important for accessing Diploma Supplement for an unlimited period of time.

It is important to note that **PDF documents could be compiled using standard structured data format XML**, which is suggested as a baseline option for making the DS digital. In this way, machine-readable XML student data would be used as a source for making a standalone pdf document in just a few clicks.

Introducing this **low-cost, open, user-friendly, and secure format** could reduce printing and handling costs for HEIs, recognition agencies, and employers. Using this format would also **increase the immediate access to Diploma Supplements** very significantly, as any user with at least intermediate digital skills would be able to view it. PDFs are not conceptually or visually remote from paper versions, and would enable holders to access and exchange documents reliably, with the ability to apply European electronic signature standards.

Option 2

User-oriented student data access solutions (**Option 2**) would provide **intermediary environments for issuing, storing, and sharing digital Diploma Supplements**. Services associated with the DS could help stakeholders 'consume' the document, and make it more useful for employment, mobility, or further education purposes. There are already cases where student information system interfaces are successfully providing access to official student records, generating secure electronic documents, or even providing electronic employment or skills matching services.

User-oriented student data access solutions could enable the most relevant DS information to be presented to different stakeholders, suggesting a **potentially modular approach** in student data presentation. Moreover, if students could access DS information at any time during their studies, the DS could also serve as a **formative document**. This could significantly improve the DS's relevance for employment purposes, since many students seek jobs while studying.

User-oriented student data access solutions could also streamline the usefulness of the DS by offering **interoperability with external services**, for example, by augmenting professional network profiles, filling in CVs, applying for guidance services, or compiling professional portfolios. It is important to note that **promoting a standard DS data format** such as XML (Option 0) could streamline interoperability.

Countries' readiness to implement such solutions strongly depend on the student information systems and services already used by HEIs, and on the availability of national level or private providers capable of implementing such services. Although many HEIs already provide a wide variety of student services, the role of the Diploma Supplement depends on whether HEIs are willing to build their systems on widespread data standards and projects that have already accumulated a wide knowledge base.

While student services and data exchange are widespread practices, direct data exchange among educational institutions in cases of educational transition (e.g. joint degrees and higher level education), or providing data for job-matching systems and other employment services, are still not widespread among HEIs within the EHEA. **These solutions may require higher input from HEIs in terms of development and feeding information**, since they require partnerships with external third parties – other HEIs and employers. **Common open data standards, interoperability solutions, and trust networks, together with best practice sharing platforms for security, authentication, and technical implementation challenges, are crucial factors for cross-border transferability** of student services related to access to and transfer of the Diploma Supplement.

Option 3

Open digital credentials such as Open Badges (**Option 3**) would **give value to skills and competences that are harder to reflect within traditional credentials** such as the Diploma Supplement. Open Badges are verifiable, portable digital badges, with embedded metadata about skills and achievements. Open badges could make the DS **more open to a wider array of experiences and learning pathways of higher education students**, and provide an attractive incentive for learners to participate in those experiences.

Open Badges, with their potential to make a strong impact on the usefulness of DS data, were still not established well enough across HEIs in the EHEA at the beginning of 2017. **To estimate the true potential impact of this technology, more pilot exercises and successful best practice examples of implementation are necessary.** Due to its novelty, it is likely to entail significantly higher dissemination costs than either XML or verified PDF solutions. Even though Option 3 may not be readily transferable across the EHEA, it **could be explored as a prospective solution in the context of emerging technology.**

Introduction

The Diploma Supplement is an integral part of three important initiatives to promote internationalisation and recognition of HE across borders – the Lisbon Recognition Convention, the Bologna Process, and Europass. The Lisbon Recognition Convention (Article IX.3) mentions that its signatory countries have agreed to promote the Diploma Supplement or any comparable document through national information centres or otherwise. Second, because the transparency of qualifications is one of the key action lines of the Bologna Process, the implementation status of the Diploma Supplement is among the criteria used to measure the progress of the countries in the Bologna Process. Third, the Diploma Supplement is amongst the Europass set of transparency tools promoted by the European Commission.

The Commission has proposed a **revision of the Europass Decision**. The proposal aims to make the Diploma Supplement more flexible, to allow for any future revisions. In preparation for the 2018 Ministerial Conference in Paris, the BFUG 2015-2018 work plan has been structured into three working groups (WGs) and four advisory groups (AGs). The fourth, the **Advisory Group on the "Revision of the Diploma Supplement"**, is mandated to support the Council of Europe, the European Commission and UNESCO in reviewing the Diploma Supplement (DS). Its eventual digitalisation was one of the key things discussed.

The purpose of this study is to look at the Diploma Supplement in an abstract sense, and to elaborate on what it would mean to digitalise it. This custom-format study includes elements of **status-quo mapping, an evaluative view on usefulness, and a feasibility analysis of future options for digitalisation of the DS at European level**. It should be noted that the focus of the study is on suggesting digitalisation solutions for the Diploma Supplement, and not about the content of the Diploma Supplement template itself, although its content does of course influence the digitalisation options. And for the Advisory Group to formulate sound recommendations, the study considers it important to define and describe the options, particularly the technical options, for the digital development of the Diploma Supplement. In short, this study is a support project with a strong technical purpose, including a cost-utility analysis of the DS digitalisation.

This report presents an overview of the current use of the Diploma Supplement, and provides examples of digitalisation practices across the EHEA. The first part outlines DS implementation patterns and summarises typical national level DS implementation problems and their potential solutions. It also includes a summary of the individual and organisational level patterns of DS implementation, and explores the usefulness of the document for students, higher education institutions and employers. The second part of the report analyses the need for DS digitalisation, outlines the strengths and weaknesses of identified digitalisation cases taken from across the EHEA and outside of Europe, and suggests potential digitalisation options for the Diploma Supplement.

1 Diploma Supplement implementation

1.1 Current status of the Diploma Supplement implementation

Summary of findings

- Over the period 2007-2015, **implementation of the DS had significantly improved**, however, **two thirds of the EHEA countries had yet to fully fulfil all of the Bologna Process criteria for the DS**. Insufficient incentives and lack of political will were reported to be the main factors for not fulfilling the requirements to issue a Diploma Supplement to every graduate, automatically, in a widely spoken European language, and free of charge.
- The Diploma Supplement **template proved to be relevant** for HEIs across EHEA. The majority of surveyed HEIs that issued a document providing a description of the acquired competences, completed studies, their nature, level, context and content along with a higher education diploma, did so following the Diploma Supplement template.
- There was a **lack of monitoring** on DS use and satisfaction at both national and international levels across the EHEA. Lack of direct feedback mechanisms were limiting the information that HEIs possessed about the potential usefulness of the DS to their students. Moreover, insufficient monitoring did not allow governments to assess the national level measures taken to enhance DS awareness and implementation.
- Admission officers evaluated the DS to be **one of the most valuable tools for qualification recognition**, but its application for this purpose was still relatively low. **High satisfaction and low uptake indicated great potential to enhance the usage** of DS among HEIs for admissions procedures.
- Even though the employers' survey carried out in the context of this study indicated that the documents outlining student achievement records (knowledge and skills of the holder, a description of the completed studies, their nature, level, context and content) were frequently used, the frequency of use of the Diploma Supplement and satisfaction of employers differed significantly among individual respondents.

1.1.1 Compliance with requirements of Bologna Process

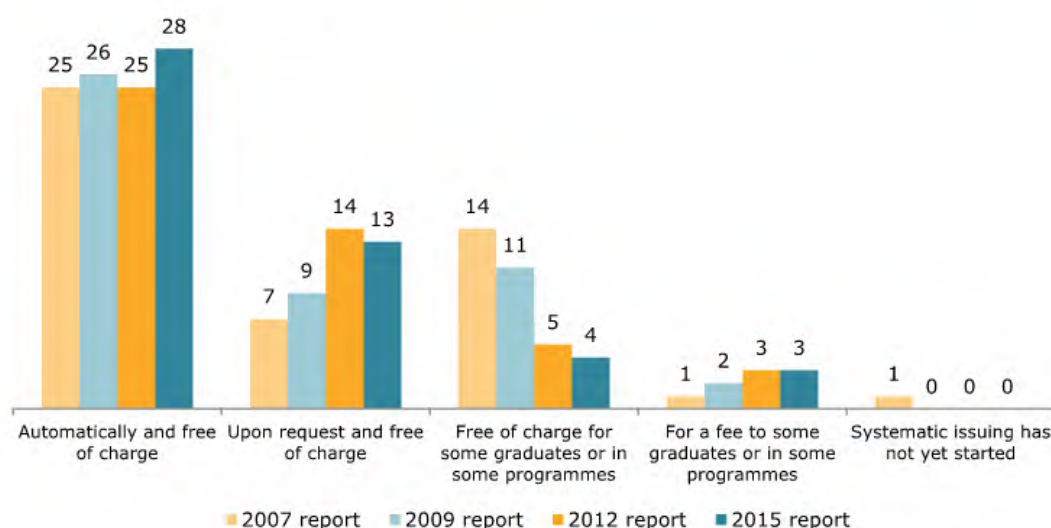
A working group supported by the Council of Europe, the European Commission and UNESCO-CEPES first developed the Diploma Supplement in 1998. The following year it featured in the Bologna Declaration as a transparency tool, but until 2003, participating countries implemented the DS on their own and did not follow specific requirements. The Bologna Process in 2003 set out the commitment of EHEA countries to provide a Diploma Supplement to all students:

- 1) automatically,
- 2) free of charge,
- 3) to every graduate, and
- 4) in a widely spoken European language.

The latest available national data of the Bologna Implementation Report shows that **in 2015 only a third of the EHEA countries had fully complied with all requirements¹**. Although our study did not aim to provide a thorough update, its findings indicate that **this goal remains out of reach as of 2017**.

Graph 1 below summarises four editions of the Bologna implementation report (2007, 2009, 2012 and 2015) and provides the development trends of the DS implementation criteria. **During the period 2007-2015 there was overall improvement** in compliance with the Bologna Process requirements.

Graph 1. Number of countries where the DS is issued in the EU/CoE/UNESCO DS format and in a widely used European language



Source: Bologna Implementation Reports (2007, 2009, 2012 and 2015).

However, the number of countries that followed all requirements for the Diploma Supplement during this period did not increase significantly. The most visible progress was seen in the growing number of countries where HEIs issued the DS to all students free of charge and upon request.

The **proportion of HEIs that issued the DS upon request** differed across the EHEA countries. According to the Bologna Follow-Up Group survey (2014), in seven countries less than half of HEIs complied with the regulation to automatically issue the Diploma Supplement. A quarter or less of the HEIs in France and Croatia did not issue it at all.

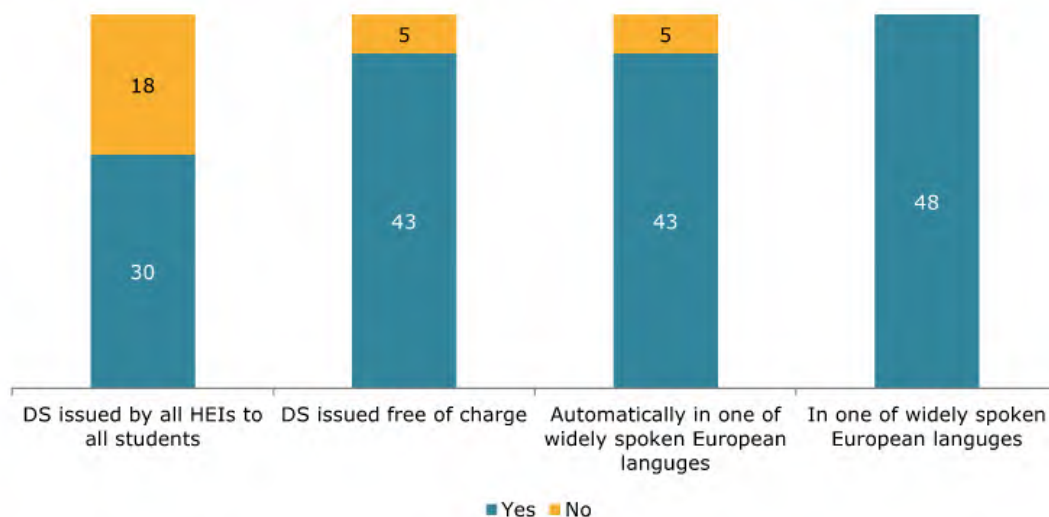
It was also evident from the survey that 30 EHEA countries ensured **the DS was issued by all HEIs to all students²**. The remaining 18 EHEA countries had some HEIs that did not use the Diploma Supplement at all, or only issued the document to some graduates. Andorra, France, Greece and Kazakhstan issued the DS automatically **to some graduates or in some programmes only**. French HEIs issued the DS to most graduates in those fields of study which typically have higher mobility, such as business and management, languages and literature, engineering programmes, etc.

¹ European Commission/EACEA/Eurydice, 2015. The European Higher Education Area in 2015: Bologna Process Implementation Report. Luxembourg: Publications Office of the European Union

² ESU, 2015. Bologna with Student Eyes 2015: Time to meet the expectations from 1999. Available at: http://media.ehea.info/file/ESU/32/8/Bologna-With-Student-Eyes_2015_565328.pdf

HEIs in 5 EHEA countries **had established a fee for the document**: the DS was not available free of charge for all graduates in Malta, Montenegro, Serbia, Russia and the Holy See (see Graph 2 below). Some countries regressed in this regard during the DS implementation period: although Montenegrin public HEIs previously issued the DS free of charge, in the academic year 2013/2014 new legislation allowed institutions to charge fees that would cover the administrative costs of issuing one. *Vice versa*, in 2015 graduates of Serbian HEIs were paying around 50-100 EUR for the Diploma and DS, but regulatory changes were expected to solve this issue. Some other EHEA members required financial contributions from graduates in specific circumstances. For example, students in Flanders paid a fee for the English DS only in cases where they had received their first DS in Dutch or any language other than English³.

Graph 2. Number of EHEA countries that follow requirements for the Diploma Supplement



Source: Bologna Follow-Up Group questionnaire, 2014

All EHEA countries issued the DS in a widely spoken European language, with most countries selecting English as the primary non-national language. Romania, Spain and Turkey offered the Diploma Supplement in other widely used European languages: French, German, Italian or Spanish. HEIs in 5 EHEA countries (Andorra, Azerbaijan, Russia, Serbia and Slovakia) issued the DS in a widely spoken European language only upon request⁴.

The survey of HEIs carried out in the context of this study⁵ revealed positive trends across implementation criteria. Around 9 of 10 surveyed HEIs in the EHEA complied with all Bologna Process criteria for the Diploma Supplement (see Graph 3 below). These results were significantly more positive than the level of implementation reported in 2015.

This could be explained by three reasons: 1) there was an improvement of DS issuance level in EHEA HEIs over the 2015-2017 period; 2) since countries which lagged behind in DS implementation had fewer HEIs than did most other EHEA

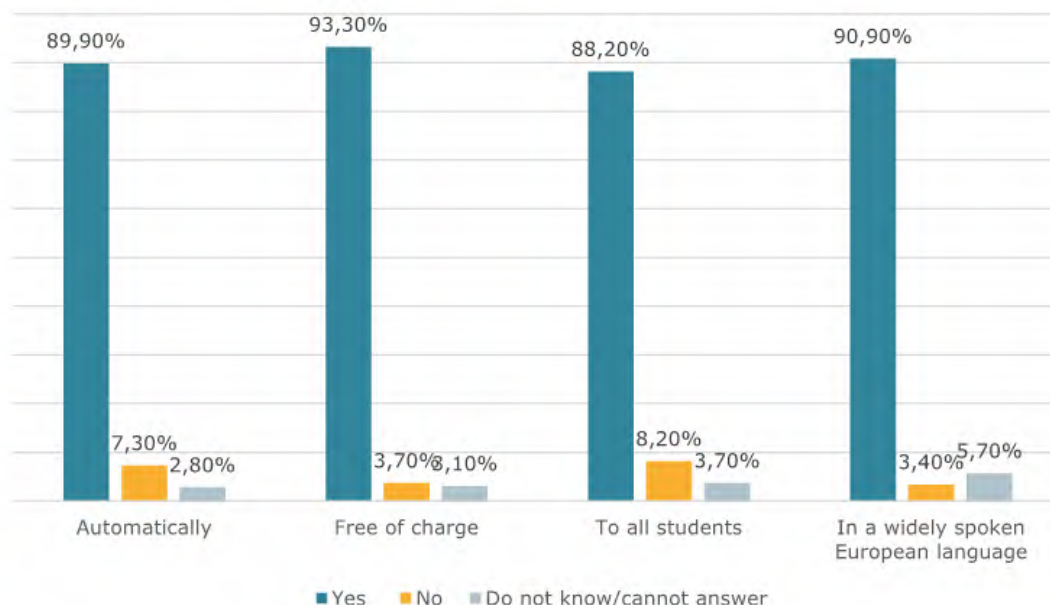
³ Bologna Follow-Up Group questionnaire of 2014

⁴ Ibid.

⁵ Survey of representatives of HEIs working with student data and documents did not aim to update previous findings on EHEA members' compliance with Bologna Implementation criteria. Rather, it presented a general picture of DS prevalence among HEIs in the EHEA.

countries, compliance in the surveyed HEIs was higher; 3) HEIs that had implemented the DS were more willing to fill out the survey.

Graph 3. Compliance with Requirements of Bologna Process (% of HEIs)



Source: Higher Education Institutions Survey, PPMI, 2017

The implementation level of DS at the micro level can also be measured by the number of label holders. The Diploma Supplement Label is an honorary distinction for HEIs that have proved implementation of ECTS and DS, recognised degrees, and study plans. The proportion of institutions with a DS label does not necessarily represent how well the DS implementation has progressed in each country, but it does describe the **interest of HEIs on a micro scale**. Bologna implementation criteria for the DS are adopted from above, while the **DS labels are individually pursued by HEIs to indicate their interest and excellent performance** in DS implementation.

The numbers of HEIs awarded with the DS label each year showed that between 2009 and 2013, the rate of correct DS implementation had been gradually increasing each year⁶. The last available data on the DS label presented in Table 1 show that **Turkish HEIs were clear leaders in terms of the DS label** with 73 awarded institutions, while **Finland, Sweden, Norway and Czech Republic followed** with over 20 HEIs having received a DS label in each country. In addition, **Cyprus, Lithuania and Iceland** were also leaders in terms of the proportion of their HEIs awarded with the DS label.

⁶ European Commission, 2015. Celebrating ECTS and diploma supplement label holders 2009-2013. Available at: <http://bookshop.europa.eu/en/celebrating-ects-and-diploma-supplement-label-holders-2009-2013-pbNC0514040/>

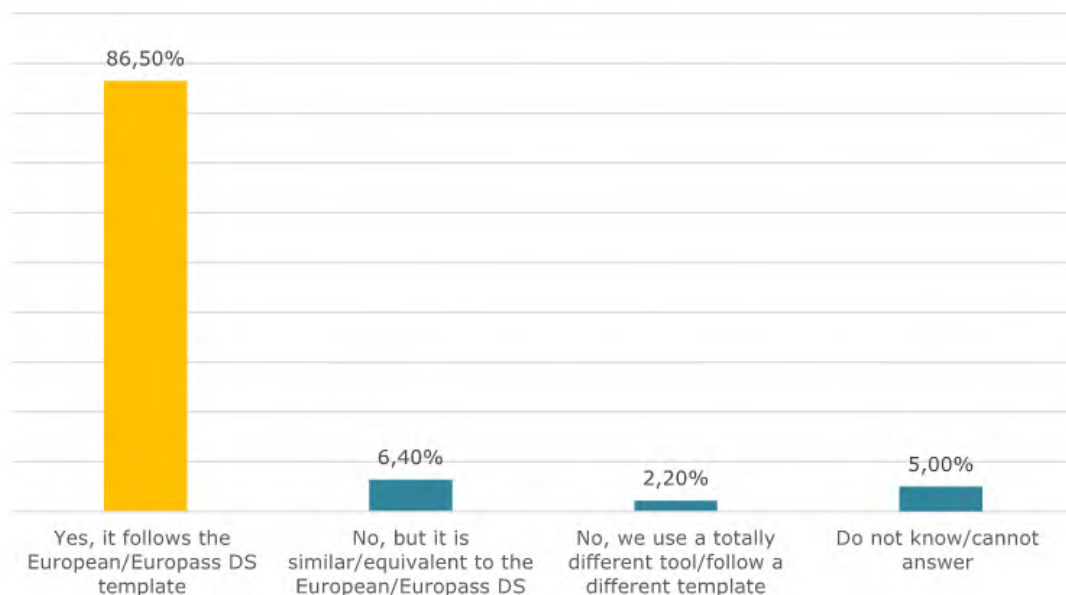
Table 1. Number of HEIs awarded with the Diploma Supplement Label in 2009-2013 and their share of all HEIs in the country

Country	BE	BG	CZ	DK	DE	IE	GR	FR	HR	IT	CY	LV	LT
Number of HEIs with DS label	2	2	23	8	2	1	10	7	2	19	7	12	17
Share of all HEIs	2%	4%	32%	20%	0%	2%	13%	1%	4%	8%	35%	21%	39%
Country	MT	NL	AT	PL	PT	SK	FI	SE	UK	IS	TR	LI	NO
Number of HEIs with DS label	1	10	17	3	14	5	25	23	3	7	73	1	22
Share of all HEIs	25%	7%	22%	1%	12%	15%	57%	49%	1%	88%	39%	25%	40%

Sources: Compiled by PPMI; Data from Ranking Web of Universities⁷; European Commission⁸

The higher education institutions' survey showed that more than 80% of surveyed HEIs in the EHEA issued a document providing a description of the acquired competences, completed studies, their nature, level, context and content along with a higher education diploma. The vast majority of these institutions followed the template of CoE/UNESCO/Europass Diploma Supplement, with only a few using its alternatives (see Graph 4).

Graph 4. Does the document issued along the HE diploma follow a European/Europass Diploma Supplement template? (% of HEIs)



Source: Higher Education Institutions Survey, PPMI, 2017

⁷ Ranking Web of Universities, 2016. Countries arranged by Number of Universities in Top Ranks. Available at: <http://www.webometrics.info/en/node/54>

⁸ European Commission, 2015. Celebrating ECTS and diploma supplement label holders 2009-2013. Available at: <http://bookshop.europa.eu/en/celebrating-ects-and-diploma-supplement-label-holders-2009-2013-pbNC0514040/>

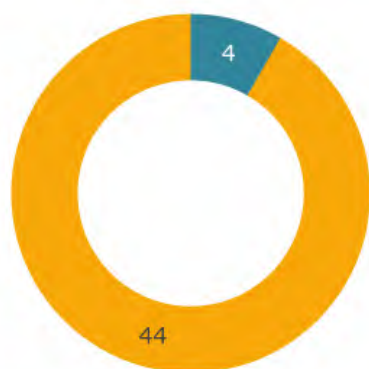
1.1.2 Status and results of the DS monitoring

Monitoring the use of the DS at national or EHEA level is crucial for institutions that shape the content and presentation of the document. Gathering the needs and satisfaction of DS users, such as recognition institutions, employers, etc., **helps to address shortcomings and tailor the DS according to the preferences of users.** Unfortunately, however, the use of the Diploma Supplement by HEIs or employers **was not monitored at the EHEA level.** Moreover, as the national level monitoring was only sporadic and followed different methodologies, **cross-country comparison of EHEA is not possible.**

In 2015, fourteen higher education systems (compared to seven in 2012) reported that they had launched studies to monitor how HEIs use the DS. The bodies carrying out such monitoring varied widely. The bodies were ministries in Belgium (French Community), Kazakhstan, Lithuania and Moldova; in Finland, the National Board of Education; in the Netherlands and Serbia, an inspectorate; in Norway, the quality assurance agency; in Germany, the Rectors' Conference; and in the UK, the UK Higher Education International Unit. **Monitoring of how employers use the DS was rare,** and only four countries performed employer surveys (see Graph 5 below).

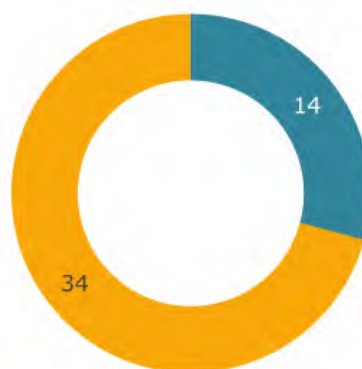
Graph 5. Number of EHEA countries monitoring the DS use by HEIs and employers.

Monitoring on how the employees use the DS



■ Yes ■ No

Monitoring on how the HEIs use the DS



■ Yes ■ No

Source: Bologna Follow-Up Group questionnaire data, 2014

According to the Bologna Follow-Up Group questionnaire of 2014, some national agencies had executed the monitoring but did not publish the results publicly, or only presented them during events. For instance, Serbian, Croatian and Finnish authorities collected feedback from HEIs and carried out regular monitoring of DS utilisation, while Dutch agencies evaluated the use of the DS through Erasmus Charter for Higher Education monitoring. None of this data was made publicly available. A study on employers' utilisation of the DS to evaluate candidates' competences and implementation by HEIs in Austria was due in June 2017. Interviewed representatives from National Erasmus Centres, national authorities, or HEIs, were not aware of any **feedback mechanisms** regarding the use of the DS.

1.1.3 Level of use and satisfaction among HEIs

HEIs not only issue the DS but are also one of its key users: during the admissions process they commonly engage in recognition and validation processes. Therefore, as **admission officers are one of the most frequent users of the document**, it is crucial to monitor their satisfaction and adjust the DS accordingly. As mentioned above, even though the use of the DS by HEIs had been scrutinised in more countries than were employers, **no monitoring was available in most EHEA countries**. Moreover, most of the data that was currently available had not been updated during the last couple of years.

One of the most thorough analyses of stakeholders' satisfaction with the DS was the 2014 report produced by the *Centre international d'études pédagogiques* (CIEP)⁹. It found that the **DS had been only the fifth most popular tool** among HEIs, employers, recruiters and public administrators. However, stakeholders in Belgium, Croatia, France, Italy, Latvia, Lithuania and the Netherlands saw it as the **most useful tool to deal with qualifications**. In each of these countries, public education and training institutions evaluated the Diploma Supplement with the highest mark in 87% of cases.¹⁰

Similarly, the European Activity Survey in 2011 revealed that 72% of British HEIs had found the DS useful to **evaluate students' achievements** and **support admissions procedures**¹¹. The 2013 survey of stakeholders in the UK showed an increase in satisfaction with the DS to 86%¹². Institutions that did not find the DS useful for either purpose stipulated that a detailed transcript of records provided them with similar information. A 2015 report on the Diploma Supplement's contribution to student mobility¹³ found that it was highly appreciated by admission officers in Germany, the Netherlands, and the UK, as it **facilitated the application process** while policy-makers agreed that it contributed to **increased internationalisation and visibility**.

According to the Bologna Follow-Up Group questionnaire of 2014, the **DS was widely recognised and used among Italian HEIs primarily as a Bologna tool**, unlike the other Europass documents that were not as widely recognised. Significant differences among countries existed: **in France and Belgium the DS is still rarely used** by HEIs to get information on qualifications, **while in Latvia and Romania it was one of the main sources**¹⁴.

9 A French public institution for educational and training cooperation within the Ministry of National Education, Higher Education and Research

10 CIEP, 2014. The use or potential use of QFs by HEIs and other stakeholders linked to mobility. Final report. Available at: http://www.ciep.fr/sources/expert_educ/reconnaissance-des-diplomes/Final-Report-QFs-UHSE/index.html

11 Universities UK, 2012. Results of the 2011 UK HE International Unit European Activity Survey of UK HEIs – England and Northern Ireland. Available at: <http://heglobal.international.ac.uk/media/1469373/E-12-03.pdf>

12 Preliminary results of the European Activity Survey 2013 in Bologna Follow-Up Group questionnaire of 2014.

13 Aertken, J., 2015. In the course of the Bologna Process: are Diploma Supplement labels contributing to the mobility of students in Germany, the Netherlands and the UK? Available at: <http://essay.utwente.nl/67294/>

14 CIEP, 2014. The use or potential use of QFs by HEIs and other stakeholders linked to mobility. Final report. Available at: http://www.ciep.fr/sources/expert_educ/reconnaissance-des-diplomes/Final-Report-QFs-UHSE/index.html

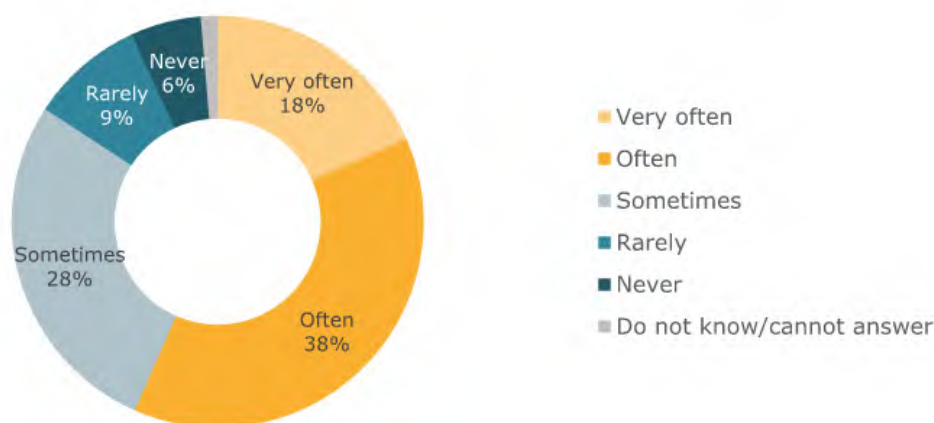
1.1.4 Level of use and satisfaction among employers

The level of use of the DS among employers was scarcely evaluated in the EHEA, with monitoring carried out only in Germany, France, Romania and Montenegro. The ENIC-NARIC in France collected data that showed it had not been popular among national employers in 2014. In contrast, **a high share of employers in Germany in 2011 considered the DS as important** (70%), with almost 50% perceiving the document as a decisive criterion in the candidate selection process¹⁵.

Stakeholders in Germany noted that the **DS had helped make acquired competences more transparent**, which made it an important instrument in the application process¹⁶. Even though in most cases the expectations for increased transparency attributable to the Diploma Supplement were higher than the actual experience, it was nevertheless **considered to be a very beneficial tool by more than two thirds of surveyed employers**.

The description of learning outcomes in the DS was the main source from which employers obtained information about the qualifications of the candidate¹⁷. This gives the Diploma Supplement an advantage over alternative documents in recognition and employment. According to our survey of employers, **around 9 of 10 surveyed persons working in HR/recruitment had at some point used the Diploma Supplement or its alternatives to acquire information about job candidates**. More than half of the surveyed enterprises asked for such documents from candidates often or very often (see Graph 6 below).

Graph 6. How often do employers use the DS to acquire information on candidates?



Source: Employers survey, PPMI, 2017

¹⁵ DAAD, 2011. Bachelor und Master auf dem Arbeitsmarkt: Die Sicht deutscher Unternehmen auf Auslandserfahrungen und Qualifikationen. Available at: <https://eu.daad.de/medien/eu/publikationen/bologna/bachelor-master-publikation.pdf>,

¹⁶ Ibid.

¹⁷ DAAD, 2007. Bachelor, Master und Auslandserfahrungen: Erwartungen und Erfahrungen deutscher Unternehmen. Available at: http://www.iwconsult.de/imperia/md/images/iwconsult/pdf/download/akzeptanz_bachelor_master.pdf

1.2 Ways to strengthen Diploma Supplement implementation

Summary of findings

- Issuing institutions often had **different understandings of the requirements for filling out the DS**, which resulted in inconsistently presented graduate data (i.e. content, structure, layout) and **diminished comparability of information** provided in the document.
- Diploma Supplement users often noticed that the DS lacked additional information that would describe **internships, mobility periods, or extraordinary achievements**. Completing such custom entries would require a significant amount of manual work. Moreover, there was no specific section for extracurricular achievements within the DS template.
- **The length and complexity of the DS was evaluated in a contradictory fashion** by different types of stakeholders. Some employers expected more information about learning outcomes, and noted that the descriptions of educational systems were irrelevant. Meanwhile, HEI representatives expected more information about the content of curricula, while ENIC-NARIC representatives expressed a need for a more comprehensive description of educational systems.
- The current format and paper medium of the DS could not provide the **flexibility** needed to simultaneously meet the very diverse needs and expectations of different stakeholder groups. For the situation to change, the future DS template would need to become **more flexible and accessible in digital as well as analogue format**.
- **The Diploma Supplement was not well-known across all of its intended target groups**. The level of use of the DS may have been higher if employers had received sufficient information on the Diploma Supplement's existence, benefits and applicability. Well-developed DS promotion campaigns, and closer cooperation with stakeholders to meet their expectations, could be used to alleviate this situation.
- Significant **resources** from HEIs were required to issue the DS, which was especially true for institutions with limited administrative and technical capacities. In some instances, the shortage of administrative, financial or human resources affected the quality of the prepared documents and limited possible innovations.
- The introduction of **obligatory DS issuance** to national legislation proved to be the most successful method of pushing DS implementation in most EHEA countries. However, such coercive action often **burdened unprepared HEIs with high initial costs**. The legal obligation to issue Diploma Supplements had the best implementation outcomes in countries where significant **guidance and support** was offered to HEIs for this purpose, and where **collaboration among HEIs** in implementing DS took place.

As discussed above, the current level of Diploma Supplement implementation across the EHEA is not yet sufficient. In order to identify possible weak points, we performed the mapping of obstacles by employing desk research and interview data analysis. The major observed areas for improvement include:

- improving the consistency of data presentation,
- raising the level of awareness about the DS,
- optimising resources, and
- governmental guidance and support.

Three main groups of success factors that led to successful implementation of the Diploma Supplement at the national level could be distinguished:

- **Macro (systemic) level factors**, which relate to the favourable conditions for DS implementation that are set up by governments. These include DS-related legislation, institutional support, and promotion of the concept.
- **Micro (organisational) level factors** are ways in which HEIs contribute to the successful implementation and wider use of the DS. These include intra-institutional preparedness to issue the DS, and their ability to manage advanced student data systems in general. Moreover, the success of the DS in any particular HEI is enabled when the institution has sufficient financial and human resources, and is driven by an appreciation of the concept by the institution.
- **Individual user level factors** relate to the awareness and perceptions of graduates, employers, recognition centres, and others. The successful implementation of the DS is more likely when these individuals are aware of the document, and possess a positive perception of its usefulness. The flexibility of the document's presentation also plays a role at this level.

1.2.1 Improving consistency of data presentation

The standardisation and comparability of data were the most frequently mentioned benefits of the DS template during the interview programme. Accordingly, properly addressing any issues related to data presentation could have a significant positive impact on the usefulness of the Diploma Supplement to its intended beneficiaries. In this sub-chapter we analyse the main factors that indicate the need for more consistent presentation of information in the Diploma Supplement.

The comparison study on different DS implementation approaches performed in 2008¹⁸ revealed some difficulties related to data presentation in the DS which are still valid as of 2017. After nearly a decade, issues related to the **clarity and consistency of information** still affected the successful implementation of the DS. This was echoed by many interviewed stakeholders and experts,¹⁹ who recalled numerous instances when it was difficult to read and understand the information in the Diploma Supplement.

This was often the result of **different interpretations of explanatory notes and titles of DS sections**. Although explanatory notes were drafted to assist HEIs in filling out the DS, in practice they were often either misinterpreted or not even consulted. This was particularly evident for the sections "Professional status" and "Programme requirements".

The description of learning outcomes in the DS was still challenging to many HEI representatives. For some, it was not clear if the description of the learning outcomes was supposed to be provided under the title "Programme requirements". Although the explanatory notes specifically state that the learning outcomes, rather than the procedures of learning, ought to be detailed in this section ("*details of the learning outcomes, knowledge, skills, competencies and stated aims and objectives associated with the qualification*")²⁰, many institutions did not know what to write, and sometimes copied either the course names or the access requirements. Therefore,

¹⁸ Study on the Diploma Supplement as seen by its users, 2008.

¹⁹ Representatives of HEIs, ENIC-NARICs, NECs, EU-level social partners.

²⁰ Diploma Supplement Explanatory Notes. Accessed at

http://ec.europa.eu/dgs/education_culture/repository/education/policy/higher-education/doc/ds_en.pdf

some stakeholders recommended that the title of section 4.2 be changed to “Learning outcomes”.

The ambiguous naming of the titles contributed to another set of problems responsible for the inconsistent descriptions of **learning outcomes**. One of the major issues has been an ongoing problem with the **capacity of the responsible staff to provide proper descriptions**. The Bologna implementation report in 2015 concluded this was due to the staff of HEIs not being competent to work with the descriptions of the learning outcomes.²¹ Some of the HEI and ENIC-NARIC representatives reported that different approaches to the description of learning outcomes could be observed even in the same HEI. A consistent system for describing learning outcomes was absent, and staff often provided descriptions of learning outcomes independently for their course units or study programmes.

The descriptions of **learning outcomes were also rarely provided for extracurricular learning activities, volunteering or mobility**, according to the interviewees. However, there was also no clear agreement on whether to include the learning outcomes of all of a student’s activities into the DS. Different stakeholder groups expressed concerns that detailed description of learning outcomes for each course and activity could also make the document very long and inconvenient.

Inconsistent descriptions of learning outcomes were caused by a lack of comparable data, which consequently diminished the core advantages of the DS. The consistency issues could to some extent be solved by the renewed DS implementation guidelines which were being revised by the BFUG Advisory Group on Revision of Diploma Supplement at the time of writing. The revision is focusing on rephrasing the guidelines in such a way that they become better understood by the issuing bodies.

Several interviewed stakeholders reported that sometimes the DS was **difficult to understand for an international audience**. For example, even in cases where the overall document was written in a widely spoken international language, various abbreviations and peculiarities of national languages were not translated.

Lack of harmonisation of national system descriptions was also one of the most frequently mentioned issues related to presentation of comparable data in the DS. According to several interviewees, a mere translation of qualification descriptions would not help them better understand different systems. Stakeholders suggested that more comprehensive descriptions of national educational systems should be provided. There was a particular lack of such information when issuing the DS for joint-degree programmes or under transnational/borderless education arrangements.

1.2.2 Providing flexibility for different user groups

Since the introduction of the DS in 2000, it has **never been revised** and has remained the same for nearly two decades. Although the information provided in the DS was reported by its users to be quite clear, they did express quite contradictory demands for changes to its format. Taken as a whole, users of the DS desired that **more specific information** be included in the document, yet simultaneously that **the document should be made shorter**.

A few interviewed HEI representatives held the view that the **DS did not provide enough information** about graduates’ competencies, learning outcomes, and the content of curricula during internships or study mobility periods. One of the chief obstacles to this is that the DS often had to be filled in by hand. One of the respondents mentioned that their university had to periodically **hire extra staff** to help handle the application paperwork, which included processing information for the DS.

²¹ EHEA Bologna implementation report 2015.

Although the excess length of the DS and filling procedures remained a burden for those who issued and used it, our findings indicate that **many employers expected even more information than was currently present in the DS**. Some interviewees also suggested the inclusion of additional information such as course descriptions or university rankings. Very particular information was requested for certain professions; interviewees from the healthcare sector, for example, wished to see specific numbers of hours of theoretical training and of practice from different subject fields.

Similarly, in addition to the standard student data²², employers expressed the need for more information on evidence of learning (papers, presentations, media artefacts, etc.), mobility experiences and extra-curricular activities (see Table 2).

Table 2. During the recruitment processes, to what extent is it important for you to have a description of the following items?

	Very important	Important	Moderately important	Of little importance	Not important at all
Evidence of learning (papers, presentations, media artefacts, etc.)	24%	40%	22%	9%	5%
Information on mobility experiences (e.g. placements abroad)	20%	35%	26%	13%	6%
Extra-curricular activities	14%	35%	31%	16%	4%

Source: Employers survey, PPMI, 2017

The DS template is in a rigid document format, meaning that the DS may only be produced **as a whole, with all data at once**. Therefore, the interviewed stakeholders often found the **DS too long to be convenient for daily use**. A more concise presentation of student information was the most frequently mentioned feature of the DS that the interviewed stakeholders wished to be included. The unsuitable length of the document was glaringly apparent when it was printed. Some of the stakeholders were concerned about any potential additions of new information in the DS, since that might produce an even lengthier document. The problem of length was further exaggerated in cases where information was repeated in several languages (e.g. in both a national and a widely spoken European language).

Some of the interviewed stakeholders expressed concern that the DS was stymied by a **lack of flexibility and interoperability with other services**, such as professional and social networks, job databases, skills matching services, and electronic student platforms, each of which could make the DS a much more useful tool for both holders and employers.

Furthermore, due to the **timing** of its **issuance**, DS data often could not be used for the admission and verification of study achievements in other HEIs. That is, since the application deadlines for second and third cycle programmes were often set before the completion of applicants' degrees (and consequently before the DSs were presented), admission decisions had to be made on the basis of other documents such as transcripts of records.

1.2.3 Raising level of awareness and perceived usefulness

The DS aims to support its users in various processes: employers and recruitment services consider the skills and qualifications of job applicants, HEIs select candidates

²² Skills/learning outcomes acquired, courses taken, grades/other assessment data, credits acquired.

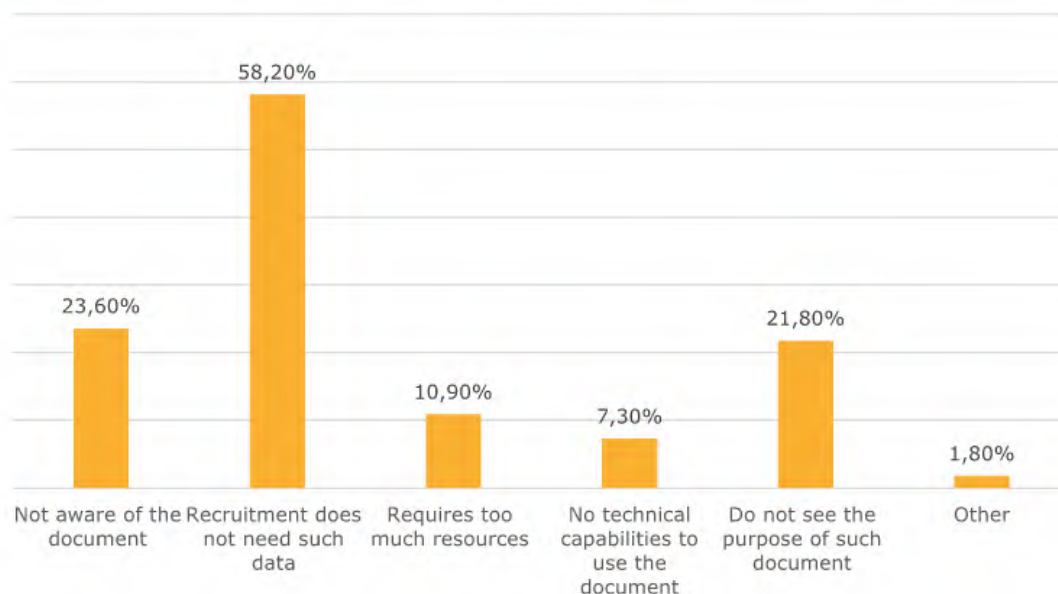
for studies and verify previous qualifications, while graduates use the DS for applications to next level studies or employment.

Wide scale implementation of the DS could be further facilitated if the document was perceived to be useful by all stakeholders. This could be done by **addressing the functionalities and details requested by stakeholders**. It was evident from our interviews that while some stakeholders favoured the status quo, others advocated for changes to the DS in terms of both content and information presentation. To match the expectations of different document users, it may be **necessary to find a consensus between different stakeholders in terms of DS content and its presentation**.

While many consulted stakeholders **were unable to identify the benefits stemming from the DS application** in their daily processes, our interviews revealed that for those stakeholders who were aware of the DS, the **common template was the key upside**. It allowed them to organise and present information in a comparable way, and made the qualifications more transparent, which in turn facilitated the work of validation and recognition institutions. Thus, **easier presentation of qualifications assisted transitions from education to employment and to further education** at different stages such as the application and selection of candidates.

The employers' survey revealed that there were three main reasons why employers did not use the tool: **lack of relevance of information presented in the DS for recruitment** (by far the most important reason), **lack of awareness about the DS**, and **lack of understanding of its purpose**.

Graph 7. Reasons for not using the DS (% of employers)



Source: Employers survey, PPMI, 2017

For instance, German, Moldovan and Montenegrin national surveys on the use of the DS showed that employers had been willing to cooperate with HEIs in making the DS more useful and applicable for employment purposes²³. Some countries such as Czech

²³ Bologna Follow-Up Group questionnaire of 2014

Republic had been **tailoring the content of the document according to the needs of major national employers**. This helped businesses and other organisations to evaluate candidate qualifications for the position.

A few interviewees also observed that there were particular **groups of HEIs that typically had less interest in the DS**. The first group consisted of **private institutions**, which often needed further incentive to provide all necessary information. The second group (which were fewer in number) consisted of **leading universities whose graduates were already doing well** in seeking further education opportunities and employment, and rarely needed additional information to supplement their degree.

A low level of awareness of the DS, and its limited applicability in daily settings, meant that in some cases alternative sources or methods of gathering student data were more commonly used; this, to some extent, diminished the use of the DS. Based on the European Activity Survey 2013 in the UK, those HE institutions that did not find the DS useful (nearly a quarter) stipulated that they tended to base their admission decisions on **other information sources** such as transcripts, interviews and auditions.²⁴ In 2014, a report produced by CIEP also found that education and training institutions rarely used the Diploma Supplement for recognition purposes²⁵. The key reason for the low take-up was that HEIs often used **their own criteria and procedures** for assessing and recognising foreign credentials, and the DS was not well integrated in their processes.

Awareness of the DS and its potential uses was also quite limited among students and graduates. A few interviewed HEI representatives affirmed that **students did not even know about the existence of the DS until they graduated**. According to the study "Diploma Supplement as seen by its users", this problem was known already in 2008, when the report concluded that informing students about the DS only after graduation diminished any potential opportunity to use partial data in the DS for unusual application deadlines and under other types of circumstance.²⁶

The Graduate survey data indicated that while many of the respondents reported that they had received detailed information about the DS, a large share of students/alumni could not even answer the question. Although this data can not tell us about how well students were actually informed about the DS, it does suggest that, at the institutional level, there is room for improvement in respect to raising students' awareness about the usability of additional student data (see Table 3).

Table 3. Did your higher education institution provide the following information on the Diploma Supplement?

	Yes	No	Do not know / cannot answer
Date the DS should be issued	38%	15%	47%
Contents of the DS	39%	15%	47%
Ways to use the DS	29%	21%	49%

Source. Graduates survey, PPMI, 2017

²⁴ UK European Activity Survey 2013.

²⁵ The use or potential use of QFs by HEIs and other stakeholders linked to mobility. CIEP, 2014.

²⁶ Study on the Diploma Supplement as seen by its users, 2008.

The Graduate survey also revealed that the most common use of the DS was related to job applications. The document was either sent with, or consulted to, fill in a CV, cover letter or professional profile (see Table 4).

Table 4. Have you used your diploma supplement in any of the following contexts?

Employment		
	Yes	No
I sent DS along with a CV/other application documents	34%	66%
I used DS during job interview	15%	85%
I used DS to explain my skills to my employer	13%	88%
I used DS to for job/skills-matching service	4%	96%
I never used DS in this context	46%	55%
Other contexts		
I used DS to fill in CV/cover letter/professional profile	34%	66%
I used DS to complement/augment my online profile	13%	87%
I used DS for applying for volunteering	6%	94%

Source: Graduates survey, PPMI, 2017

Several EHEA countries were taking **specific measures to enhance awareness of the Diploma Supplement, and to inform stakeholders about its added value**. For instance, Bologna Experts in Belgium gathered a focus group of HEI officers, students and employers, and after collecting the group's expectations and perspectives, they developed a promotional leaflet to raise awareness and knowledge about the applicability of the DS among students and graduates. In 2012, the Croatian NEC and Bologna experts group issued a renewed DS booklet with instructions and good practice examples, and organised additional promotion events in 2013 and 2014. Such promotional activities may feature, but are not limited to, direct contact with focus user groups, seminars, workshops, social networks, and websites (including ENIC-NARIC).

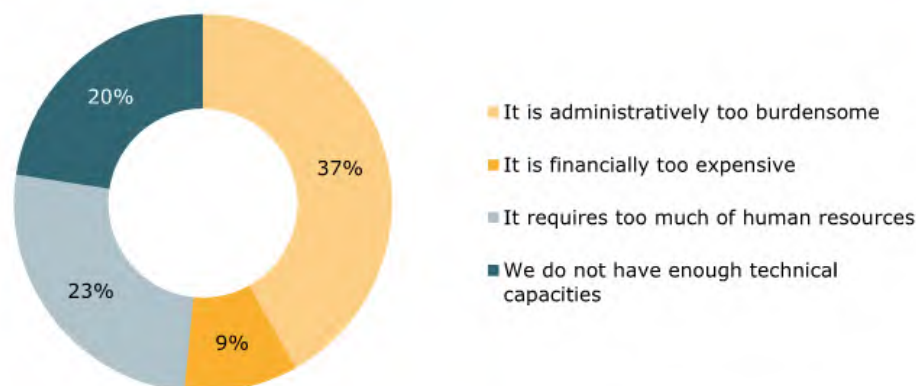
1.2.4 Optimising resources

Both interview and survey data revealed that implementation of the DS required **considerable resources**, especially from smaller institutions.

Many interviewed HEI representatives mentioned the need for extra working hours to manage the DS during graduation season. Some institutions also found it challenging to present information in two languages and lacked the resources for translation.

According to the HEI survey, institutions that were not issuing the DS or any similar document, shared a common belief that issuing this document may cause too much **administrative burden**. Also, a significant proportion of HEIs believed that they did not have the sufficient technical or human capacities for issuing the DS (see Graph 8).

Graph 8. Reasons for not issuing a document providing a description of the acquired competences, completed studies, their nature, level, context and content along with a higher education diploma.



Source: Employers survey, PPMI, 2017

On the other hand, representatives of HEIs that **did issue the DS** were more optimistic regarding the resource-related challenges of issuing the DS. However, there was still a significant number of HEIs representatives who claimed that issuing the DS caused administrative burden or required significant human resources (see Table 5).

Table 5. Based on your experience, to what extent do you agree with the following statements about the Diploma Supplement (or an equivalent document)?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Issuing a DS or an equivalent document is administratively burdensome	14%	30%	31%	35%	20%
Issuing a DS or an equivalent document is technically complicated	9%	18%	29%	38%	18%
Issuing a DS or an equivalent document requires a lot of human resources	8%	24%	23%	31%	14%
Issuing a DS or an equivalent document is financially expensive	4%	19%	24%	37%	16%

Source: Higher education institutions survey, PPMI, 2017

1.2.5 Government guidance and support

According to a Bologna Follow-Up Group questionnaire, 30 countries across the EHEA had national legal regulations on the DS issuance process. The **requirement to issue the DS usually helped to ensure the uniformity of the document and its issuance process**. The National Europass Centres which were interviewed generally agreed that a uniform DS format should become mandatory at national level.

Representatives of HEIs and qualification recognition institutions, however, warned that **coercive legal measures may bring high initial costs for HEIs**. Prior to the adoption of new regulations, significant **preparation** of their student data systems, explanatory notes, amongst other things, **would be necessary to mitigate these costs** and ensure an effective transition to the nationwide implementation of the DS.



The experience of some EHEA members showed that it may not be necessary to adopt coercive legislation if **HEIs acknowledged the benefits of the DS**. For instance, Ireland had no national legal requirement to issue the DS. Despite that, Irish HEIs have been issuing the DS for every graduate automatically and free of charge. The Austrian government, as another example, introduced legislative changes only after successfully adopting the DS in each field of study within HEIs.

To avoid dissatisfaction among HEIs, it is essential to provide them with **sufficient incentives** irrespective of whether or not a legal requirement to issue the DS is introduced. Interviewed HEIs claimed that they would support regulations on the compulsory issuance of the DS if they were **combined with rewarding factors, and a clear explanation of its benefits**. **Governmental support to absorb initial costs** may also contribute to a successful nationwide DS implementation process.

In addition to financial support for DS introduction, stakeholders highlighted the **importance of institutional guidance to HEIs** during the implementation stage and after. For example, Austrian national authorities believed that sufficient counselling helped to overcome the initial rejection of the common template by HEIs. In Turkey, HEIs benefited from Erasmus+ national agency support. Some good practices were also notable in Nordic and Baltic States, where **national authorities supported HEIs** on how to fill in the document properly, and provided standard descriptions and examples. This practice varied from common description of the educational system (in Latvia), to template sentences of how professional status should be described (in Finland). **Specific and clear wording could be ensured by providing HEIs with specific guidelines** for filling in the Diploma Supplement, tailored according to the national context in addition to the European level explanatory notes, as demonstrated by Estonian, Danish, or Lithuanian examples²⁷. Interviewed registrars confirmed that guidance was crucial as **provision of examples and explanations could help to produce a high quality DS**. With a nationally approved description of the higher education system in place, the institutions did not have to create their own explanations that might differ from other HEIs in the same country.

Guidance on implementing the DS is not limited to support from national or European authorities. It could be complemented by **collaboration and experience sharing among HEIs**, particularly if the efforts were led by institutions whose implementation of the DS were more advanced. Even though such cooperation examples HEIs were rather rare across EHEA, we identified some good practice examples. In Armenia, ENIC-NARIC had been helping HEIs implement the format, contents and presentation of the DS. Later, it transformed into a collaborative effort among HEIs. The case in Austria was similar, where **pioneer institutions in the implementation phase subsequently collaborated with other HEIs**, not only on the DS, but also more generally on the introduction and management of student data systems.

²⁷ Akadeemilise Õiendi Täitmise Juhend. (Akadeemilistele Õienditele, Mis Antakse Välja Alates 01.01.2012)
http://adm.archimedes.ee/enic/wp-includes/ms-files.php?file=2012/07/AO_ja_DS_juhend_2012.pdf

2 Feasibility of digitalisation

Summary of findings

- Most of the interviewed **stakeholders were in favour of the** digitalisation of the Diploma Supplement. The **digitalisation effort could potentially close the existing DS implementation gaps** and provide further benefits to its users.
- The **costs** of introducing the **digital Diploma Supplement were not that high**, however, the **perception of costs** made some HEIs reluctant. This could be resolved by providing a **clear explanation of the costs** involved and better dissemination efforts of digital practices.
- The **employers** largely agreed that digitalisation of the DS **could reduce recruitment process costs**. Likewise, many **HEI** and **ENIC-NARIC** representatives either **expected or confirmed** that digitalisation of the DS **would aid faster accreditation and validation**.
- Digital technologies allow for more varied security measures, which would ensure a **higher security standard for student data** than the paper format. However, in order to make the use of the DS as convenient as possible, security measures should take into account related services such as user **authentication options**.
- A digital DS would allow for a **more flexible format of the document**. More flexibility would allow issues related to the current **length and formatting** of the DS to be addressed, and accommodate **more customised information**. Digitalisation also opens up the opportunity for **further integration of the document with other related services**.

2.1 The need for DS digitalisation and its potential impact

Although one of the main objectives of this study is to analyse the feasibility of the digitalisation of the DS, it should be noted that any potential upgrades may not replace the existing DS template, and would solely concern the format of data transfer, processing and layout. While the DS template would continue to ensure a recognisable structure across the EHEA, digitalisation would provide more opportunities to use this standard document in a more flexible way.

2.1.1 Increasing use of digital and online technology

Between 2005 and 2015 the levels of student mobility increased by more than 50% worldwide, surpassing 5 million people studying abroad. In some of Europe's leading economies (UK, France, the Netherlands, Belgium, Austria, and Denmark) the international student enrolment level was higher than the OECD average and was between 10-18%.²⁸ This increasing rate of educational mobility demonstrates the importance of student data portability between institutions and countries.

Meanwhile, the digital economy is growing at seven times the rate of the rest of the economy.²⁹ According to Eurostat, in 2015 almost 54% of Europeans accessed the internet through their mobile phones, compared to 11% in 2010. There was also a rapid growth of various online public and private services that were previously

²⁸ Education at a Glance 2015: OECD Indicators. OECD, 2015.

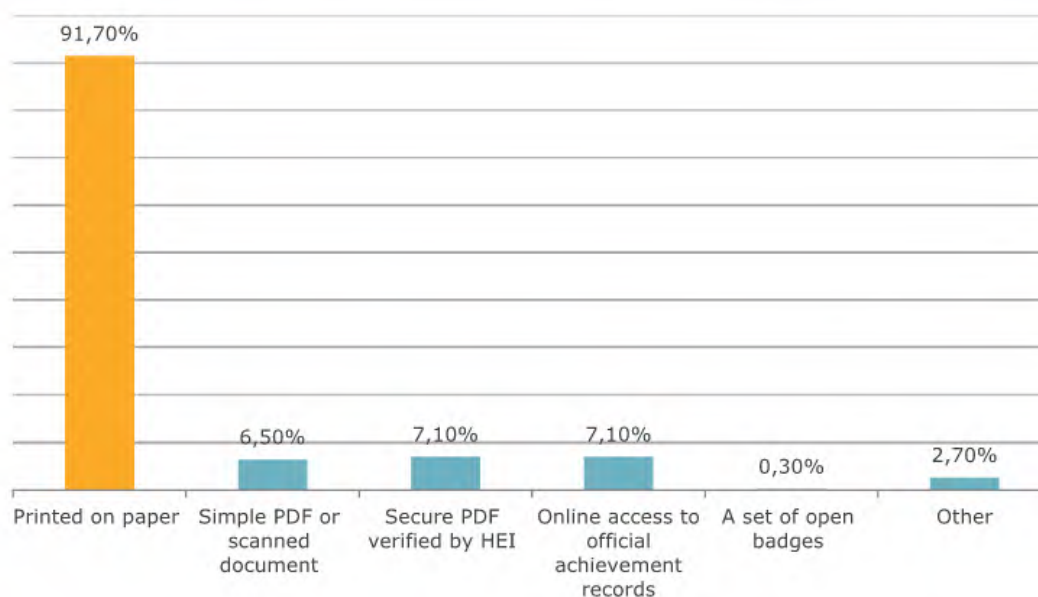
²⁹ The EU explained: Digital agenda for Europe.

typically accessible only in traditional environments (e.g. banking services, job search, shopping, educational courses, and public administrative services).³⁰

Digital literacy among Europeans is high, and there is an unprecedented use of various digital services. Based on the Digital Economy and Society Index (DESI), internet connectivity and human ICT skills have surpassed both the level of digital technology integration³¹ and digital public services³², which points to the unexploited potential of ICT to be applied to other areas.³³

Since the introduction of the DS, the spread of internet access at home, in the workplace, and in educational institutions, has grown rapidly. The advent of portable connected devices such as smartphones and tablets, and the development of social networks (including professionally-oriented ones such as LinkedIn), have significantly affected the spheres of education and the labour market. Meanwhile, the Diploma Supplement has remained a paper document in the majority of higher education institutions. The HEI survey suggests that the absolute majority of HEIs still issue the DS primarily on printed paper (see Graph 9).

Graph 9. In what format does your HE institution issue the Diploma Supplement (or equivalent document) to graduates?



Source: Higher Education Institutions Survey, PPMI, 2017

³⁰ http://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators

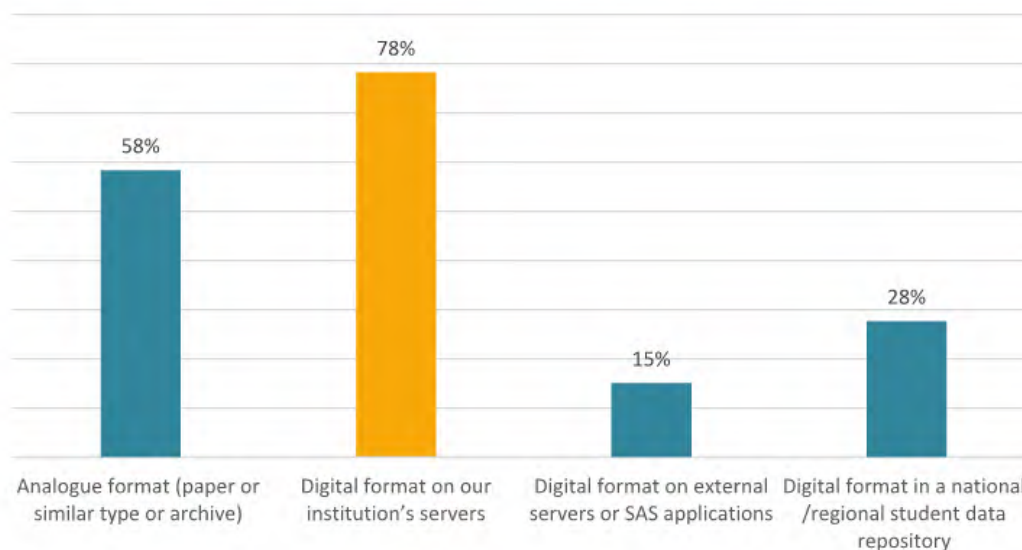
³¹ The Integration of Digital Technology dimension measures the digitisation of businesses and their exploitation of the online sales channel. By adopting digital technology businesses can enhance efficiency, reduce costs and better engage customers, collaborators and business partners. Furthermore, the Internet as a sales outlet offers access to wider markets and potential for growth. Accessed at <https://ec.europa.eu/digital-single-market/en/desi>

³² The Digital Public Services dimension measures the digitisation of public services, focusing on eGovernment. Modernisation and digitisation of public services can lead to efficiency gains for the public administration, citizens and businesses alike as well as to the delivery of better services for the citizen. Accessed at <https://ec.europa.eu/digital-single-market/en/desi>

³³ <https://ec.europa.eu/digital-single-market/en/desi>

This despite the fact that the majority of surveyed HEIs stored their student data digitally. Graph 10 shows that 78% of surveyed HEIs stored student data in digital format on their own servers (e.g. Student Information System, Learning Management System, ePortfolio system, or similar).

Graph 10. Where does your higher education institution store the student record data?



Note: respondents could choose more than one option.
Source: Higher Education Institutions Survey, PPMI, 2017

2.1.2 Addressing the high costs of issuing and processing analogue documents

The processing of paper documents is very expensive. An example taken from the financial sector shows that replacing paper invoices with e-invoices could generate savings of EUR 240 billion over a period of six years across Europe.³⁴ In the educational sector, the Dutch ministerial agency for education (DUO) has estimated the cost of processing the paper documents international students receive when they try to enrol in Dutch HEIs. Manual or semi-manual application processes made the enrolment of foreign student very expensive and elaborate, costing an estimated 450 euros per student. The expenses consist of printing, postage, notary and other costs typical of analogue processes.

It was argued in a previous chapter that HEI representatives often dealt with excessive workloads related to filling out the Diploma Supplement. As one of the interviewed stakeholders stressed, any introduction of new tools or revision of the existing ones should not cause additional administrative burdens. With this in mind, all of the solutions we propose for DS digitalisation would save resources in the medium-term³⁵. However, some of the more advanced options would require higher initial investments (financial, administrative and human resources).

According to our survey findings, a vast majority of employers agreed that digitalisation of the DS could reduce costs of the recruitment process (see Table 6). This was echoed by many of the interviewed HEIs representatives:

³⁴ SEPA: potential benefits at stake. Researching the impact of SEPA on the payments market and its stakeholders.

³⁵ Based on interviews with representatives involved in the development of Erasmus Without Papers, EMREX, HEAR, Open Badges, Dutch system of digital exchange of student data, HEIs managing student data electronically.

- 'I think it would be so helpful for administrators, for all of us who are dealing with the preparation of the DS. If we had the digital document we would not have to issue the paper document and it would help the students in this way. It would reduce cost, save time.' [Representative of university, Bosnia and Herzegovina]
- 'Our institution would be in favour of digitalising the Diploma Supplement, it would reduce the costs of issuing it, and it would be really useful to get rid of all the paper.' [Representative of university, Belgium]
- 'Today we have some handmade security attributes on the document, they take time. So of course it will save time and paper resources.' [Representative of university, Sweden]
- 'Overall, digitalisation drastically reduces bureaucracy. Especially for companies engaging with universities.' [Expert of student records and digitalisation, UK]

Source: stakeholder interview programme.

Several interviewed HEIs and ENIC-NARIC representatives also mentioned that faster accreditation and validation could be one of the key advantages of a digital DS. To paraphrase one of the interviewees, a digital DS that could be verified online would help avoid official translations, legalisation of documents (apostilles), and other bureaucratic procedures. Similarly, surveyed employers believed that a digital DS would aid the verification processes (see Table 6).

Table 6. Do you agree with the following statements about the impact of digital versions of the Diploma Supplement?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Digital DS reduces costs of recruitment process	22%	56%	19%	2%	0%
Digital DS saves time during analysis of applications	28%	48%	20%	4%	1%
Digital DS is easier to verify	25%	47%	22%	6%	0%
Digital DS makes the overall recruitment process easier	20%	49%	28%	3%	0%

Source: Employer survey, PPMI

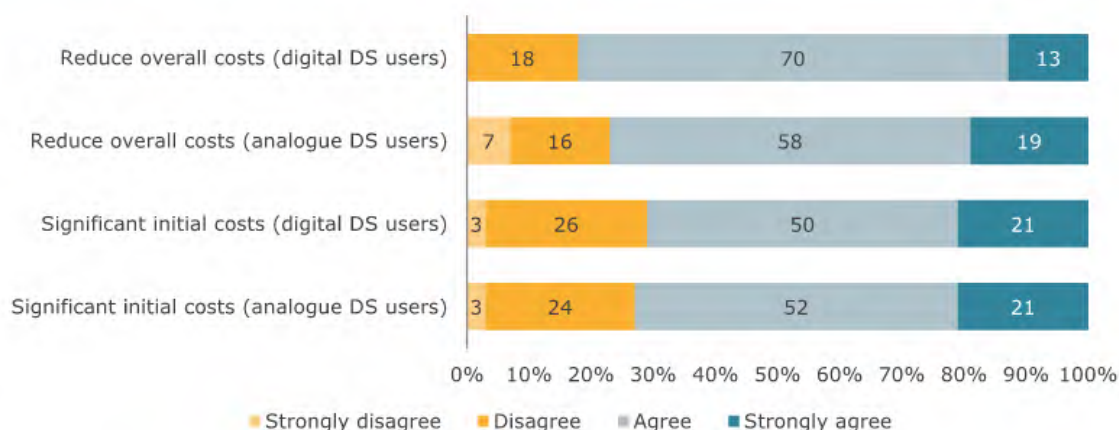
One of the interviewed ENIC-NARIC representatives noted that the perceived initial cost of DS digitalisation was one of the reasons for the relatively slow uptake at the beginning of the digitalisation process. Our survey data confirmed that institutions may be discouraged away from digitalisation efforts if they perceive the initial costs to be high. And, a majority of surveyed HEI representatives did indeed believe that digitalising the DS or an equivalent document would require significant initial costs. These expectations were confirmed by some HEIs that had already experienced digitalisation (see Graph 11). However, as our survey (see Graph 11) and interview data suggest, in many cases the initial costs paid off over time. Usually in these cases, the interviewed representatives mentioned that their organisations gained tangible benefits even in the short-term, and any considerable investments were required only once.

HEIs which did not yet have electronic student data management systems beforehand, and where most of the administrative work was done manually, incurred more significant costs related to DS digitalisation. The interviews indicate that digital

student data management systems are the most efficient solution for processing student data. Such a system connects students, graduates, academic and non-academic workers, which facilitates efficient dissemination of the DS. In such systems, the preparation and issuance processes of the Diploma Supplements could be automated, leading to significant savings in human resources. However, it is necessary to ensure that the system is created in a way which actually allows the quick issuance of the DS (e.g. data can be exported into the DS format automatically). Many interviewed HEIs also believed that setting up a national information system for HEIs would be a step towards better efficiency. A good example of an integrated student data management system was found in Croatia, where the Ministry of Education actively invested in a central student data system to facilitate the issuance of the Diploma Supplement among other aims.

As an Italian HEI reported, the setup of the national student data management system was a very demanding process, which required a lot of work for data standardisation and uploading to the integrated system. It could be concluded that the initial costs of DS digitalisation would highly depend on the level of preparedness of institutions, in particular their existing student data management processes, their existing descriptions of subjects, and the presence of IT staff and infrastructure.

Graph 11. Initial costs and savings of digitalisation



Note: The extent to which HEI representatives agreed that digitalising the DS or an equivalent document required or would require significant initial costs. The extent to which HEI representatives agreed that digitalising the DS or an equivalent document reduced or would reduce the overall costs of issuing this document.

Source: Employer survey, PPMI.

2.1.3 More security and easier verification

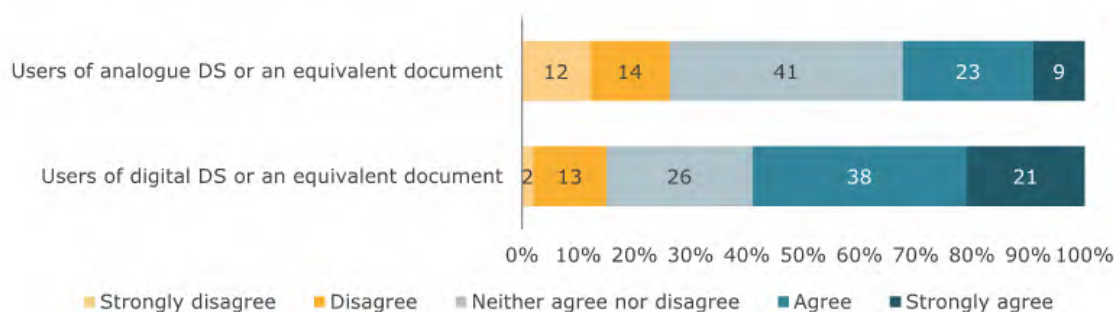
Traditional printed diplomas and associated documents (such as the DS) have for a long time have been subject to relatively high levels of fraud, since the security measures applicable to paper documents were quite limited. International education fraud is a global problem, and the cost of fraud worldwide that is related to paper documents is estimated to be USD 2.5 billion annually.³⁶ A French private company Verifdiploma, which specialises in degree verification and student data management, estimates that approximately 8% of the diplomas and associated documents it checks

³⁶ The Future of Digital Student Data Portability: Defining the Digital Student Data Ecosystem. Groningen Declaration Annual Meeting 2014.

are fraudulent. The American Association of Collegiate Registrars and Admissions Officers (AACRAO) has provided a similar figure, estimating that 5-10% of diplomas are forged. The credibility of additional student data that is usually presented as part of job applications is also often in doubt. In the United Kingdom, for example, one third of job applicants admitted to lying (at least to small extent) on their CVs, and the information most common falsified were their qualifications.³⁷

Our data shows that digitalisation of the DS would directly address these needs related to verification and recognition processes. According to the HEIs survey data, the respondents believed that digital Diploma Supplements were more secure than analogue documents and significantly eased the recognition process. Although those institutions that issue the DS on paper seemed largely undecided about the impact of digitalisation on security, those HEI representatives that already work with the digital DS were more likely to agree that it did have security benefits (see Graph 12).

Graph 12. To what extent do you agree that the digital version of the DS or an equivalent document is/would be more secure?

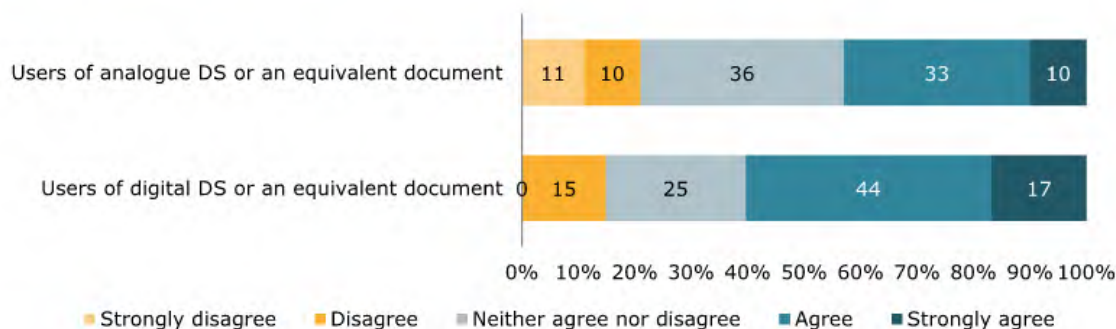


Source: Higher Education Institutions Survey, PPMI, 2017

As several interviewed representatives of the NARICs pointed out, digitalisation of their processes would allow them to verify credentials quicker and more assuredly, which would in turn shorten response times to students. During the group discussions of the annual NARIC meeting in 2016, many representatives agreed that digitalisation would help solve student data fraud. This issue could be tackled by allowing a direct exchange of DS data between HEIs and recognition authorities. The HEI survey data showed that institutions working with printed Diploma Supplements expected to see a significant improvement of the recognition process if the DS were to be digitalised. Importantly, HEIs issuing digital Diploma Supplements confirmed that digitalisation did indeed aid the recognition process (see Graph 13).

³⁷ Higher Education Degree Datacheck (HEDD) survey data. HEDD is UK Higher Education's official service for candidate verification and university authentication.

Graph 13. To what extent do you agree that the digital version of the DS or an equivalent document significantly eased/would ease the recognition process?



Source: Higher Education Institutions Survey, PPMI, 2017

Our analysis of digital student data management technologies revealed several types of security measures, and they corresponded to different complexity levels. For example, PDF documents can be protected with a simple digital signature, but different authentication systems were used by institutions and governments, such as those used for accessing student systems, online banking or e-government services.³⁸ Although authentication systems could be used as security measures to access student data, the use of such authentication options were confined to certain institutions or countries, since there were no universal mechanisms to ensure the recognition of different authentication mechanisms across borders. The various authentication and security measures are discussed in more detail in section 2.4., including a cost-utility analysis of different digitalisation options.

2.1.4 A more flexible structure of the DS

According to the interviewed stakeholders, which included labour market representatives, the Diploma Supplement could be improved by brevity, better presentation of data, and provision of additional information. The current document was perceived to be too lengthy, and the data presented excessive. On the other hand, several interviewees mentioned that employers' increasingly needed even more detailed information on potential employees. This could indicate that the current structure of the DS does not always provide the most relevant data for all types of stakeholders. It should be acknowledged, however, that **different data was necessary for academic and professional recognition purposes**. Also, different countries and even different HEIs across Europe varied significantly in how they prioritised one over another.

According to the interviewed digital student data experts, depending on how it is implemented, digitalisation could allow for a more user-friendly presentation of student data, while also maintaining the same or even a greater level of detail. Even simply providing the document in a PDF with the same structure as the paper version would still have advantages over the paper version; at the very least, information would be searchable in a PDF, making it more convenient to navigate through the form's information. These different expectations could be best met by applying a **modular approach**, which would allow tailoring of the DS template to specific needs.

³⁸ Currently one of the most advanced technologies used to secure the data is the so-called Affymetrix encryptions which provide different access permissions for different entities in the network. For example, universities, students, teachers, or employers would each have a public and a private key which would grant the permission to access information which was made available for either public or individual access. Currently this technology is however underdeveloped and remains one of the most expensive solutions.



Hence, the DS would become a formative document with an option to present only relevant information without affecting the length of DS. Different modules could represent not only currently available DS information, but also potentially integrate data from external platforms and professional networks.

Solutions such as Open Badges or other equivalent technologies that allow for a formative document could provide the highest level of flexibility in terms of the presentation of data. Integrated with external platforms, these solutions could allow the presentation of both formally and non-formally acquired skills and other related experience, the student profile could be anonymised, and there would be more opportunities to search for certain profiles of students who match the required skills. In addition, profiles could be linked with professional networks such as LinkedIn, Opportunity, ePortfolio, and others.

Moreover, a flexible approach to the format would correspond to the increasing needs for more specific information. For example, some National Europass Centres claim that the DS should focus on key aspects such as competences or activities during studies, and could also include extracurricular activities such as volunteering or membership in societies. Such an approach was applied for by the Higher Education Achievement Report (HEAR) in the UK, which had a specific section (no. 6) dedicated to this.

2.2 Mapping and shortlisting the digitalisation practices

The term 'digitalisation' has not yet been operationalised in the context of Diploma Supplement, and is therefore understood differently across EHEA countries and between HEIs. These understandings range from very basic (e.g. simply scanning a paper document may be defined as 'digitalisation') to quite advanced (e.g. complex student data storage and exchange systems that are integrated with labour market tools and which offer users several functionalities). Our interviews revealed that digitalisation experts, recognition experts, and student record managers, often have very different notions about the ideal level of DS digitalisation and its scope.

Analytically separating the whole array of ideas of what digitalisation could be is important, and first it is necessary to look at how digital elements could apply **to the whole process of issuing and using the Diploma Supplement**. There are a few important elements:

First, and essentially, the DS is a tool to deal with student records and potentially other student data. Digitalisation could therefore apply to **the way student data is stored, collected and managed**. Related to this, there are further considerations at micro level:

- Is the student data stored in digital format at all; i.e. does the HEI have an electronic database of student records?
- What format of data storage is used? Is it ensured that this format is compatible with other formats used by other HEIs, and is it ready for exchange?
- Does the data need to be entered manually for each learner? How does the information (on learning outcomes obtained, grades, etc.) reach the database? Who has permission to manage and edit it?

Second, it is necessary to look at which digitalisation practices can be applied when **presenting student data (or issuing the DS)**. Again, there are a number of important micro-level considerations:

- Is the DS issued in any type of electronic format (including even scanned and unsecured PDF's)?

- What format of presentation or output is used? What is the interoperability potential of the specific format?
- Is the document automatically generated from the database? Is the method of issuing a digital DS more or less convenient for the HEI's staff compared to the paper version?
- Does the digital DS save costs (e.g. on printing) compared to the paper version? Or are there additional costs which make it more expensive?
- What new security features are offered by digitalisation of the DS? Does the security of the DS (in terms of personal data protection, safety of HEI's information systems, and protection against fraud and forgery) improve or decrease after introducing a specific DS digitalisation practice?

Finally, the main purpose of the DS is its **contribution to academic and professional recognition of qualifications**. The digital practices tackling issues in this area particularly target **user-friendliness and access to data**. The main considerations are:

- Does the digitalisation practice offer a more user-friendly experience to its users (e.g. more easily viewable, easier to find information, shorter or more structured)?
- Does the digitalisation practice enable and promote access to data during the course of studies? Is this functionality used by students and graduates to reflect on their skills, or to find employment, further studies and learning opportunities?
- Does the digitalisation practice ease lifetime-accessibility to the DS? Can graduates access their DS at any time during their career and from anywhere?
- Who has access to the data and who controls the data (e.g. graduates themselves, HEIs, potential employers, potential places of further learning)?
- What are the identification mechanisms used?

The digitalisation cases existing in Europe can also be characterised by the level at which they are implemented and by their collaborative scope. Digitalisation cases can be:

- **Institutional** – for example, an HEI introduces a digital practice single-handedly or within a small consortium of HEIs. This can be done with or without regard to other existing practices in different HEIs.
- **National level initiatives** – HEIs in a single country may participate in effort building, or by adopting common digital practices. Such initiatives are also likely to have strong (legal, financial, administrative and other) support from the country's government. Such initiatives may lead to laws and by-laws which regulate the practice, to the establishment of national student data repositories, to national services assisting employment and tracking of graduates, etc.
- **International initiatives** – HEIs may set up international (regional, European, or worldwide) networks in order to exchange digitalisation practices related to student data and the DS, and to ease collaboration. These networks may be funded from Erasmus+ or other comparable sources.

Below we present examples of DS and student data digitalisation initiatives across and outside Europe. These include initiatives that deal with all three potential areas of DS digitalisation and with single HEI, national and international initiatives.

EMREX

EMREX is the solution for electronic transfer of student records between higher education institutions in Europe. It works in the following way: an electronic transfer of a student's achievement is initiated by a student's approval through the Student Mobility Plug-in (SMP), installed in the student web or student portal at the home university; the student's records are then obtained from the National Contact Point (NCP) of the host university in question. EMREX is neither an IT project as such, nor a project aiming to develop a new system. Rather, EMREX utilises existing infrastructure (e.g. user authentication, authorisation, data warehouses, etc.). Its tangible outcome is a federated solution that supports the exchange of student data on achievements.

Output: Student data transfer; online interface.

Scope: International, Norway, Finland, Denmark, Sweden, Italy, Poland.

Strengths	<p>Utilises XML format, which is widespread worldwide. This format would allow for the implementation of digital DS as well. Its source code and instructions for implementation are clearly provided online; no licencing costs; in GitHub.</p> <p>With EMREX, some of the recognition process can, with little effort, be handled automatically or semi-automatically.</p> <p>The solution contains specific security measures to prevent unauthorised access and altering of data.</p> <p>High scalability and easy implementation for any HEI utilising a digital student data system.</p> <p>The solution is very versatile and can be adapted to local authentication and data storage infrastructure.</p> <p>The solution is compatible with a decentralised management model – HEIs themselves are responsible for operation of the solution on their end. This leads to better sustainability.</p>
Weaknesses	<p>No solution yet on how the common authentication/log-in could be carried out across Europe.</p> <p>No solution for storing the results. When the NCP returns results to the EMREX client, the EMREX client must provide a solution for storing these results locally.</p> <p>If the recipient has not implemented the EMREX model, the output can be viewed on a screen, or as a PDF file, which is only a marginal improvement over the paper version: the issue of length and user-friendliness remains. No clear solution or platform envisaged for how to better present the data to all potential users.</p> <p>Sustainability of the solution may depend on future funding.</p>
Intended impact	<p>Less administrative burden for institutions due to automated processes.</p> <p>Simpler exchange of information both for the student and the involved institutions. -Increased availability, quality and reliability of information about student records of achievement information.</p> <p>More transparent mobility process.</p> <p>Easier recognition of previous academic studies and degrees because of increased eligibility.</p> <p>Higher quality of the achievement data exchanged between European higher education institutions.</p>

Erasmus Without Paper (EWP)

The Erasmus Without Paper project aims to create a network supporting the electronic exchange of student data by interlinking the existing Erasmus student databases of Higher Education Institutions (HEIs), with the goal to permanently migrate from the paper world to the electronic world of student data. The EWP Network attempts to standardise student data transfer on a European-wide scale. The transfer does not involve documents themselves (e.g. scanned copies) but rather the data that is contained in these documents, so that they can be used for the generation of various documents, processed automatically, and stored in institutional databases. No data is held centrally.

Output: Student data transfer.

Scope: International, Belgium, Norway, Poland, Sweden, Portugal, Italy, Austria, Spain.

Strengths	<p>There is no need for specific software or infrastructure; the project provides a platform that enables the electronic exchange of information amongst the tools already used by HEIs.</p> <p>The project attempts to standardise student data transfer on a European-wide scale; the project specifications, source code, and documentation are free of charge and open source.</p> <p>It is a decentralised P2P network, where student data itself is never stored (minimising exposure to regulatory issues).</p> <p>The Registry maintainer needs to be contacted only once. Afterwards, any updates are maintained by simply updating the discovery manifest file.</p> <p>The solution has high scalability, as it is based on widespread XML format.</p> <p>It is almost a completely decentralised model.</p>
Weaknesses	<p>Compared to EMREX, the data is with HEI administrators instead of students or graduates. This makes the project more hands-on for the administrators, but there is less attention paid to how the data could be used by graduates or potential employers.</p> <p>There is no specific platform or comparable solution foreseen for how to better present this data to learners or the labour market.</p> <p>The sustainability of the solution may depend on future funding.</p>
Intended impact	<p>To reduce costs, to increase the efficiency of labour, and to provide better access to student data across Europe. This can eventually lead to permanent migration from the paper world to the electronic world of student data.</p>

Stork 2.0. eAcademia Pilot

Secure idenTity acrOss boRders linKed (STORK) makes it easier for citizens to access online public services across borders by implementing Europe-wide interoperable cross border platforms for the mutual recognition of national electronic identity (eID) between participating countries. The eAcademia pilot has built a cross-border interoperability platform, in which services offered by higher education institutions and other government institutions can be accessed using electronic credentials (i.e. username and password) issued by foreign countries. The private sector was also involved in the pilot; they were allowed to tailor the academic information found in the Electronic Diploma Supplement (e-DS) to their own purposes. For example, in order to assess job candidates' qualifications, the private sector participants in the pilot were able to find proof of candidates' qualifications online. The e-DS was adopted as an academic data model during the development of the eAcademia Pilot project.

Output: Student data transfer, Services.

Scope: International, Czech Republic, Greece, Iceland, Italy, Lithuania, Portugal, Slovenia, Spain, Sweden, Turkey, UK.

Strengths	<p>Elements of the eAcademia attribute profile were modelled after a proposed standard being deployed at Spanish university council level, calling for wider standardisation.</p> <p>Users are granted access via trusted identities and data through a reliable intermediary.</p> <p>Services are interconnected through a cross-border infrastructure that allows interoperability.</p> <p>It has high legal, security and trust assurance standards for identity services, to avoid the risks of non-consented data access for the user or cyber-attacks.</p> <p>The project found a way to integrate the complex Diploma Supplement structure; it was comprised of several different student attributes, including students' names, the curriculum, courses and qualifications into a simple valued string.</p> <p>It included non-academic partners such as private employment services.</p>
Weaknesses	<p>Finding a common naming framework for institutions and for university degrees was challenging.</p> <p>The pilot project was limited to a very small number of use cases.</p> <p>Uncertainty in adopting the results of STORK 2.0 in private and public institutions and initiatives due to uncertainty of the future maintenance of the infrastructure;</p> <p>It carried risks for sustainability and adoption related to the need for permanent coordination and governance mechanisms for the eIDAS infrastructure and maintenance of STORK 2.0 results; low number of users of the national eID schemes.</p> <p>There is currently no solution for easy connectors with commercial software.</p> <p>The user experience, and the flexibility of its infrastructure, was burdened by high legal and trust assurance requirements intended to offer trusted identity services. This puts its adoption at risk.</p>

Intended impact

To reduce costs, since the existence of a single and standard gateway for service and data connection is not only beneficial for cross-border environments, but also for national infrastructures, and even internally to institutions.

To open up the business opportunities that would accompany cross-border interoperability with other educational institutions.

To make student and staff mobility simpler and cheaper, which will encourage many more students to choose to study abroad; to reduce administrative complexity, paperwork and front-desk attention, especially in the long-term, with the associated cost reductions.

To make recruitment and candidate evaluation processes more efficient and reliable; to handle academic records with more trusted validation and automated processing.

Diploma Registry in Norway

The Diploma Registry works as an intermediary between the applicant, the recruiter, and the education institution, to ensure that degrees and results are transferred directly from the source (the education institution) to the recruitment system. This ensures that results cannot be tampered with when transferred to the recruiter. The applicant can publish the study results as a PDF or Web page through the Diploma Registry, or make a raw data transfer between the source and the destination.

Output: Student data transfer, Standalone electronic document.

Scope: National, Norway

Strengths

The Diploma Registry provides a solution for **verifying degrees and grades, thus reducing workload both for recruiters and student administrators.**

The solution can provide **trusted content directly to the employer** with no need for additional interoperability.

It has the **ability to transfer raw data** to the connected third party recruitment services.

There is a potential for **international scalability**, since the solution is using EMREX protocols to connect to other countries' results providers.

Weaknesses

The solution is targeted at a national market and has limited functionalities at international level.

The solution is based on national eID system, and even though this solution provides secure authentication, it may limit international transferability due to the limited use of eID and lack of infrastructure across Europe.

Intended impact

To create a service that companies and public agencies can rely on, and where the owner of the results can make them available to companies and agencies.

The Diploma registry:

- makes it easier for applicants to present their results;
- makes it easy for employers and educational institutions to receive results;
- ensures the information is correct.

e-HEAR (Higher Education Achievement Report)

The HEAR is specific to the UK and is a concise (no longer than 6 pages in printed form) electronic document produced by HEIs. It provides a record of a student's achievement during their time in higher education. The HEAR incorporates the European Diploma Supplement and may be accessed at any time during a student's career with the institution and afterwards. The document is verified by the Academic Registrar or an equivalent officer. The document, in addition to the information provided in the usual DS format, includes voluntary and extracurricular activities, participation in clubs, societies, awards received, etc. The Higher Education Academy (HEA) provides national support for the implementation and maintenance of the HEAR.

Output: Standalone electronic document (some HEIs provide associated online interface and services).

Scope: National, UK.

Strengths	<p>It enables institutions to provide a detailed picture of student achievement that have been verified by the institution, including academic work, extra-curricular activities, prizes and employability awards, voluntary work, and offices held in student union clubs and societies.</p> <p>It can be used as a formative tool, which may be available and used from a student's entry to higher education and throughout their higher education experience.</p> <p>It could aid selection in graduate recruitment.</p> <p>It complies with the DS international standards; the software is easily adaptable to a range of source records systems.</p> <p>It is a "live" reference tool, promoting students' engagement.</p> <p>It is accessible by others and searchable by third parties; it meets the expectations of younger generations, e.g. mobile accessibility.</p> <p>It maximises the potential of IT and social media (LinkedIn).</p> <p>Digitally secured and verified by the university.</p> <p>Data can be decoupled from the 'document format' and passed to other relevant services (e.g. LinkedIn, employer and HE institution applicant management systems).</p>
Weaknesses	<p>High involvement is required from all parties who participate in the chain.</p>
Intended impact	<p>To offer a more sophisticated approach to recording student achievement: the provision of a rich record of student activity adds value to the student experience, and can encourage students to make the best use of their time at university.</p> <p>Over time, to reduce administrative tasks, produce efficiency and cost savings, and improve student record systems.</p> <p>To make a contribution to issues relating to quality and standards in higher education by, for example, providing more detailed and transparent information on the assessment process, as well as reporting on students' achievements outside the formal curriculum.</p> <p>To enable students to represent a wide range of their achievements to employers and postgraduate tutors, thereby enhancing their employability.</p>

Spanish Electronic Diploma Supplement (e-DS)

The e-DS is a proposed content model for the DS from an XML specification. This application targets HEIs, employers, students and service companies related to the proposed model. The XML data model of the e-DS has been designed following the information contained in the outline structure for the DS and ECTS/DS labels. The main features include the usage of rich text to provide an attractive impression using customized style sheets, the ability to add attached documents referenced from optional elements, the introduction of external web links with extra information, and the integration of electronic signature elements. An electronic DS may include attachments, extension content and several digital XML signatures. This solution supports various electronic signature formats, including XAdES-A, PAdEs (PDF Advanced e-sign), and mobile electronic signature is also supported. Timestamping and batch processing functionalities are also offered.

Output: Standalone electronic document

Scope: National, Spain.

Strengths	<p>It establishes minimum basic fields and provision of multiple optional fields, adding value in specific contexts.</p> <p>It defines rich text elements to promote attractive prints through custom stylesheets.</p> <p>It defines optional extension elements useful in sectoral environments, national contexts, etc.</p> <p>It integrates of electronic signature elements suitable for national and European electronic signature standards and developments.</p> <p>It makes including attached files referenced from optional elements possible.</p> <p>It has a policy of naming the elements in English in order to facilitate their internationalization.</p>
Weaknesses	<p>This data model is still not widespread and has a low number of implementations.</p> <p>Some of the elements defined in the model are optional in order to enable compatibility in different countries, but in some contexts it would be recommended to be mandatory.</p> <p>It is domestic (Spanish) in scope only.</p> <p>It has not yet developed an interoperability strategy with other international systems.</p>
Intended impact	<p>The implantation of this data model in the university context promotes the development of different applications and additional services such as the e-DS issuance and verification through university website; the provision of academic attributes to other entities; and the ubiquitous access to academic information from mobile devices.</p> <p>To facilitate recognition of studies and degrees between HEIs.</p> <p>To make the DS issuance in paper and electronic format cheaper.</p> <p>For HEIs, it offers a mechanism for exchanging academic information through electronic means; for companies, it offers data focused on employability, and; for students, it is an official electronic document.</p>

Dutch diploma register (DUO)

In 2012, DUO (the executive agency of the Dutch MoE) established a diploma register. It is an online register that contains details of diplomas, certificates and testimonials of Dutch programmes of study that are funded by the Ministry of Education, Culture and Science. These details are linked to the personal details of the owner of the diploma. The register is made available by the Ministry of Education, Culture and Science to combat fraud. The register can also be used cross-border in projects to support international student mobility. As part of an international cooperation and improving processes, DUO has been piloting the exchange of student data together with Flanders, a region of Belgium.

Output: Standalone electronic document, student data exchange

Scope: National/International, Netherlands/China, Norway, Denmark, Finland, Sweden, Italy, Poland, Germany, United States.

Strengths	<p>The solution uses SFTP, which is a standard way of exchanging data through the internet.</p> <p>The solution uses PDF, another standard way of presenting data.</p> <p>The solution uses web-services and xml-messages compatible with other projects such as Emrex.</p> <p>Being an official register in the Netherlands, it has a high adoption rate and there is no competing registry.</p>
Weaknesses	<p>At the time of writing, there is no possibility to store the Diploma Supplement within the registry.</p> <p>Data Exchange features are not yet fully emphasized.</p> <p>Its focus is predominantly domestic.</p> <p>Currently, its technological implementation is based on consolidated technologies but is not innovative.</p> <p>Its roadmap for further developments is unclear.</p>
Intended impact	<p>To facilitate international mobility.</p> <p>To reduce administrative burden for students and HEIs.</p> <p>To prevent fraud.</p>

CINECA ESSE3 Diploma Supplement

ESSE3 is the Higher Education Student Information System (HE-SIS), produced by CINECA an Italian inter-University Consortium, and used by 70 Italian public and private Universities. ESSE3 manages all the Course Catalogue and Student Data required by the full Diploma Supplement report, and can produce it automatically at the end of the graduation process. Students can download their Diploma Supplement from the ESSE3 web-portal using their personal username and password. The DS can also be digitally signed by a University Administrator in PDF-A format before students download it.

Output: Standalone electronic document, online interface.

Scope: National, Italy.

Strengths	<p>It is completely automated.</p> <p>It is fully integrated as a SIS functionality.</p> <p>It has a high penetration rate in Italy (75% of HEI uses SIS);</p> <p>It is self-service.</p> <p>It is free of charge for students.</p> <p>It is involved in both EMREX and EWP Projects.</p> <p>It is developing international Interoperability features within the EWP and EMREX projects.</p>
Weaknesses	<p>It does not provide XML or other "machine readable" formats, only PDF.</p> <p>Its focus is domestic (Italy) only, and no data/document exchange service is provided outside of Italy.</p>
Intended impact	<p>To lessen the administrative burden for institutions by automating processes.</p> <p>To increase the availability, quality and reliability of transcripts and other educational documents.</p>

Digitary

Digitary is a private provider of solutions for issuing, distributing, and verifying digital Diploma Supplements and other student documents. It enables HEIs to issue digitally signed Diploma Supplement as PDF documents (and XML data) to their students and graduates online. These documents contain legally binding digital signatures in accord with EU legislation and ETSI standards. Digitary supports "privacy by design": graduates control the sharing of their documents with third parties in a secure, audited way. Employers can integrate Digitary with their HR systems and verify student documents online. Digitary also facilitates the digital exchange of DS and other academic documents with institutions in Australia, China, India, New Zealand, and the United States.

Output: Student data transfer, Standalone electronic document, Online interface, Services.

Scope: International, Ireland, UK, Portugal, Australia, New Zealand, China, India, USA.

Strengths	<p>Digitary uses web services and XML data standards to allow for easy data export from student information systems.</p> <p>Individuals can share their records with third parties online, controlling who can see their records, and for how long.</p> <p>Third parties can use this service to receive and verify records in a variety of ways.</p> <p>It is designed with EU privacy, data security and compliance in mind, and it is built and hosted within the EU.</p> <p>Worldwide use – its documents are verified in over 40 countries;</p> <p>It is fast and easy for HEIs to adopt.</p>
Weaknesses	<p>The solution requires a paid licence from HEIs.</p> <p>As a technological solution it is solid, but it does not yet leverage the latest trends (e.g. badges, Blockchain).</p> <p>It faces competition from global competitors (Parchment, National Student Clearinghouse).</p>
Intended impact	<p>To enable organisations (employers, HEIs) in over 40 countries to verify documents through an integrated online platform.</p> <p>To ease the sharing and verification of student records.</p> <p>To eliminate the need for paper documents.</p>

SPEEDE Server

SPEEDE Server transfers electronic transcripts between HEIs. SPEEDE Server was put into service in 1995 by the University of Texas at Austin. In 2012, the university made an offer to the National Student Clearinghouse to assume responsibility and operations for SPEEDE Server, and since October 2013, the National Student Clearinghouse has been responsible for its operation. Participating institutions have to register at the National Student Clearinghouse to use the server, which allows them to send single files containing multiple ISA-IEA envelopes to the server: one file per intended recipient. Each envelope can contain multiple transcripts, requests, acknowledgements, or other EDI transactions. The server sends the specified recipient a file containing one or more ISA envelopes from different schools.

Output: Student data transfer.

Scope: International, USA, Canada.

Strengths	<p>It enables to quickly order documents online.</p> <p>It works in an open-access G.R.E.E.N. (Global Registrar Edurecord Exchange Network) environment that conforms with the electronic data exchange standards recommended by the PESC and other nationally and internationally recognized standard-setting bodies.</p> <p>It can use both XML and EDI; both standards are consistent - Processes can be batched and automated;</p> <p>A high number of current institutions use this standard.</p> <p>The sender and receiver are identified.</p> <p>It is possible to send automated acknowledgements of both delivery and receipt.</p>
Weaknesses	<p>Applicants may give incorrect student information resulting in delivery delays; delivery of transcripts can take up to two days; it should be quicker.</p> <p>Some institutions could be limited by its technical complexity; its full benefits require translation software and SIS compatibility.</p> <p>Its data mapping can be cumbersome.</p> <p>There is a prevailing perception that it is complex and requires excess IT resources.</p> <p>The ANSI ASC X12A Education sub-committee has been inactive since 2005.</p> <p>It entails many small but important setup details, although they are required only once.</p>
Intended impact	<p>To foster the free, open and secure exchange of education documents and data.</p> <p>To lessen the administrative burden for institutions through automated processing.</p> <p>To simplify the exchange of information between institutions.</p> <p>To increase the availability, quality and reliability of transcripts and other educational documents.</p> <p>To achieve a higher quality of achievement data exchanged between US HEIs.</p> <p>To promote global educational data exchange.</p>

Ellucian eTranscript

The National Student Clearinghouse and Ellucian have formed a strategic alliance to enable real-time electronic authentication, production, and transfer of transcripts between the Clearinghouse and Ellucian's administrative systems (Banner, Colleague, and PowerCampus). The Clearinghouse has the largest number of Ellucian customers compared with other transcript-order providers.

Output: Standalone electronic document, Online interface.

Scope: National, USA.

Strengths	<p>The solution is high scalable, as it is based on widespread XML format.</p> <p>It combines XML for data transfer and presents the transcript in universal certified PDF format.</p> <p>It integrates an electronic signature.</p> <p>There is widespread use of the service.</p> <p>It is free of charge.</p>
Weaknesses	<p>The solution requires paid licence from HEIs.</p> <p>The solution requires HEIs to have the Ellucian SIS installed.</p> <p>It has a domestic (USA) focus.</p> <p>There is no clear strategy to participate in international interoperability cooperation.</p>
Intended impact	<p>To foster the free, open and secure exchange of education documents and data.</p> <p>To lessen the administrative burden for institutions by automating processes.</p> <p>To simplify the exchange of information between institutions.</p> <p>To increase the availability, quality and reliability of transcripts and other educational documents.</p> <p>To increase the quality of the achievement data exchanged between US HEIs.</p> <p>To involve global educational data exchange.</p>

Parchment

Parchment is a major competitor of the NSC/Elucian system. The company got its start with high school transcripts. It launched in 2004, and by 2010 it was processing 1 million credentials per year, and as of 2017 that number has grown to 1 million credentials every month. Currently Parchment provide a network of digital credentials services, which works with transcripts, diplomas, verifications and other electronic documents. For instance, their service 'Parchment Send' offers ordering and fulfilling of these documents from the registrar's office and includes an online ordering platform, secure electronic delivery with Blue Ribbon technology, and end-to-end security with data encrypted at rest.

Output: Student data transfer, Standalone electronic document, Online interface.

Scope: National, USA.

Strengths	<p>It integrates with every Student Information System.</p> <p>The solution significantly decreases student document processing time.</p> <p>Implementation takes under 30 days.</p> <p>It is the only eTranscript provider which is Oracle OVI Certified.</p> <p>Its automated eTranscript service can provide analyses of student destination universities, employers and internships.</p>
Weaknesses	<p>Because it is a private provider, HEIs in the long term may face difficulties and transition costs if the company is ever forced out of the market.</p> <p>It may become expensive for students, particularly if the provider approaches a monopoly on the market.</p>
Intended impact	<p>To foster the free, open and secure exchange of education documents and data.</p> <p>To lessen the administrative burden for institutions due to automated processes.</p> <p>To exchange information more easily between institutions.</p> <p>To increase the availability, quality and reliability of transcripts and other educational documents.</p> <p>To increase the quality of the achievement data exchanged between US HEIs.</p> <p>To involve global educational data exchange.</p>

My eEquals - Digital Student Data

The Digital Student Data Project, referred to as My eEquals, was established to ensure that students and employers could verify the legitimacy of academic qualifications provided by Australian and New Zealand students.

Its first phase focused on delivering data-enabled secure PDF replicas of each university's key academic records (testamur or parchment, transcript, AHEGS (Australian Higher Education Graduation Statement)). The initiative was piloted at four sites, starting with Monash and the University of Melbourne. At Australian National University, Digitary also introduced eTranscript exchange functionality that allows ANU students and graduates to send electronic transcripts from their Digitary accounts to up to 3000 US institutions.

Output: Student data transfer, Standalone electronic document, Online interface.

Scope: International, Australia, New Zealand (China, US, UK, and South Africa, India to join in the future).

Strengths	<p>It promotes collaboration between universities, which enables HEIs to benefit from an initiative at a relatively low cost, which is especially beneficial for smaller HEIs.</p> <p>It is an efficient way to verify and process academic records, i.e. academic record data portability leading to faster decision making within universities.</p> <p>It is able to provide controlled access to study records by third parties which are chosen by students; it is able to access student records from multiple student systems and formats.</p> <p>It makes significant productivity improvements relating to access, assessment, and verification of Australian and overseas qualifications.</p> <p>By using the Digitary system, students can provide a hyperlink (URL) with any electronic application rather than attaching scanned documents or sending originals. This is particularly beneficial when submitting multiple applications or overseas applications.</p> <p>For students, the electronic document is cheaper (or free) than the respective physical document.</p>
Weaknesses	<p>It requires an initial financial contribution from HEIs to evaluate the feasibility of the system, and a licence fee per-annum.</p> <p>The platform is in the pilot phase and not yet in production.</p>
Intended impact	<p>To increase the integrity and security of credentials by providing third-parties with a verified document from a secure and trusted source. This reduces the need for the production and verification of hard copy documents and diminishes opportunities for fraud.</p> <p>To make improvements in HEIs' productivity, by streamlining the production and management of academic records, and by enabling HEIs to provide and access secure academic records from local and international institutions via international nodes.</p> <p>To contribute to student mobility and data portability by giving students control of their academic records in a form that is easily accessible and secure, both locally and globally.</p>

Credential Solutions Electronic Transcripts

Credential Solutions Electronic Transcripts is a system that manages and transfers digital transcripts. It works as part of larger network that integrates online ordering (Transcript Plus) and automation software (RoboRegistrar). This solution enables digital trading of EDI, XML and PDF transcripts through secure a Credential Solutions network, as well as other hubs such as Speede Server. The solution extracts student records using existing integration with a student integration system, and includes formatting, transmission, and receipt acknowledgement. To ensure that only certified institutions participate, sending HEIs must be accredited. Differently from some of the other market solutions, email is not used to deliver electronic transcripts.

Output: Student data transfer, Standalone electronic document, Online interface.

Scope: National, USA.

Strengths	<p>It works on global scale.</p> <p>Delivery can be made to network receivers or out-of-network recipients.</p> <p>Network members - both senders and receivers - are verified.</p> <p>There is no cost for receiving institutions.</p> <p>No proprietary software is required.</p>
Weaknesses	<p>Because it is a private provider, HEIs in the long term may face difficulties and transition costs if the company is ever forced out of the market.</p> <p>It may become expensive for students, particularly if the provider approaches a monopoly on the market.</p>
Intended impact	<p>To foster the free, open and secure exchange of education documents and data.</p> <p>To lessen the administrative burden for institutions due to automated processes.</p> <p>To exchange information more easily between institutions.</p> <p>To increase the availability, quality and reliability of transcripts and other educational documents.</p> <p>To increase the quality of the achievement data exchanged between US HEIs.</p> <p>To involve global educational data exchange.</p>

Bestr open badge platform

Bestr adopts the Open Badges standard to represent skills and competences acquired in formal, non-formal and informal environments. Through Bestr the companies themselves can define the competencies they need, the universities and the training institutions can offer the resources to acquire them, and whoever thinks to possess a specific competence, can prove it and certify it undergoing a verification process which is defined and agreed upon by companies and educational institutions. Whomever claims to possess a specific competence can be asked to prove and certify it by undergoing a verification process, which is defined and agreed upon by companies and educational institutions.

Output: Open Badges.

Scope: National, Italy

Strengths	<p>Open Badges offers new opportunities to recognise more diverse learning activities within the scope of higher education degree.</p> <p>Open Badges can be adapted to any context, since they are community-driven and not controlled top-down by credentialing authorities.</p> <p>The use of different types of metadata fields allows for an information-rich representation of any credential.</p> <p>Metadata including links can help explain the context, meaning, process and result of the activity that the badge was awarded for.</p> <p>Easy sharing: it is possible to attach a badge to a LinkedIn profile, share it on social media and download the image, or to upload it onto another Open Badge management system.</p>
Weaknesses	<p>In order to add badges to conventional credentials, HEIs must set up a student information system plugin if the service is not supported by the system provider.</p> <p>Open Badges may possibly foster a culture of permanent assessment, risk of devaluation, and missing quality standards (national and international).</p> <p>Currently, open badges is not a widespread and well known standard.</p>
Intended impact	<p>To give value to extracurricular activities and e-learning.</p> <p>To raise the visibility and recognition of competencies acquired in informal and non-formal settings.</p> <p>To contribute to open education and lifelong learning.</p>

Stanford Blockchain ledger

Stanford University's public credentials verification service uses private blockchain implementation, which offers drag&drop functionality for Stanford's academic credentials that are produced as digitally signed, xml-based pdfs.

Output: Standalone electronic document, Online interface, Services.

Scope: National, USA

Strengths	<p>As a first mover, Stanford can leverage years of consolidated innovation in adding services and interconnected information around its transcripts of record.</p> <p>Using internal development resources allows for complete control over the implementation.</p> <p>Its compliance with PESC's standards and active involvement with that community will ensure market endorsement and continuous feedback from domain experts.</p> <p>Its implementation is very straight-forward and user friendly.</p>
Weaknesses	<p>The Blockchain implementation is in pilot phase and relies on a proprietary implementation of a private Blockchain, and does not use any of the currently available platforms (Ethereum, Hyperledger).</p> <p>This may put it at a disadvantage: to evolve and scale the application quickly, it needs support from the community. The current service on the Blockchain is limited to the "credential verification" case.</p>
Intended impact	<p>Stanford intends to open source the Blockchain verification service and support its customized uptake by other ivy-league universities in the USA.</p> <p>The pilot has already been introduced to the Groningen Declaration Network seminar in 2016, which may lead to further interest and adoption of the model by more international universities.</p>

Learning Machine Blockcerts

Learning Machine is a commercial company that uses the Blockcerts standard as part of its software ecosystem for governments, universities, professional member organizations, corporations, recipients, and independent verifiers. Blockcerts is a free, open standard that allows organizations and individuals to build applications that issue and verify official records on the blockchain. Blockcerts records are owned by recipients and instantly verifiable by independent parties such as potential employers or admissions committees. They are designed to last a lifetime and be maximally portable across systems and geographical jurisdictions. Any type of document may be issued as a Blockcert, including diploma supplements. Supplements may be issued as standalone documents or adjoined to other documents, such as diplomas.

Output: Student data transfer, Standalone electronic document, Online interface, Services.

Scope: International, Malta, USA, Australia

Strengths	<p>Because they are issued on the blockchain, which cannot be edited, Blockcerts are tamper-proof. Any attempt to alter the Blockcert file will render the file invalid during the verification process. Blockcerts can also be set to expire or be revoked, meaning that even though the recipient continues to own them, they no longer verify as valid.</p> <p>Blockcerts are sent directly to recipients and are not linked to any public identity. This means that recipients have control over how they share and disclose their data.</p> <p>Recipients own their Blockcerts. This means they can take them with them wherever in the world they go and instantly share and verify them without need for the issuing institution or a verification service to confirm the authenticity of their credentials.</p>
Weaknesses	<p>Blockcerts are still early in the blockchain adoption cycle among governments, corporations, and school systems.</p> <p>Culturally, it will take some time for people and institutions to acclimate to student-owned official records.</p>
Intended impact	<p>Blockcerts were designed to maximize individual mobility, recognition, and employment opportunities. Because the records are learner-owned, individuals can take them anywhere in the world to prove their credentials to anyone.</p> <p>Even in situations of crisis which render educational institutions or governments defunct and unable to provide or verify credentials (like the war in Syria), individuals still have access to their original records.</p> <p>Free and near-instantaneous verification maximizes opportunities for recognition, and in turn opens up employment opportunities. Similarly, job search websites and HR databases that read Blockcerts allow employers to quickly sort through verified credentials to find their best applicants for any position.</p>

2.3 Building the digitalisation options

Findings from interview programme and the meetings with the stakeholders³⁹ suggest that the preferable approach to digitalise the Diploma Supplement would be incremental building upon already existing and widely accepted solutions. Following this approach, in the following sections, we will first set out and analyse a baseline option for digitalisation, and then several intermediary digitalisation options of varying complexity. The options range from a version of the DS that has a minimum set of features to be considered digital, to more elaborate options that could be achieved by incrementally adding new features and functionalities on top of the basic requirements.

This approach, proposing both baseline and intermediary digitalisation options, enables a comparison of the transferability of the proposed options across the EHEA and within HEIs, that may have different pre-existing technological and conceptual solutions for issuing the Diploma Supplement.

Since the focus of the study is the Diploma Supplement as a document or service issued together with a higher education diploma, we present the basic set of requirements for making a Diploma Supplement digital (Option 0). We then present a set of intermediary digitalisation approaches, which outline not only potential formats of the digital DS, but also student data exchange and interoperability solutions. **Option 0** discusses the need for structured, machine readable data formats for compiling the Diploma Supplement and the meaningful exchange of student data. **Options 1-3** discuss data output formats, and how to expand data exchange. It should be noted that these options are not mutually exclusive; they can be combined for maximum effect. They can also be adopted by EHEA countries at their own pace; since they would build upon the baseline requirements, data exchange would be ensured regardless of any additions, and so only the presentation and utilisation of the data would differ.

Below is a summary of the proposed digitalisation options and the implementation issues they would help resolve.

Option 0: Standard data exchange format

The baseline Option 0 suggests a **standard data exchange format for compiling and sharing the Diploma Supplement**. This approach implies that a digital Diploma Supplement could be primarily understood as a basic set of data described in a standardised way, which carries higher sharing and integration potential than the analogue document.

Digital documents may pose challenges that analogue paper documents do not. Data may come in a variety of different formats, thus one of the main challenges to implementing digital credentials is interoperability. It may not be possible to achieve a uniform digital Diploma Supplement throughout the EHEA, but it is feasible to have a **common interoperability data format** that would help **share student information more effectively and offer additional services**.

The basis for the digital Diploma Supplement is formed by most of the commonly used data formats and already existing good practices. Student information transfer projects such as EMREX or EWP showed that European level initiatives can gain momentum, and suggest **transferable solutions for countries and individual HEIs using different student information systems**.

The standard data exchange format could help solve the following Diploma Supplement implementation issues:

³⁹ Naric Meeting, December 2016, Brussels

- **Inconsistent presentation of data:** having a common data standard for compiling and transferring the DS would encourage HEIs to describe the different DS sections in a more consistent manner, and to seek solutions to harmonise standard sections within the DS template.
- **Using alternative sources of information:** a common data format would place emphasis on the portability and exchange of student records rather than a specific document format. Turning from the concept of a *document* towards the concept of a *data set* opens up a plethora of possibilities to develop the Diploma Supplement as a digital artefact that is easy to generate, share, and consume.
- **Lack of flexibility:** introducing a standard data format that is both human-readable and machine-readable could help to make it more flexible and interoperable with other services. An open data standard for the Diploma Supplement would open immense opportunities to share student data and generate the Diploma Supplement output in a variety of different formats, and thereby streamline connections among employers, HEIs and DS holders.

Option 1. Standalone certified electronic document (PDF/A)

Option 1 suggests a standalone **certified electronic document (PDF/A format) with a methodology for inserting security and authentication measures** into the process of transmitting and receiving these documents. This solution explores standard ways to secure documents from internet threats and maintain a traceable origin of documents, as well as lock down the original content against unintentional or malicious alterations.

Finding simple and familiar solutions is an important way to improve the feasibility of a digital DS. **A relatively simple solution, such as a certified PDF, would combine the benefits of paper and digital document formats.** The already familiar look of a PDF document can mirror the structure of the current paper Diploma Supplement, and augment it with additional certification features (e.g. an electronic signature), while significantly increasing its sharing potential.

The ability to produce certified PDF documents by using a standardised structured data format (analysed within Option 0) further increases the possibilities for automated processing of such documents (as they are machine readable). This would lead to easier recognition procedures, saving of resources, and creating the preconditions for providing online services associated with processing student information (e.g. skills matching services).

The standalone certified electronic document could help solving the following Diploma Supplement implementation issues:

- **Resource-intensive process of issuing and handling a DS:** issuing the DS in a digital format such as PDF would help save printing and handling costs for HEIs. Interviewed HEIs representatives pointed out that printing a Diploma Supplement on high quality paper with security features incurred significant costs. Furthermore, this option could reduce handling costs for recognition centres and employers alike. The PDF format enables documents to be exchanged reliably, regardless of software, hardware, or operating system. Were the PDF document to be based on XML format, this would make the Diploma Supplement machine readable and reduce the handling costs even further.

Option 2. User-oriented student data access solutions supporting digital Diploma Supplement

Option 2 encompasses student data access solutions, and is oriented towards a wide spectrum of services related to student achievement records. This includes, but is not limited to, viewing at any time, sharing achievement records with employers and HEIs, skills matching service integration, and social network integration.

This solution may require in-house or private support service to facilitate the interface and integration with other services.

We analyse the feasibility of the following features identified in the case studies:

- authentication solutions,
- security measures,
- raw student data transfer solutions among stakeholders,
- possibility to share the output with third parties,
- possibility to access employment services and,
- data format and storage solutions.

Digital standalone documents can only realise their full potential when they are associated with specific services. Additional services such as online interfaces help DS stakeholders 'consume' the document, and make it useful for employment, mobility, or further education purposes by connecting the holder of the document and its other potential users.

The user-oriented student data access solutions supporting a digital Diploma Supplement could help in solving the following implementation issues:

- **Low level of awareness about DS:** a solution that is able to provide relevant digital service to labour market participants (both employers and potential or existing employees) is likely to achieve higher levels of awareness across Europe. As an example, the Europass CV format is ubiquitous across Europe and the brand is primarily associated with the CV format. Being one of the Europass documents, the Diploma Supplement could similarly streamline its brand by increasing its interoperability with European transparency tools and related services.
- **Convenience and costs of handling the DS:** in the hiring process, graduates and employers are primarily focused on the digital presentation of skills, competences and qualifications. Moreover, hiring increasingly happens with the assistance of social networks and online-assisted private career placement services. Online integration would make student data more usable in these contexts. A Diploma Supplement associated with an online interface could become a source of information for augmenting professional network profiles (e.g. LinkedIn), filling in CVs (Europass CV), applying for guidance services, or compiling professional portfolios. A significant advantage would be that information came from a certified and easily verifiable source.
- **Lack of flexibility:** having an online interface for viewing and sharing Diploma Supplement information would allow the application of a modular approach in presenting data. Depending on the type of user, student data could be flexibly presented in different levels of detail, or by putting emphasis on different types of data. While some of the interviewed stakeholders found the current Diploma Supplement to be too long, others mentioned that they observed an increasing need for even more detailed information. Having an online interface with a possibility to share different bits of relevant data may help to present more relevant information to different stakeholders.

Option 3. Open digital credentials

Option 3 proposes the use of Open Badges to augment conventional education credentials such as the Diploma Supplement. Open Badges are verifiable, portable digital badges with embedded metadata about skills and achievements.

Already existing DS formats and services can be augmented with open credentials coming from a variety of sources. Open Badges can be adjusted to any context and represent achievements, competences, participation, memberships, commitments, and similar information that are not reflected by traditional credentials but are important for employability and lifelong learning goals.

Open digital credentials could help resolve the following Diploma Supplement implementation issue:

- **Lack of flexibility:** Open Badges would make the DS more open to the wider array of experiences and learning pathways of higher-education learners, and provide an attractive incentive for them to participate in those experiences. Open Badges enable recording of skills and competences that are otherwise left outside the scope of traditional credentials.

2.4 Cost-utility analysis

The section below presents the proposed Diploma Supplement digitalisation options in more detail, including a detailed analysis of **cost and utility elements**.

2.4.1 Option 0. Standard data exchange format

The baseline digitalisation option (Option 0) proposes the development of a **standard data exchange format for compiling and sharing the Diploma Supplement**. This approach understands a digital Diploma Supplement to primarily be a **basic set of data described in a standardised way, demonstrating a high sharing and integration potential**, as opposed to the analogue document.

Interviewed digitalisation experts believe that a standard data exchange format creates the basis for generating a particular output, i.e. a Diploma Supplement, in a variety of different formats, such as a simple PDF, or a more complex interactive student record service.⁴⁰ Standardised data exchange methods make it easier for institutions to produce digital documents in a formal way, producing **standard outcomes that could be re-used in other contexts**.

Most of the identified practices of digital student data management and exchange employ **XML for the purposes of data exchange, storing data, or generating documents in a variety of formats** (see the box below for specific examples).

Instances of successful digital student data management and transfer projects and initiatives using XML:

- **EMREX** project uses ELMO, the XML format for exchanging student results.
- **Erasmus Without Papers (EWP)** project uses XML Schema for describing data formats in detail.
- **Higher Education Achievement Report (HEAR)** in the UK is compiled using a standard XML format.
- **STORK 2.0 e-Academia pilot project** adopted an XML format to exchange electronic Diploma Supplements between the MS, is being promoted as a standard in Spain, and has the potential to achieve standardization at a higher level.
- **Ladok** system in Sweden uses Atom, an XML-based format for publishing information that uses HTTP for transport.
- **Diploma Registry system in Norway** uses ELMO XML format, the same format as in EMREX.
- **Credential Solutions** in the US enables HEIs to electronically trade XML (and other format) electronic transcripts.
- **Ellucian eTranscript** system in the UK Uses XML for student data transfer.
- **SPEEDE Server** system uses and approved XML data standard for student information exchange between HEIs in the US and Canada since 2004.
- **The Digital Student Data (DSD)** project in Australia and New Zealand uses a structured data

XML (eXtensible Markup Language) is a markup language defining a set of rules for encoding documents in a format that is both **human readable and machine-readable**.⁴¹ XML is primarily a language for describing data and allowing machines to parse formally structured content.

On a European scale, the ISA Analysis of structured e-Document formats used in TransEuropean Systems also showed that the **dominant schema representation technique for e-Documents has been XML**.⁴² The study analysed structured e-Document formats and engineering methods used for exchanging information between public administrations in Europe. One of the good practice recommendations from this study was to use a standard e-Document engineering method, which offers: a methodology for requirement analysis and conceptual modelling; a standardised library of data types and elements⁴³; and; conventions for rules to define, describe and use a representation language (e.g. XML) to express information exchanges in a consistent manner. Standard methods enable the creation of e-Documents in a formal way, and produces standard outcomes. Such an approach could be also highly beneficial for promoting a digital Diploma Supplement template.

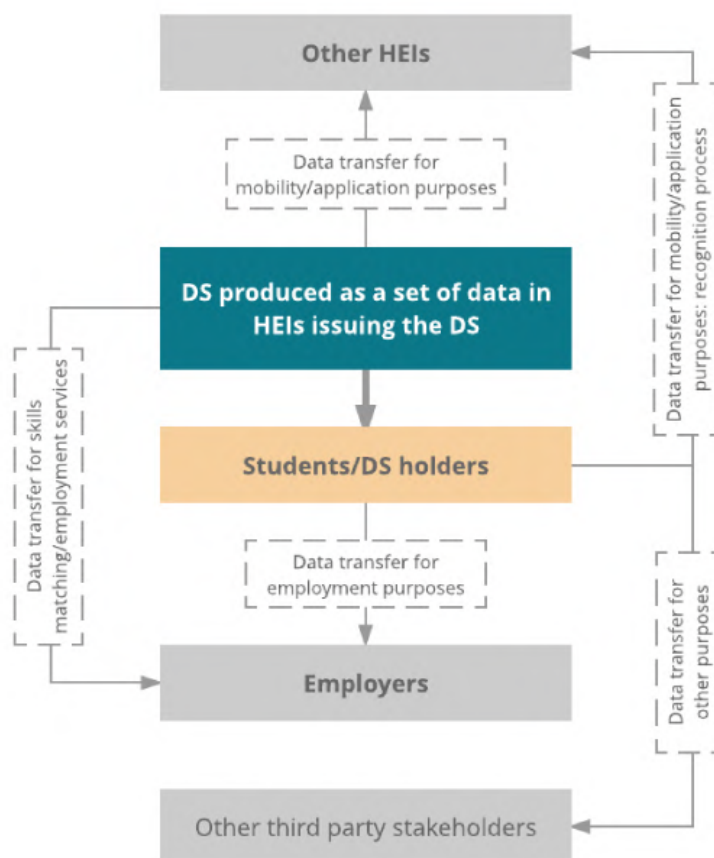
Using a standard markup language for creating digital Diploma Supplement puts the emphasis on the **portability and exchange of student records**, rather than a specific document format (see the DS exchange model below).

⁴¹ Fernig, "XML and Student Information Systems."

⁴² Bausà Peris et al., "Analysis of Structured E-Document Formats Used in Trans-European Systems. Survey on Standardized E-Document Formats."

⁴³ Library of data elements - a library that is used to generate the e-Document definitions.

Figure 1. Potential Diploma Supplement data exchange pathways



Source: created by authors

The survey of HEIs suggests that most of them already store student information electronically in structured data formats such as XML, JSON-LD, or relational databases.⁴⁴ Structured data formats are relatively easy to convert, and thus student information could readily be converted to a standard structured data format with only minor additional resources.

⁴⁴ Higher Education Institutions survey, PPMI, 2017.

Cost-utility analysis of the baseline Option 0

The table below summarises the cost elements of the XML as a standard for digital Diploma Supplement.

Table 7. Option 0 cost elements

Type of costs	Justification and evidence	Assessment of the level of costs
Development costs	<p>The development costs depend highly on the present technological environment of an HEI. The main cost elements for implementing a standard way to describe data are not directly related to technical issues, but rather to internal administrative matters, requiring administrators to describe student achievements in a standardised way.</p> <p>The Spanish Electronic Diploma Supplement (e-DS) case study estimated that implementing the digital DS from an XML specification in the context of the STORK2 project took approximately 50 person days, with an additional 10 days to accommodate change requests, to revise the e-DS.⁴⁵ The project was publicly funded.</p> <p>A larger research intensive institution set up a HEAR report template that is based on an XML model, and used the services of one senior developer, one senior database administrator and a junior database administrator to help with the actual report template. Altogether, it took this team 180 hours (approx. 25 8-hour working days).</p> <p>Warsaw university, which implemented a plug-in solution for EMREX ELMO (XML) format, indicated that it took them "only a few weeks", meaning approximately between 25-60 working days.⁴⁶</p>	25-60 person days
Dissemination costs	<p>The dissemination costs would be low in countries and HEIs where the XML student data sharing practices are already widespread. Currently, that would include the majority of digitalisation cases outlined above: Nordic countries, Italy, and Poland implementing EMREX; Spain, having already established a digital DS solution based on XML; Erasmus Without Papers, covering 8 European countries with dissemination potential of over 400 HEIs from 36 European countries, and; HEIs in the UK using HEAR XML specification. Moreover, most of the identified cases outside Europe (e.g. Ellucian e-transcript, Credential Solutions, eQuals) also use XML as the primary data format.</p>	Low (conditional)
	<p>The dissemination costs would be high in countries and HEIs having different, yet effective, practices of issuing the Diploma Supplement, since different data standards are already established.</p>	High (conditional)
Technical, administrative, content support and maintenance costs	<p>Once established, the maintenance costs of the standard data format may become a routine operation.</p> <p>In the case of EMREX in Warsaw University, the Emrex plugin was</p>	Low/routine

⁴⁵ "Supplement Electronic Title to the European (SET-E). Case Study Documenting the Electronic Diploma Supplement Standard."

⁴⁶ "Case: Poland – Emrex."

Type of costs	Justification and evidence	Assessment of the level of costs
	<p>integrated into the usual student information system used by Polish universities.</p> <p>In the case of HEAR, HEIs also reported (in 'Higher Education Achievement Report, a Reference Pack for Institutions') that the maintenance of the report template did not cause any additional maintenance costs once established.</p>	

The table below summarises the utility elements of XML as a standard for the digital Diploma Supplement.

Table 8. Option 0 utility elements

Element of utility	Justification and evidence	Qualitative utility score
Impact on recognition, mobility and employment (usefulness)	<ul style="list-style-type: none"> - Having an open data standard for the Diploma Supplement opens immense opportunities to share student data and generate the Diploma Supplement output in a variety of other formats. Perceiving the Diploma Supplement as a data set, rather than as a physical object, enables opportunities to streamline connections between employers, HEIs and DS holders.⁴⁷ - Open models such as XML could significantly ease the student data transfer between different stakeholders. For example, the electronic Diploma Supplement in Spain is generated using an XML data model and offers HEIs a mechanism for exchanging academic information through electronic means; for companies, it offers data focused on employability, and; for graduates it offers a fully legal and recognised official electronic document.⁴⁸ 	High
Openness of the format	<p>XML specification:</p> <p>XML is an open standard. The XML specification may be distributed freely, so long as all text and legal notices remain intact.⁴⁹</p> <p>Case studies:</p> <p>The HEAR⁵⁰ XML Data Specification stresses that it is crucially important to make use of already existing information models and open standards that have already been established, for the following reasons:</p> <ul style="list-style-type: none"> - to make use of good practice in information management, - to mitigate the need to define different and bespoke information items likely to add unnecessary complexity to education information systems, - to promote the re-use of information structures and models in the interests of efficient design of new systems and upgrading old ones, and - to enhance the ability of information systems to work together automatically (interoperability). 	High

⁴⁷ Interview programme

⁴⁸ "Supplement Electronic Title to the European (SET-E). Case Study Documenting the Electronic Diploma Supplement Standard."

⁴⁹ Extensible Markup Language (XML) 1.0 (Fifth Edition), <https://www.w3.org/TR/xml/#sec-origin-goals>.

⁵⁰ Higher Education Achievement Report in the UK, equivalent to the European Diploma Supplement. <http://www.hear.ac.uk/>

	<p>The HEAR XML data specification re-uses the European Learner Mobility Achievement Information standard (EuroLMAI) and elements from several other standards.⁵¹</p> <p>Emrex project uses XML ELMO format to transfer student mobility data between universities across borders. This project offers a simple technical solution for securely sending and receiving student data in XML format. For recipients (e.g. students), the Emrex solution does not require them to use any additional software, they can receive the data using a mobility plugin that is a simple website. For the sending party, the solution enables them to convert student achievement data to XML Elmo format and transfer it by using existing student information systems. In Poland, the functionality to create and process ELMO XML format was built into the student information system software used by most of Polish universities.⁵²</p> <p>The majority of interviewed stakeholders and digitalisation experts refer to XML as an open data sharing format that could be used to reach a greater standardisation regarding sharing the student achievement data.</p>	
User-friendliness of the format	<p>User friendliness of the data format:</p> <p>The user-friendliness of the XML format is directly relevant at the development/data management stage, thus it would generate the highest utility for stakeholders directly working with student data, most importantly, HEIs.</p> <p>eXtensible Markup Language (XML) is a simple, very flexible text format. The specification of XML presents the following characteristics which indicate the user-friendliness of the format:⁵³</p> <ol style="list-style-type: none"> 1. It shall be easy to write programs which process XML documents. 2. The number of optional features in XML is to be kept to the absolute minimum, ideally zero. 3. XML documents should be human-legible and reasonably clear. 4. The XML design should be prepared quickly. 5. The design of XML shall be formal and concise. 6. XML documents shall be easy to create. 7. Terseness in XML markup is of minimal importance. <p>User friendliness of the potential output from the XML data model (Spain case study):</p> <p>The XML data model of the e-DS enabled specific elements that greatly increased the user-friendliness of the document:</p> <ul style="list-style-type: none"> - Definition of rich text elements to promote attractive prints through custom stylesheets. - Definition of optional extension elements useful in sectoral environments, national contexts, etc. - Integration of electronic signature elements suitable for national and European electronic signature standards and developments. - Possibility of including attached files referenced from 	High

51 JISC, "Higher Education Achievement Report (HEAR) XML Data Specification: Relationship with Standards."

52 'Case: Poland – Emrex', http://emrex.eu/?page_id=878.

53 'Extensible Markup Language (XML)', <https://www.w3.org/XML/>.

	<p>optional elements.⁵⁴</p> <p>Although XML enables a variety of different format outputs to be generated (e.g. a secure PDF document, input for skills matching service, interactive interface), it should be noted that the user-friendliness of the output (Diploma Supplement) itself highly depends on specific solutions and the means of presentation selected by the issuing institutions.</p>	
Security against fraud, unauthorised altering of the data, or forgery	<p>Since XML data is transferred among institutions, security measures need to be applied in two ways. First, it is necessary to ensure that the source of the data is verified. This can be done by employing XAdES-compliant certification solutions. XAdES is a profile of XML signatures compliant with the eIDAS Regulation, which is legally binding across European Union since 2014 and it established an internal market for trust services. Second, the data must be secured against interception while being transferred.</p>	n/a
Personal data protection	<p>Personal data protection in the case of an XML exchange can be ensured only by protecting it against interception. After the person's data is with the recipient organisation, it is protected only by the goodwill of that organisation.</p>	n/a
Implementation timeline (readiness for final use)	<p>The University of Warsaw has recently implemented the Emrex solution for transferring transcripts of record as a PDF document embedded in a structured XML file. The university reported that implementing the function to generate the transcript of records (document structurally similar to DS) as XML and PDF in the EMREX ELMO format "was intuitive and took only a few weeks".</p>	Short
Other technical implementation challenges	<p>A digitalisation expert working on HEAR implementation in the UK reported the following: "All the main suppliers of systems that support achievement information in the UK support the standard XML representation of the DS and they raise no technical issues".⁵⁵ That is, there are evidently no major technical implementation challenges when the data standard is already well established and commonly used in a country.</p> <p>The Emrex project experience shows that in order to be able to read XML data, there needs to be local integration with the specific student information system that the HEI uses. While it enables a decentralised approach for each HEI, it might require additional resources to facilitate the plugin.⁵⁶</p>	Higher utility
Transferability of the solution to all EHEA countries (legal, technological, practical, perception aspects)	<p>The XML format has been designed to support a wide variety of applications and to generate outputs in a variety of formats.</p> <p>The case studies show that the most widespread and successful instances of digitalisation of the Diploma Supplement (and similar student records), employed XML standard as a basis to transfer, generate, and integrate a variety of services with the Diploma Supplement (or equivalent documents).</p> <p>The interview programme also indicates that an overall positive view towards this structured data standard. If a Diploma Supplement is to be digital, the best way is to primarily create it as a set of structured data, and then gradually build up functionalities to achieve higher utility. Interviewed digitalisation experts agree that XML is already a de-facto <i>lingua franca</i> for structured student information exchange between HEIs.</p>	High

⁵⁴ "Supplement Electronic Title to the European (SET-E). Case Study Documenting the Electronic Diploma Supplement Standard."

⁵⁵ Interview programme.

⁵⁶ Interview programme.

2.4.2 Option 1. A standalone certified electronic document (PDF/A)

This DS digitalisation option proposes that a Diploma Supplement be issued as a standalone secure electronic document, and a methodology for inserting levels of security and authentication should be inserted into the process of transmitting and receiving these documents. This option explores standard ways to secure documents from internet threats and maintain a traceable origin of documents, as well as lock down the original content of the documents against unintentional alterations. The standalone document solution could be delivered to anyone, anywhere, and read with almost any device.

Desk research and interview programme findings show that PDF (Portable Document Format) is the most common format for issuing electronic student record documents (see examples below).

Instances of successful digital student data management and transfer projects and initiatives issuing a standalone electronic Diploma Supplement or an equivalent document

- **ESSE3 Student Information System** CINECA, the Italian inter-University Consortium, enables students to download an **electronically signed secure Diploma Supplement in PDF format**.
- **Higher Education Achievement Report HEAR** (Diploma Supplement in the UK) is issued as a secure electronic document and can be accessed by students whilst studying on a degree programme, or after completion and graduation. In this way, HEAR functions as a **formative document**.
- The National Swedish system **Ladok** is used for the administration of higher education and documentation of academic information, and enables students to download a PDF-format verifiable copy of a transcript of records. Under the current system, the electronic Diploma Supplement is not available.
- A private provider of online student record service, **Digitary** enables the production of digitally signed PDF documents from University student information systems.
- Within the **Ellucian eTranscript** system in the US, students can submit a transcript request outside of normal office hours and receive an official PDF transcript within 20 to 30 minutes.

PDF is a file format used to present and exchange documents reliably, independent of software, hardware, or operating system. Invented by Adobe, PDF is now an open standard maintained by the International Organization for Standardization (ISO). PDFs can in principle contain links and buttons, form fields, audio, video, and business logic. They can also be signed electronically and are easily viewed using free software.⁵⁷

The Diploma Supplement is a document which may need to be used **at any point during a person's career**, and this means that access to the data should be ensured for **50 years or more**. This longevity issue is often described in the ICT industry as a '**digital dark age**', a hypothetical future situation where historical files stored in obsolete formats are unreadable. Standardisation and development of open data formats (and actually preserving the data in those formats), are meant to ensure the preservation of data.

The ISO standard for the long-term preservation of electronic documents is called PDF/A. This format is the usual PDF format, but adds a variety of requirements for documents, which ensure that they are readable whatever future technological developments may turn out to be. In particular, PDF/A requires documents to include specific standards-based metadata and to be self-sustained, for example by embedding fonts within the document rather than using linked fonts. Some additional features such as audio and video content, and the use of XFA (XML Forms Architecture) forms within the document, are also prohibited. Currently, **XFA forms may in fact be used to fill out student data** into the electronic version of Diploma Supplement by some HEIs. So, unless the PDF/A standard is updated to include such forms, **HEIs should be discouraged** from using them within PDFs when issuing the DS.

⁵⁷ "What Is PDF?"

The PDF/A standard (PDF/A-2 and PDF/A-3 were versions adopted in 2011 and 2012 respectively) also supports PDF Advanced Electronic Signatures (PAdES). Advanced Electronic Signatures ensure that the signatory can be uniquely identified and linked to the signature, that the signatory is the sole owner of the private key used for the signature, and that the signature can identify and become invalidated in case the document is tampered with after the moment of signing. PAdES is compliant with EU Regulation N°910/2014 on electronic identification and trust services for electronic transactions in the internal market (eIDAS Regulation), which is binding in EU Member States since 2014.⁵⁸ The eIDAS Regulation creates an internal European market for electronic trust services - namely electronic signatures, electronic seals, time stamps, electronic delivery services and website authentication - by ensuring that they will work across borders and have the same legal status as traditional paper based processes. The Diploma Supplement could, then, be issued in a PDF format which:

- is trustworthy and secure from breaches,
- has a universal cross-border legal status at least within the EU, and
- follows the international standard for long-term document preservation.

However, the existing **PDF/A standards do not support encryption**, and in fact encryption goes against the principle of long-term preservation. Passwords and data-keys may get lost over time, making the document unreadable and defeating the purpose of the Diploma Supplement. The issue of personal data protection in this case becomes important: by sending out the PDF version of a Diploma Supplement (e.g. to a potential employer), the holder of the qualification would risk that their data could be used by third parties. Nevertheless, this is not different from any other way of sharing the DS, except perhaps physically displaying the DS data (whether on paper or in digital format) without providing a copy to the party concerned.

Using PDF/A for the long-term preservation of data also makes it **necessary to check** whether issuers of the Diploma Supplement are actually following the principles of the standard. At the time of writing, the leading solution for this issue is veraPDF - open source PDF/A validator software supported by the PDF industry and funded by the European Union's PREFORMA project.⁵⁹ The question remains, however, of who should track whether HEIs are only issuing the digital DS in PDF/A format. In principle, this could be performed by a national or international standardisation entity, a government agency, NARICs, National Europass Centres, consortia of universities, etc. In any case, such tracking implies some costs.

The widely-used Adobe PDF reader software established both a common platform for reading electronic documents, and a common methodology for inserting levels of security and authentication into the process of transmitting and receiving documents. Adobe and businesses, such as in the banking and pharmaceutical industries, began working on standard ways to verify and secure PDFs in order to maintain a traceable origin of documents, and to lock down the original content of the documents against unintentional alterations. Moreover, PDF format is readable by a variety of third party software on a variety of operating systems and platforms.

Issuing the Diploma Supplement as a certified PDF document can be a straightforward way to achieve a simple digital output. It does not require an extensive IT infrastructure of either the issuing party or the potential user.

The table below presents a cost-utility analysis of issuing a Diploma Supplement as a standalone certified PDF/A electronic document.

⁵⁸ <https://ec.europa.eu/digital-single-market/en/trust-services-and-eid>

⁵⁹ <http://verapdf.org/home/>

Cost-utility analysis of Option 1

The table below summarises the cost elements of employing **certified PDF/A** as a standalone document exchange format.

Table 9. Option 1 cost elements

Type of costs	Justification and evidence	Assessment of the level of costs
Development costs	<p>Similar to the introduction of XML data exchange format, the development costs of Diploma Supplements in certified PDF/A format depend on which technology is already available at HEIs. A number of HEIs across Europe, as illustrated by the case studies, already issue the Diploma Supplement in PDF format, and some of them in a certified format. Additionally, some HEIs issue other types of documents (e.g. transcripts of record) in this format and therefore could easily adapt. According to the interviews with digitalisation experts, issuing a PDF document if the data is stored in XML format is also 'one click away'. In addition to tailor made solutions, the software market offers many low-priced options for converting XML into PDF.</p> <p>There are many private providers offering electronic signature solutions across different markets in EHEA. In the European Union, any services provided are compliant with the eIDAS Regulation and therefore follow the necessary certification standards. Generally, the cost of certification solutions for a single HEI could range from several hundred to several thousand euros per year, depending on the specific provider chosen and on the number of certificates issued. In practice, a single certification rarely costs more than 1 euro.</p> <p>The issued PDFs would have to be checked for compliance with the PDF/A standard. Using the veraPDF tool, which is recognised by industry leaders developing the PDF format, this may be done free of charge.</p>	<p>Low</p> <ul style="list-style-type: none"> - PDFs can be generated from XML data using low-priced tools - Costs of e-signature depend on the market and the number of documents certified, but are generally below EUR 1 per document. - Software for checking compliance with PDF/A standard is open source and free of charge
Dissemination costs	<p>The dissemination costs would be low in countries and HEIs where the Diploma Supplement or any other documents (e.g. transcripts of record) are issued in a verified PDF format. The dissemination costs would be medium in countries and HEIs where certified PDFs are not issued by the HEIs in any context. HEIs not using this feature may need some convincing, especially if they themselves would have to cover the costs of introducing the PDF format and certification solutions.</p> <p>The following dissemination issues (requiring significant human resources to manage and solve) may arise regardless of whether or not a certain HEI already provides verified PDFs:</p> <ul style="list-style-type: none"> • The already issued document or the version of the document that the HEI issues may not be compliant with PDF/A format; it may include multimedia elements, encryption, XFA forms, linked fonts, etc. • The PDFs issued or planned to be issued may not be based on data exported from XML format, but rather, on, for example, scanned paper documents. Recall that the introduction of XML format for student data management is the base option we suggest, so this may mean that the practices of document management within HEIs need to be 	<p>Medium</p>

Type of costs	Justification and evidence	Assessment of the level of costs
	<p>revised.</p> <ul style="list-style-type: none"> It is necessary to check compliance with PDF/A format, and required or recommended revisions to the format may be seen as a bureaucratic burden. 	
Technical, administrative, content support and maintenance costs	<p>Once established, the maintenance costs of issuing PDFs from XML data are low.</p> <p>Certification solutions may offer a subscription which needs to be renewed every year. Otherwise, they would not impose significant support costs.</p> <p>The software for ensuring PDF/A compliance is open source and free of charge. However, the status quo is such that compliance would be left up to the goodwill of HEIs, and would not lead to a format of digital DS which could truly make it readable in several decades' time. Human resources from either a national or an international organisation would be necessary to check compliance.</p>	Low/routine

The table below summarizes the utility elements of a standalone digital Diploma Supplement issued in certified PDF/A format.

Table 10. Option 1 utility elements

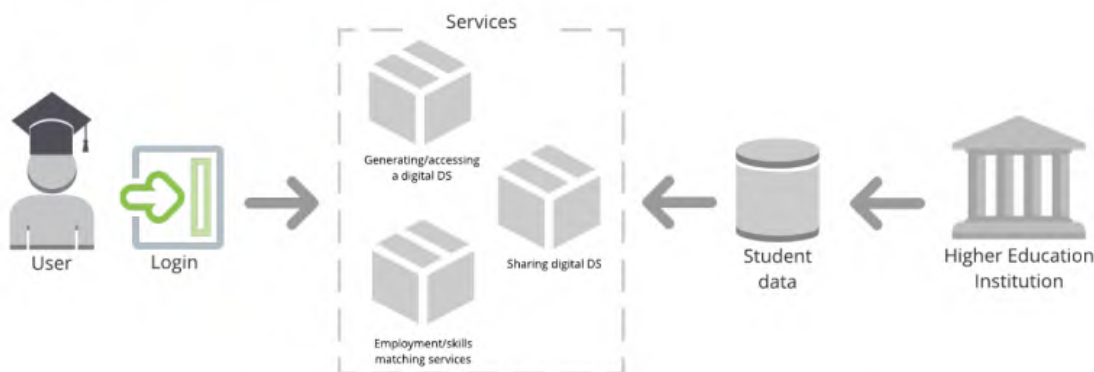
Element of utility	Justification and evidence	Qualitative utility score
Impact on recognition, mobility and employment (usefulness)	<p>XML and PDF formats both have their specific uses and audiences, and are complementary. XML is a machine-readable data format allowing for easy exchange of information not only between HEIs, but also among HEIs and employers, private or public employment services, and others. However, it is not well known and understood among the general public. Conversely, PDF is unsuitable for automatic data exchange, but ubiquitous in all spheres of professional, academic and personal life. Since any user with at least an intermediate level of digital skill would be able to view it, the choice of this format would increase the immediate access to the Diploma Supplement very significantly. These include numerous employers, as PDFs are widely used for CVs, motivational letters and other documents used in the job application process.</p> <p>According to interviews with digitalisation experts, PDF nevertheless has some significant limitations as a Diploma Supplement presentation format. It is a rigid format, and would do little to ease the tension between the desire for more information within the DS, and the desire to shorten its length. The modular approach is theoretically possible, but would require issuance of new documents every time, making it hardly feasible. Moreover, the PDF version of the document would not support any of the interoperability functionalities stemming from the machine-readable nature of the native XML format.</p> <p>The certification solutions would likely also have a significant impact on usefulness of the Diploma Supplement. The PAdES certification would ensure that all digitally signed Diploma Supplements are correct and have not been tampered with. Keeping in mind that there is a significant rate of forgery and fraud in paper diplomas and supplements, this could significantly contribute to the trustworthiness, and in turn the use, of the document. The superior anti-fraud measures of the electronic signatures should however be promoted among the potential user groups.</p>	Medium

	Finally, the compliance with PDF/A format, specifically developed for archiving purposes, would ensure the longevity of the digital Diploma Supplements.	
Openness of the format	All of the elements considered are open format: PDF/A is an ISO-recognised open data standard, certification solutions are privately offered but based on a common European standard, and the tool for checking compliance with PDF/A requirements is open source and free of charge.	High
User-friendliness of the format	<p>Being ubiquitous, PDF is a very user-friendly format which would significantly increase the reach of the Diploma Supplement. The certification solutions offered are also very easy to use and implement. Manually checking compliance with PDF/A would be quite an advanced endeavour, but it can also be done automatically via veraPDF tool.</p> <p>However, PDF is not very user-friendly tool in terms of data exchange. A variety of interviewees and survey respondents have noted, for example, that receiving application documents in non-machine-readable PDF format requires significant manual data entry efforts. Therefore, any digital Diploma Supplement in PDF format would need to be supplemented with machine-readable XML data.</p>	High
Security against fraud, unauthorised altering of the data, or forgery	<p>PADES electronic signature standard ensures that:</p> <ul style="list-style-type: none"> – the document signed can be linked to its signatory, – there is only one owner of the signature, – the signature is able to identify whether the document has been tampered with since the moment of signing, and – in case of tampering, the signature invalidates itself. 	High
Personal data protection	In theory, a PDF document can be protected against unauthorised access, and in fact some HEIs are issuing such Diploma Supplements (according to interview data with Irish HEIs). However, access protection goes against the principle of long-term preservation and is not allowed in PDF/A format. Therefore, a Diploma Supplement shared with a third party could be later used without further authorisation from its owner.	Low
Implementation timeline (readiness for final use)	<p>The solutions themselves can be implemented on very short notice, especially where student data is kept in XML format or issued in non-certified PDFs. According to interviews with companies providing certification solutions for HEIs, this can be implemented in 'several days'. Within the EU, electronic signatures are part of the newly established internal market for trust services. However, it is uncertain whether the electronic signature services in other EHEA countries are consistently following the PADES principles. In the event they are not, it may take time for the market to adapt.</p> <p>The necessity to ensure compliance with PDF/A format would likely require quite significant and lengthy division of functions among organisations at either national or international level. Given the political nature of such discussions, it is uncertain how soon the decision could be made.</p>	Short/ Medium (in case a solution is sought to ensure that PDF/A format is followed)
Transferability of the solution to all EHEA countries (legal, technological, practical, perception aspects)	PDF has become a go-to format for electronic documents across the world. In this regard, the transferability of the solution is high. The area where potential bottlenecks may arise is verification (digital signature). PDF format supports a variety of digital signature solutions. All EU Member States must comply with the eIDAS regulation and are therefore ready to provide truly secure certification. The legal frameworks in the remaining EHEA countries may vary, and this may also lead to lower trust in electronic signatures in those countries. The PDF/A format can also be ensured across all countries, with the only bottleneck being the organisation responsible for ensuring this compliance.	High

2.4.3 Option 2. User-oriented student data access solutions supporting digital Diploma Supplement

Option 2 encompasses student data access solutions, and is oriented towards a wide spectrum of services related to student achievement records. This includes, but is not limited to, viewing at any time, sharing achievement records with employers and HEIs, skills matching service integration, and social network integration. Such solutions may require in-house or private support services to facilitate the interface and integration with other services. The basic functionality of a user interface would **enable a secure user login for the student**, thus creating authorised student services. On the other side of the system, an HEI would collect student data and feed it into the system (see figure below).

Figure 2. User interface scheme.



Source: created by authors.

User-oriented student data access solutions pave the way to not only generate or access a digital Diploma Supplement, but to actually use it. Ultimately, what distinguishes a digital document from a paper one is the service associated with a dataset versus a document.

Case studies and interview programme findings indicate that one of the most commonly used user-oriented interface solutions are **student information systems**. Students can log into the system and obtain services related to their student information. During the study period, this usually includes routine services such as registering for courses, viewing student records, downloading transcripts (official or unofficial), applying for official documents from the students' records office, etc. Such interfaces hold a high potential to become **intermediary environments for issuing, storing, and sharing a digital Diploma Supplement**. User interface solutions could also facilitate employers' access to students for matching skills.

The main functionalities of a student user interface associated with a digital DS may include, but is not limited to:

Viewing student records online or storing them in an online portfolio.	Generating and downloading a verified electronic Diploma Supplement. This functionality can be implemented while building upon Option 0 and Option 1. A verified PDF document could be readily generated using a standard structured data model implemented within a student information system.	Transferring Diploma Supplement data to other HEIs. This functionality would also build upon Option 0. A standardised student data format would enable sharing of structured student information within HEIs in an automated way. A user interface would enable the student, who is the owner of his/her own data, to safely authorise the direct transfer of their Diploma Supplement or other relevant student data.	Sharing the Diploma Supplement with third parties, e.g. employment or skills matching services, professional networks, or EU transparency tools such as Europass. This could be done via direct student data transfer (see Option 1), or by sharing certified electronic documents (see Option 2).
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There are already cases where student information system interfaces are successfully providing access to official student records, generating secure electronic documents, or even providing electronic employment or skills matching services. Student information systems with service integration can be developed and distributed at three different levels:

National level	<p>Student information systems developed at the national level (e.g. Ladok in Sweden, Norwegian Diploma Registry) may have: uniform login and security arrangements; standardised data models for producing and sharing documents; national level support and guidance arrangements, and; national level financing arrangements for system development and support. National level student information systems create a network of all national level HEIs connected to it.</p> <p>Uniform models have great potential for integration with other national level e-government systems such as electronic IDs for authentication.</p>
Private external providers	<p>Student information system integrations developed by private external providers (e.g. Digitary in Ireland and internationally, Gradintel in UK and internationally, Parchment in the US) could be tailor-made for individual HEIs.</p> <p>These models tend to be service-oriented and work as intermediaries among HEIs, students, and employers. Both HEIs and employers agree to pay a certain fee to a private service provider in exchange for a wide array of user-oriented services: student information management for HEIs; skills matching and talent search for employers, and; student services and employment opportunities for students. The more users the private student service providers have, the more added value they can create by facilitating a network of HEIs, students/graduates, and employers.</p>
Individual solutions	<p>In contexts where national level student information systems or widespread private provider services are not available, student information systems may not have a readily available network of institutions and stakeholders sharing the same information and data standards.</p> <p>In such contexts it is crucially important to seek interoperability in order to produce and share student information that can be made accessible not only for the holder, but for different stakeholders. Information accessibility is one of the main conditions for upgrading the Diploma Supplement from a simple paper document to a set of live data that can be easily integrated with further student and employment services.</p>

Cost-utility analysis of Option 2

The table below summarises the cost elements of user-oriented student data access solutions. Considering the complexity of current user-oriented solutions, we present specific conditions determining whether costs and utility of the potential solution would be high or low.

Table 11. Option 2 cost elements

Type of costs	Justification and evidence	Assessment of the level of costs
Development costs	<p>Development costs highly depend on whether an HEI already has a functioning student information system, and at what level it is developed.</p> <ul style="list-style-type: none"> Development costs would be low if the HEI already has an electronic student information system providing student services. Our survey of HEIs showed that most could use their student information systems to issue electronic Diploma Supplements with only minor changes.⁶⁰ Development costs would also be low if the student information system is developed at the national level. Interviewed HEI representatives that use national level systems confirmed that development of additional functionalities, such as issuing a digital DS or adding interoperability functions, happen as routine exercises and do not pose significant additional costs for individual institutions. The development costs would amount to a fixed one-time purchase if the student information services or the interface plugin is implemented by a private provider, and built upon an already existing student information system. This option would pose costs proportionate to the size of an HEI. The development costs also depend on competencies available to an HEI's IT department, thus having internal IT capacities would further diminish development costs. 	Low (conditional)
	<p>The development costs could be high if an HEI does not have technical capacities or enough human resources to develop a student information system capable of producing secure electronic documents, of providing a user interface and additional services, and if there is no widespread private provider available in the market. One of the main obstacles mentioned by the interviewed HEI representatives was the relatively high initial costs of digitalising internal processes.</p>	High (conditional)

⁶⁰ Higher Education Institutions survey, PPMI, 2017.

Type of costs	Justification and evidence	Assessment of the level of costs
Dissemination costs	<ul style="list-style-type: none"> Dissemination costs would be low for HEIs who use student information systems developed at a national or in a wide HEI consortium level (e.g. Norway, Sweden, Poland, Italy). A wide network of participating HEIs enable a seamless, centralised implementation and dissemination of digital practices. Dissemination costs would be low for HEIs who purchase student information system services from widespread private providers that are well established in the market. Well established private providers (e.g. Digitary in Ireland, Gradintel in the UK) are able to establish common interoperability standards and seamless dissemination within the network of their users and beyond. One of the most established private provider claims that the system could be kick-started within days, and can readily start issuing digitally signed Diploma Supplements, provide access for employers, and facilitate exchange of digital DS and other academic documents with many institutions in Europe and worldwide.⁶¹ Dissemination costs would be low for HEIs that already participate in high profile international student services or interoperability projects such as EMREX, EWP, or STORK, since they already have experience in building interoperability plugins and participate in wide international knowledge sharing networks. 	Low (conditional)
	Dissemination costs would be high for HEIs not participating in any networks or projects on the basis of student information systems or good practice exchange.	High (conditional)
Technical, administrative, content support and maintenance costs	For HEIs building services upon existing student information systems (national level or individual), technical, administrative, content support, and maintenance costs, would become routine. Interviewed HEI representatives agreed that additional services usually pose initial establishment and training costs on existing staff, but once established, it becomes routine maintenance.	Low/routine
	HEIs purchasing student information system services from private providers would imply continuous per-annum maintenance or subscription costs. However, the interviewed private providers confirmed that an annual licence fee is proportionate to the size of an HEI.	High (conditional)

⁶¹ Case study programme.

The table below summarizes the utility elements of user-oriented student data access solutions supporting the digital Diploma Supplement.

Table 12. Option 2 utility elements

Element of utility	Justification and evidence	Qualitative utility score
Impact on recognition, mobility and employment (usefulness)	<p>The main purpose of user-oriented student data access solutions is to create authorised services where students and graduates can access their education achievements and make them available to companies and public agencies (e.g. potential employers or other HEIs). Student information systems which are integrated with services have the following benefits for different stakeholders:</p> <ul style="list-style-type: none"> ▪ students and graduates can more easily access and present their skills and competences, ▪ employers and educational institutions can receive information on skills and competences of students/graduates, and ▪ information is ensured to be authentic and correct. 	High
Openness of the format	<p>User-oriented student data access solutions function as intermediaries between the HEI (data producer), student (data owner), and third parties (other HEIs, employers, public). Thus the most important condition for the openness of the system is its interoperability potential:</p> <ul style="list-style-type: none"> ▪ whether the system can produce and process open structured data formats such as XML (see Option 0 above); ▪ whether the system can produce and process standardised documents such as secure PDFs (Option 1). <p>If the system can produce and process open and standardised student information data formats such as XML or other widespread structured data formats, and produce standardised documents (see Options 0 and 1 above), the openness of the system is high. For example, the UK's version of the Diploma Supplement's (HEAR) XML technical specification is available online on GitHub, so developers of the student information systems can build readily available plugins for the HEIs.</p>	High (conditional)
	<p>If a user-oriented student data access solution can only produce and process specific student information data formats and documents requiring additional software or knowledge to process, the openness of the system is low.</p>	Low (conditional)
User-friendliness/ flexibility	<p>User-oriented student data access solutions can demonstrate a high level of user friendliness and flexibility.</p> <ul style="list-style-type: none"> ▪ Using the Diploma Supplement as a formative document. Even though formally the Diploma Supplement is a document issued upon graduation, in the UK, its Diploma Supplement (HEAR) implementation showed that using a DS as a formative document can add a lot of value to the document's user friendliness and flexibility. The HEAR in the UK starts being developed as soon as students enrol in the HEI, and is built while they are studying. This functionality for students to access the DS over the duration of their course of study enables students to look at their progress and achievements as they go along, and to think about how 	High

	<p>to improve and make the most of their studies. On the other hand, employers often hire while students are still studying, so being able to access and share a Diploma Supplement before graduation makes this document extremely valuable for seizing employment opportunities.</p> <ul style="list-style-type: none"> ▪ Providing trusted content to third parties. An online access solution adds user friendliness and flexibility by enabling users to readily share their achievement records in a secure and certified way, whenever needed. Some of the analysed systems enabled the transfer of verified information about student's achievements (e.g. Diploma Supplements' content) directly to other registered HEIs or Employers. This can be done either by raw data transfer or by sharing achievement records through secure URL links, publishing on a temporary website, downloading and sharing certified electronic documents, etc. ▪ Possibility to verify degrees and grades online. The Diploma Registry in Norway provides a solution for verifying degrees and grades online, thus reducing the workload of both recruiters and student administrators. ▪ Possibility to implement third party integration with professional networks, online portfolios, transparency tools such as Europass, and others. 	
Security against fraud, unauthorised altering of the data, or forgery	<p>Authentication solutions:</p> <ul style="list-style-type: none"> ▪ Logging in using a national ID solution (e.g. the Diploma Registry in Norway provides national level authentication, the STORK2 pilot provides secure cross-border authentication through national eID system, and DUO uses Dutch Digital ID identification service). This solution may ensure the highest level of authentication security, but its transferability is limited to countries who already have functional eID arrangements at the national level. ▪ Decentralised authentication solution based on one point of strong authentication and a trust network. Emrex established a two-step login solution comprised of an anonymous statistical log that can be shared with the whole EMREX network, and a national log that fulfils the national requirements for logging. The national log is not shared between countries, and will be different between different implementations (e.g. in Norway there is Feide and ID-porten, Haka in Finland, and Swamid in Sweden). This solution is highly transferable since it does not require any uniform authentication methods for individual HEIs. A trust network is based on the assumption that there is at least one point of strong identification, for example, the student should be required to personally be present with a valid identity to receive his/her username. <p>The examples below illustrate high level security features applied in analysed cases:</p> <ul style="list-style-type: none"> ▪ System hardware is hosted in a fully managed, redundant, multi-tiered infrastructure with multiple layers of security; systems are monitored for security vulnerabilities. ▪ Security measures are applied both on data servers and during transfers of data. 	High

	<ul style="list-style-type: none"> ▪ Documents can only be accessed by authorised individuals. Parties with a provided link can access the student data. Users can manage whom to give the authentication to to access the documents. ▪ Communication with the web application is encrypted (SSL encryption). ▪ Achievement results are collected directly from the educational institutions databases. All sending and receiving parties must be authenticated. 	
Personal data protection	<p>Personal data protection arrangements within the analysed cases are in line with the reform of EU data protection rules. The General Data Protection Regulation makes it easier access to one's own data and to transfer personal data between service providers.⁶²</p> <p>The main personal data protection provision regarding user-oriented data access solutions is that the student or holder of qualifications owns the data. All of the analysed cases had provisions specifying that the student or graduate is the one to give permissions to transfer their student information to other HEIs in cases of mobility or application, to access his/her own data, and to share it with other third parties (e.g. employers, professional networks, guidance services, etc.).</p>	High

⁶² Regulation of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation).

Implementation timeline (readiness for final use)	<p>The readiness of HEIs to feed student data into an electronic student information system is one of the main factors that could determine an implementation timeline. Some of the interviewed HEI representatives pointed out that in order to provide electronic student services, internal management of student records has to be electronic first. Institutions that handle student information manually would have to adjust their internal processes to the electronic system requirements gradually, significantly increasing the implementation timeline. While nearly 60% of surveyed HEIs within the EHEA store student information in an analogue format (paper or similar type of archive), it only seems to serve as a backup option, since nearly all surveyed HEIs also store student record data in digital format on institution's servers (78,3%), cloud (15,1%), or national/regional student data repository (27,7%).⁶³</p> <p>The table below shows the percentage of surveyed HEIs across the EHEA that used student records for the following purposes:</p> <table> <tr> <th></th> <th>Very often/often</th> </tr> <tr> <td>Providing students with data on their performance during the course of their studies</td> <td>80%</td> </tr> <tr> <td>Issuing a document presenting students' educational performance upon graduation</td> <td>84%</td> </tr> <tr> <td>Exchanging data with other educational institutions in cases of mobility</td> <td>50%</td> </tr> <tr> <td>Exchanging data with other educational institutions in cases of educational transition (e.g. joint degrees, higher level education)</td> <td>34%</td> </tr> <tr> <td>Providing data for job-matching systems or other employment services</td> <td>15%</td> </tr> <tr> <td>Improving student services</td> <td>44%</td> </tr> <tr> <td>Alumni services</td> <td>34%</td> </tr> </table> <p>The table shows that the majority of HEIs already make use of student data for providing students with data on their performance during the course of their studies, for issuing a document presenting student's educational performance upon graduation, or for exchanging data with other educational institutions in cases of mobility. These findings show that student services and data exchange are already widespread practices, and so associating them specifically with the Diploma Supplement would not pose significant time constraints.</p> <p>On the other hand, exchanging data with other educational institutions in cases of educational transition (e.g. joint degrees, higher level education), or providing data for job-matching systems or other employment services, are still not widespread among HEIs within the EHEA. These solutions may require higher input from HEIs in terms of development and feeding information, since they require partnerships with external third parties, i.e. other HEIs and employers. Participation in wide scope projects such as EMREX may significantly shorten the implementation timeline, since such initiatives create vast knowledge bases and openly available technical solutions for participating partners.</p> <p>Student services related to securely accessing and sharing the Diploma Supplement can be implemented gradually, starting from the most basic services such as online viewing and transfer of student records for mobility purposes, moving towards more complex services such as issuing certified electronic documents, providing skills-matching services, or sharing data directly with</p>		Very often/often	Providing students with data on their performance during the course of their studies	80%	Issuing a document presenting students' educational performance upon graduation	84%	Exchanging data with other educational institutions in cases of mobility	50%	Exchanging data with other educational institutions in cases of educational transition (e.g. joint degrees, higher level education)	34%	Providing data for job-matching systems or other employment services	15%	Improving student services	44%	Alumni services	34%	Short (conditional)
		Very often/often																
	Providing students with data on their performance during the course of their studies	80%																
	Issuing a document presenting students' educational performance upon graduation	84%																
	Exchanging data with other educational institutions in cases of mobility	50%																
	Exchanging data with other educational institutions in cases of educational transition (e.g. joint degrees, higher level education)	34%																
	Providing data for job-matching systems or other employment services	15%																
	Improving student services	44%																
	Alumni services	34%																
		Long (conditional)																

63 Higher Education Institutions survey, PPMI, 2017.

	other HEIs within the same country or across borders. Gradual implementation implies that HEIs can implement electronic Diploma Supplement services at their own pace.	
Other technical implementation challenges	<p>One of the main challenges related to user-oriented student data access solutions is related to lifelong accessibility. A lot of interviewed HEIs and digitalisation experts pointed out that the services discussed above are usually available to students or recent graduates, and the question of lifelong accessibility remains open.</p> <p>One of the possible ways to resolve this issue may be related to electronic identity services provided at the national level. For instance, citizens would be able to access their student records using a national identification portal for an unlimited amount of time. However, underdeveloped national level identification services within the EHEA, lack of technical solutions to associate HEIs' services with higher level authentication infrastructure, and limited capacity to securely store digital information for an unlimited amount of time, remain to be obstacles to lifelong online access to student records.</p>	Lower utility
Transferability of the solution to all EHEA countries (legal, technological, practical, perception aspects)	<p>The fact that the majority of HEIs within the EHEA already store student records in structured electronic formats, increases the transferability potential of user oriented student data access solutions related to the Diploma Supplement.</p> <p>Even though many HEIs already provide a wide variety of student services, the Diploma Supplement's role within these developments depend on whether HEIs are willing to build their systems on widespread data standards and projects that have already accumulated a wide knowledge base. Examples such as EMREX or HEAR demonstrate that using open data standards and creating trust networks between HEIs can help streamline specific solutions at the national level and across borders.</p> <p>Interview and case-study programme findings indicate that a combination of centralised and de-centralised approaches is a crucial factor for transferability of user-oriented student data access solutions.</p> <ul style="list-style-type: none"> ▪ Common open data standards, interoperability solutions, and trust networks are crucially important for cross-border transferability of student services related to access and transfer of the Diploma Supplement. ▪ Individual solutions and best practice sharing platforms for security, authentication, and technical implementation challenges are crucial for disseminating digital practices among individual HEIs across the entire EHEA. 	High

2.4.4 Option 3. Open digital credentials

Lifelong learning initiatives and the growing popularity of flexible learning pathways call for new ways to recognise achievements gained in formal, informal and non-formal environments. Open digital credentials such as Open Badges enable representation, verification, and sharing of skills and competences acquired in a variety of digital and non-digital learning environments.⁶⁴

Open Badges are **verifiable, portable digital badges with embedded metadata about skills and achievements**. They comply with the Open Badges Specification and are shareable across the web. Each Open Badge is associated with an image and information about the badge, its recipient, the issuer, and any supporting evidence. All the information may be packaged within a badge image file that can be displayed online.⁶⁵ Every badge tells its own story about what it signifies, how it was earned and which organisation conferred it.

Open Badge metadata includes:

- the defined outcomes required to earn the badge and the evidence earners provided to demonstrate their competence;
- the qualifications of the learning provider, credential sponsor, or issuing organisation and their trustworthiness;
- the relationship between the badge and larger programmes, professional learning pathways, and/or larger skill sets, and;
- verification of the badge earner's identity and relevant, secure, trusted communications about their qualifications, competences and skills.

Open Badges support the goals of the Groningen Declaration, being portable evidence of learning that citizens can share and display with whomever they want, wherever, and whenever. **The Open Badges could be used to augment conventional education credentials such as the Diploma Supplement.** Being community-driven and not controlled top-down by credentialing infrastructure, Open Badges can be adjusted to any context and represent achievements, competencies, participation, membership, commitment, and similar skills and competences that are not reflected by traditional credentials but important for employability and lifelong learning goals.

⁶⁴ Buchem, van den Broek, and Lloyd, "Open Badge Network Discussion Paper on Open Badges at Policy Levels."

⁶⁵ "What's an Open Badge?", <https://openbadges.org/get-started/>

Cost-utility analysis of Option 3

The table below summarises the cost elements of open digital credentials.

Table 13. Option 0 cost elements

Type of costs	Justification and evidence	Assessment of the level of costs
Development costs	<p>The open badges is an open source solution and would not pose development or maintenance costs <i>per se</i>. However, issuing Open Badges require a technology platform that supports the Open Badges Specification.</p> <p>The platform should support services such as online badge design, badge discovery, issuing, assessment workflow, display, user profiles, social sharing and tools to integrate with existing learning systems. There is a number of external online platforms available to support badge system development and deployment.⁶⁶ For instance, in Italy Bestr. open badge platform acts as an intermediary helping Italian HEIs to define and issue Open Badges that can be integrated within student information systems.⁶⁷</p>	A one-time fee per badge created and a marginal cost per badge issued
Dissemination costs	<p>The paper pointed out that efforts to establish Open Badges at policy levels were still at very early stage, and thus it would probably take at least a few years for Open Badges to become a recognised concept in the Open Education ecosystem.⁶⁸</p> <p>The dissemination of the Open Badge concept would imply raising public awareness, making them more known within formal, non-formal, and informal educational settings, and raising awareness at policy level.</p> <p>Existing European initiatives such as Erasmus+ funded Open Badge Network⁶⁹, or global networks such as Badge Alliance⁷⁰, could be leveraged to reinforce already ongoing dissemination practices.</p>	High
Technical, administrative, content support and maintenance costs	<p>Issuing badges may imply a "pay-per-use" pricing model that is based on the number of badges created and issued. There is a one-time fee per badge created and a marginal cost per badge issued, according to volume.</p>	A one-time fee per badge created and a marginal cost per badge issued (medium)

⁶⁶ "Badge Alliance » Badge Issuing Platforms." <http://www.badgealliance.org/badge-issuing-platforms/>

⁶⁷ Case study programme, Bestr. case.

⁶⁸ Buchem, van den Broek, and Lloyd, "Open Badge Network Discussion Paper on Open Badges at Policy Levels."

⁶⁹ The Open Badge Network (OBN) is an Erasmus + project which brings together organisations from across Europe to support the development of an Open Badge ecosystem, promoting the use of Open Badges to recognise non-formal and informal learning, <http://www.openbadgenetwork.com/>

⁷⁰ The Badge Alliance, launched at the Summit to Reconnect Learning in 2014, is a network of organizations and individuals, now a project of IMS Global Learning Consortium. <http://www.badgealliance.org/>

The table below summarizes the utility elements of open digital credentials.

Table 14. Option 3 utility elements

Element of utility	Justification and evidence	Qualitative utility score
Impact on recognition, mobility and employment (usefulness)	<ul style="list-style-type: none"> Unlike traditional credentials, Open Badges enable the recording of specific experiences, skills, and competences that otherwise are not visible to potential employers or other third parties. In other words, Open Badges can give value to competences acquired in informal and non-formal settings, facilitating recognition of learning outcomes of lifelong learning. Open Badges can give value to extracurricular activities and e-learning by augmenting traditional credentials such as the Diploma Supplement. Open Badges, as digital micro-credentials based on occupational standards, could help match student data with labour market skills needs, and facilitate skills matching services. 	High
Openness of the format	In late 2011, Mozilla, HASTAC and the MacArthur Foundation came together at the centre of a broad community of collaborators to produce an open technical standard for any organization to create, issue, manage and verify digital badges. In March 2013, they released the first version of their Open Badge specification and the Open Badges Infrastructure (OBI) software that implements the standard.	High
User-friendliness of the format	<p>From a <i>consumer</i> perspective, Open Badges seem to be an attractive option for users, enabling unlimited flexibility in recording and sharing achievements. They can be displayed wherever earners want to on the web, and share them for employment, education or lifelong learning purposes.⁷¹ It is also possible to attach a badge to a LinkedIn profile, share it on social media, and download the image or upload it onto another Open Badge management system.</p> <p>However, results from the international surveys presented in the Open Badge Network Discussion Paper showed that one of the key issues was current low awareness of the Open Badge concept. Respondents who were aware of Open Badges agreed that more dissemination activities would be needed to make them mainstream.⁷²</p> <p>Some of the interviewed digitalisation experts pointed out that there was still lack of trust in Open Badges stemming from lack of awareness or little interest. There were also views that Open Badges may not be recognised as official credentials since they are not widespread and well known as a standard for educational credentials.⁷³</p>	Low (due to low popularity and awareness of the concept)
Security against fraud, unauthorised altering of the data, or forgery	<p>It is very important to be able to check the authenticity of a credential at any moment, and the badge is able to show this information.</p> <p>Badges are protected by assertion mechanisms. The assertion describes three key aspects of an Open Badge: (1) who a badge was awarded to; (2) what that badge represents; and (3) who issued the badge. Viewers of badges (e.g. peers, employers) can</p>	High

71 "Badge Alliance » Why Badges?" <http://www.badgealliance.org/why-badges/>

72 Buchem, van den Broek, and Lloyd, "Open Badge Network Discussion Paper on Open Badges at Policy Levels."

73 Interview programme.

	verify the badge based on the data contained in the assertion and displayed from an earner's public collections of Open Badges. Each assertion has a unique ID. Additionally, badge assertions can be hosted at the location where the badge is produced, or secured with digital signatures or authentication codes.	
Personal data protection	<p>The mechanism for using the badges is fully user-centred. The student/graduate has to accept the badge that was issued to him/her, i.e. the badge has to be "claimed".</p> <p>Badges could also be used as anonymous credentials within skills-matching systems to eliminate any contextual bias and potential preconceptions within hiring practices.</p>	High
Implementation timeline (readiness for final use)	<p>As mentioned above, efforts to establish Open Badges at policy levels were still at a very early stage, and thus it would probably take at least a few years for Open Badges to become a recognised concept in the Open Education Ecosystem.⁷⁴</p> <p>There is a low level of awareness, a lack of trust in the concept of open badges, and a lack of commonly established standards; these may not allow for quick take-up. However, work done at the international level, Open Badge communities may make this concept more accepted in the near future.</p>	Long
Other technical implementation challenges	In order to add badges to conventional credentials, HEIs have to set up a student information system plugin if this service is not supported by the system provider.	Lower utility
Transferability of the solution to all EHEA countries (legal, technological, practical, perception aspects)	<p>At the moment, Open Badges is not a widespread and well known standard of credentials. Findings from the interview programme indicate that HEIs and digitalisation experts working with Diploma Supplement digitalisation are rather sceptical of Open Badges because this standard has not yet been widely used by European HEIs.</p> <p>On the other hand, there is significant work being done to develop Open Badge standards for the near future. For instance, the Bologna Open Recognition Declaration (bord) calls for a universal open architecture for the recognition of lifelong and lifewide learning achievements. The community of declaration signatories have prompted discussions which led to the idea to create an Open Recognition Alliance to carry the open recognition vision forward.⁷⁵</p> <p>An Open Badge Network (Erasmus+ project) aims to establish a trusted source of independent information, tools and informed practice, facilitating a badge ecosystem to be developed across Europe.</p> <p>Even though the Open Badge concept may not be readily transferable across the entire EHEA, voluntary and EU funded Europe-wide initiatives are taking place to mainstream open recognition movement, and may be streamlined to unlock the potential of open micro credentials for better recognition of lifelong learning achievements.</p>	Lower transferability

74 Buchem, van den Broek, and Lloyd, "Open Badge Network Discussion Paper on Open Badges at Policy Levels."

75 "Bologna Open Recognition Declaration." <http://www.openrecognition.org/>

Conclusions

Diploma Supplement implementation

- During the period 2007 to 2015, the DS implementation situation significantly improved. Nevertheless, higher education institutions in two-thirds of EHEA countries had not yet followed all of the four Bologna requirements (providing Diploma Supplements automatically, free of charge, to all graduates, and in a widely spoken European language).
- Higher education institutions evaluated the DS as one of the most valuable tools for managing student data, especially for recognition of qualifications in the context of admission procedures. The Diploma Supplement was also often used by HR/recruitment officers in businesses across EHEA countries to acquire information on job candidates.
- Inconsistencies in the presentation of information were persistent, and the comparability of student data was therefore diminished.
- The DS was, on the one hand, perceived to be too long and therefore not user-friendly, but, on the other hand, still lacked some important information. Part of the issue was that the Diploma Supplement was used by several target groups with completely different needs. Employers expressed that the DS lacked information on mobility experiences and extracurricular activities.
- The Diploma Supplement was not well known among students, who usually became aware of it only upon graduation. Many of the stakeholders were also unaware of the purpose of this document. In some cases, HEIs only issued the Diploma Supplements because of a legal obligation. The perception that implementing the Diploma Supplement would incur high costs also hindered implementation of the DS.
- These issues implied the necessity of support for HEIs in implementing the Diploma Supplement, but also the importance of raising awareness among HEIs, students and employers about the document's potential usefulness. In particular, providing HEIs with rewards, examples and explanations, along with experience-sharing sessions, proved to be useful measures.

The need for digitalisation

- The European digital economy has been growing several times faster than the rest of the economy. However, while the Diploma Supplement has been widely implemented across the EHEA, **so far the DS has remained mainly a paper document, with only a small proportion of HEIs issuing it in any digital format.** This has happened despite evidence that virtually all HEIs stored the student data in digital format.
- In the few existing examples of digital Diploma Supplements, the **full potential of digitalisation was not exploited**, as unverified PDF documents were among the most popular digital DS formats.
- The digitalisation of the Diploma Supplement was **strongly supported by stakeholders.** However, the perception of HEIs was that digitalisation would create significant costs while bringing uncertain benefits, and they were reluctant to launch this process. Although HEIs which had already implemented digitalisation were significantly more positive, more clearly communicating the costs and benefits would increase the willingness of HEIs to digitalise the Diploma Supplement. It

would also significantly help communicate the cost-benefit ratio to HEIs if digitalisation elements were clearly defined and operationalised.

- Manual handling and processing of paper documents is relatively more expensive than digital data. Therefore, digitalising the DS could **reduce issuing and handling costs for both HEIs and users of the document** (e.g. recognition centres and employers). A digital format would enable a faster and more reliable exchange of information. **Presenting the DS in a machine-readable format could significantly reduce the amount of manual labour.**
- Traditional printed diplomas and associated documents have been subject to relatively high levels of fraud. Most of the consulted stakeholders agreed that **security and verification measures enabled by a digital format could make the DS safer and easier to verify.** Advanced digital signatures or direct DS data exchange among HEIs, recognition authorities, and employers could significantly reduce fraud and allow faster and higher quality verification of the credentials.
- The current format of the DS could not provide the flexibility needed to meet the needs of different stakeholders, evident from the conflicting perceptions of the length and complexity of the DS. **Digitalising the DS could enable the presentation of the most relevant information for different stakeholders** e.g. in a modular fashion or via search functionality.

Digitalisation options

The Diploma Supplement could be digitalised by incrementally building upon already existing widely accepted solutions. Following this approach, this report presents a baseline option and three intermediary digitalisation options of varying complexity. These options could be implemented by incrementally adding new features and functionalities on top of the basic requirements.

Option 0

- Digitalisation of the Diploma Supplement could begin by promoting **a common data exchange standard based on XML** (baseline **Option 0**). XML is a widely used open standard, which is already employed by many HEIs across Europe and worldwide. This option would incur relatively low development, dissemination, and technical/maintenance costs, especially within countries that have already implemented European and national projects working with XML standard.
- A standard data exchange format would form a strong basis for understanding the **DS as a set of data** described in a standardised way, demonstrating high sharing and integration potential, as opposed to a paper document. With relatively **low costs**, a common data exchange standard could offer **significant impacts on interoperability and exchange** of the DS, while ensuring **user-friendliness** and a **high level of security**.

Option 1

- To reach the general public, a digital Diploma Supplement would have to be presented in a very well-known document format. Accordingly, **Option 1** suggests **PDF**, which is widely used to present and exchange documents reliably, and independently of software, hardware, or operating system. PDF offers a **verification functionality** which could significantly limit fraudulent presentation of data. It also complies with **a global long-term preservation standard** (PDF/A), which is particularly important for accessing Diploma Supplement for an unlimited period of time.

- It is important to note that **PDF documents can be compiled using standard structured data format XML**, which is suggested as a baseline option for making the DS digital.
- Introducing this **low-cost, open, and user-friendly, format with verification possibilities** could reduce printing and handling costs for HEIs, recognition agencies, and employers. PDFs are not conceptually or visually remote from paper versions, and would enable holders to exchange documents reliably, with the ability to apply European electronic signature standards.

Option 2

- User-oriented student data access solutions (**Option 2**) would provide **intermediary environments** for issuing, storing, and sharing a digital Diploma Supplement. Services associated with the DS could help stakeholders 'consume' the document, and make it more useful for employment, mobility, or further education purposes.
- User-oriented student data access solutions could enable the most relevant DS information to be presented to different stakeholders, suggesting a **potentially modular approach** in student data presentation. Moreover, if students could access DS information at any time during their studies, the DS could also serve as a **formative document**. This could significantly improve DS's relevance for employment purposes, since many students seek for jobs while studying.
- User-oriented student data access solutions could also streamline usefulness of the DS by offering **interoperability with external services**, for example, by augmenting professional network profiles, filling in CVs, applying for guidance services, or compiling professional portfolios. It is important to note that **promoting a standard DS data format** such as XML (Option 0) could streamline interoperability.
- Countries' readiness to implement such solutions strongly depends on the student information systems and services already used by HEIs, and on the availability of national level or private providers capable of implementing such services. Therefore, although services associated with the digital DS have significant uses, such solution would not yet be fully transferable across the whole EHEA.

Option 3

- Open digital credentials such as Open Badges (**Option 3**) would give value to skills and competences that were harder to reflect within traditional credentials such as the Diploma Supplement. Open badges could make the DS more **open to a wider array of experiences and learning pathways** of higher education students, and provide an attractive incentive for learners to participate in those experiences.
- Open Badges, with their potential to make a strong impact on the usefulness of the DS data, were **still not established well enough** across HEIs in EHEA in the beginning of 2017. To estimate the true potential impact of this technology, more pilot exercises and successful best practice examples of implementation are necessary. Due to its novelty, it is likely to entail significantly higher dissemination costs than either XML or verified PDF solutions. Even though Option 3 may not be readily transferable across the EHEA, it could be explored as a prospective solution in the context of emerging technology.



Annex 1 Methodology

A1.1 Interview programme

For the draft final report, we conducted 59 interviews out of a planned 70. This included 28 interviews with experts from the countries selected for in-depth field research: Armenia, Austria, Belgium, Czech Republic, Finland, France, Germany, Italy, Latvia, the Netherlands, and the United Kingdom. We also carried out 24 interviews with representatives of various institutions in countries outside the in-depth field research scope, and conducted seven interviews with European or international institutions and organisations.

The interviews targeted five groups of stakeholders outlined below (see table below).

Table 15. Number of interviewed stakeholders

	National authorities, ENIC-NARIC, NEC	Members of the Advisory Group on the Revision of the Diploma Supplement	Experts on student records and digitalisation	HEIs, DS label holders	Social partners, educational, student and alumni associations, participants of relevant projects
Conducted number of interviews	13	3	17	30	12
Agreed number of interviews	5 to 7	5	12 to 15	25 to 30	10 to 12

Source: compiled by authors

Additionally, we gathered insights from the discussions of the following meetings with stakeholders:

- AG4 Group meeting in Vienna, 2016 October 28;
- The ET2020 Working Group meeting in Brussels, 2016 November 14; and
- The NARIC meeting in Brussels, 2016 December 1.

To further focus the interview programme on digitalisation, we were able to identify specific HEIs that were issuing or planning to issue digital Diploma Supplements or comparable documents. We found potential interviewees through the HEI survey that had been launched (the respondents were asked to identify higher education institutions they work for), and we requested interviews with representatives from the identified universities.

We used two types of interview questionnaires for different stakeholders. The first aimed to overview general aspects of the study (implementation, challenges and solutions, and common digital issues). The second questionnaire specifically focused on the digital part of the study and involved more technical details. Interviews with government agencies, ENIC-NARIC, NEC, the Advisory Group on the Revision of the DS, HEIs and social partners followed the first questionnaire. Conversations with experts on student records and digitalisation were followed by the more elaborate second version.

We conducted several interviews in person, while the majority were Skype/phone calls. The approximate length of most interviews was one hour. A couple of interviewees expressed their willingness to fill out the questionnaire by hand due to language barriers, or because they needed to check information with colleagues/partners. All interviews were transcribed and analysed using qualitative data analysis (QDA) software.

A1.2 Surveys

We carried out a survey programme to gather data for answering specific operationalised questions about the purpose, content and structure of the DS. The survey programme also aimed at addressing the questions on digitalisation of the DS and comparable documents.

Higher Education Institutions survey

Higher education institution personnel can be classified as working with: *databases of student records/data; diplomas and/or accompanying documents recording student data; student data exchange related to student mobility, double/joint degrees or job matching; recognition of diplomas and/or other student records; and any other position working with student records and data.* To disseminate the survey to these personnel, we contacted the NARIC centres and asked for their assistance in distributing the survey to the HEIs. 14 out of 48 contacted NARICs agreed to help by providing a list of HEIs with contact details, or disseminated the survey themselves.

To ensure that the survey programme represents all EHEA member states, we contacted HEIs in the rest of the 34 countries using publicly available email addresses.

We received 1113 responses for the HEIs survey (446 complete and 667 partial) which we used for the analysis. In addition, we applied data cleaning methodology to quarantine an additional 321 responses. Our HEI survey covered all EHEA countries excluding the Holy See, Liechtenstein and the Former Yugoslav Republic of Macedonia (see distribution in Table 16 below).

Table 16. Country distribution of responses in HEIs survey

Country	Percent	Country	Percent
Albania	0.8%	Latvia	1.0%
Andorra	0.2%	Liechtenstein	0.0%
Armenia	0.8%	Lithuania	5.0%
Austria	4.8%	Luxembourg	0.2%
Azerbaijan	0.8%	Malta	0.2%
Belarus	0.5%	Moldova	0.5%
Belgium	4.3%	Montenegro	0.5%
Bosnia and Herzegovina	0.3%	Netherlands	2.9%
Bulgaria	1.6%	Norway	2.1%
Croatia	0.8%	Poland	5.1%
Cyprus	0.8%	Portugal	6.4%
Czech Republic	0.6%	Romania	2.4%
Denmark	1.3%	Russian Federation	1.3%
Estonia	0.5%	Serbia	0.6%
Finland	1.4%	Slovak Republic	0.3%
France	3.2%	Slovenia	0.5%
Georgia	1.6%	Spain	1.9%
Germany	15.8%	Sweden	6.9%
Greece	0.6%	Switzerland	1.3%
Holy See	0.0%	Former Yugoslav Republic of Macedonia	0.0%

Hungary	0.8%	Turkey	9.3%
Iceland	0.3%	Ukraine	0.6%
Ireland	5.0%	United Kingdom	0.8%
Italy	1.9%	Other	0.3%
Kazakhstan	1.3%		

Source: Higher education institutions survey, PPMI.

Survey of graduates

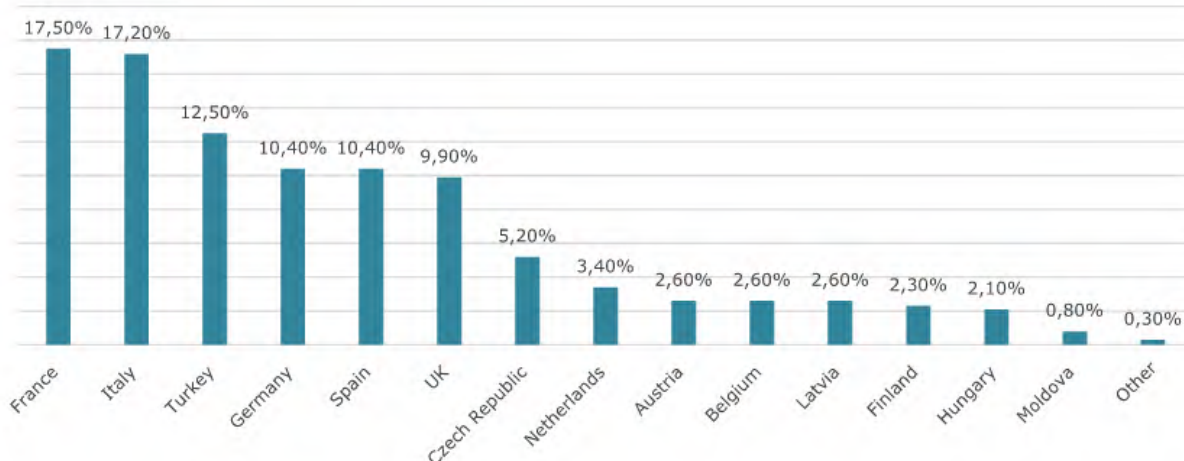
We contacted the following organisations to support us disseminate the graduate survey: ESN, EDEN (European Distance and eLearning Network), ESU, AEGEE-Europe, European Students' Forum, GaragErasmus, EMA, OCEANS and European Youth Forum. Even though some of the organisations agreed to help with reaching students/graduates, the country coverage was still insufficient. To meet the balance between respondents in different EHEA countries, we had to manually collect contacts of separate student unions of HEIs, and send out requests to disseminate the survey.

A total of 9,020 graduates participated in the study, resulting in 5,972 complete and 3,048 partial responses. As responses from different countries in the graduates' survey varied significantly, we applied weighting methodology for country responses. We divided the number of responses of every surveyed country by the number of students in the respective EHEA countries to calculate the response/student ratio. After this step, we weighted ratios according to the total number of students and scaled weights to fit the sample size. This allowed us to have the sum of total weights equal to the number of responses. In order to avoid large distortions in the sample, we applied minimal and maximum thresholds equal to 0,25 and 4. This meant that independently from the scaled weight, the weight of responses was divided or multiplied by a maximum of four. Such a methodology resulted in a lower total response size after weighting, and decreased from 9,020 to 6,295.

Survey of employers

We disseminated the employer survey with the assistance of alumni associations, the ESN (which manages the website erasmusintern.org, where employers can post internship opportunities), and through employer organisations. Additionally, we used the external sample supply solution (panels of respondents) to gather a representative sample of respondents. In the employer survey, we collected responses from countries that had been selected as focus areas of the study (excluding Georgia, see distribution in Graph 14 below).

Graph 14. Distribution of countries in the employer survey



Source: Employer survey, PPMI

We gathered responses of representatives from numerous business sectors, as illustrated in the table below.

Table 17. Distribution of business sectors in the employer survey

Business sector	Percentage
Agriculture, forestry and fishing	5.0%
Mining and quarrying	2.9%
Manufacturing	17.3%
Electricity, gas, steam and air conditioning supply	3.9%
Water supply; sewerage; waste management and remediation activities	2.9%
Construction	9.9%
Wholesale and retail trade; repair of motor vehicles and motorcycles	5.8%
Transporting and storage	7.6%
Accommodation and food service activities	6.3%
Information and communication	11.0%
Financial and insurance activities	4.7%
Real estate activities	5.5%
Professional, scientific and technical activities	11.5%
Administrative and support service activities	8.4%
Public administration and defence; compulsory social security	5.5%
Education or training	9.7%
Human health and social work activities	7.9%
Arts, entertainment and recreation	4.5%
Other	13.1%

Source: Employer survey, PPMI

A1.3 Cost-utility analysis approach

Cost assessment

For the cost assessment we developed a framework of conditional costs, meaning that the costs of developing a certain digitalisation option highly depended on already existing pre-conditions within the individual HEIs and, on a higher scale, within the EHEA countries.

To estimate the costs of each option, we employed a cost-assessment framework outlined in the table below.

Table 18. Operationalisation of cost elements

Type of costs	Estimation methods	Pre-conditions reducing costs
Development costs	a) The estimation of working days needed to develop options in question. b) The estimation of capital investments, if any (e.g. infrastructure to be purchased).	Whether student data storage was in a digital, machine readable format (e.g. spreadsheets, xml, linked data, relational database). The existence of a digital student data management system (e.g. Student Information System, Learning Management System, ePortfolio system or similar).
Dissemination costs	The dissemination options explored included an estimation of whether the existing networks/tools could be used to produce synergies in dissemination and how this could be achieved for different options.	The existing practices and/or infrastructure of sharing digital student data with students, with other HEIs, with employers, and other third parties.
Technical, administrative, content support and maintenance costs	The estimation of workload required to support different options per annum, both in terms of technical, administrative staff and the need to involve thematic staff/ experts for managing the content of the solution.	The existing technical, administrative, content support and maintenance staff capacities.

Utility assessment

In terms of utility, the central element to be estimated was the impact (usefulness) of a certain option to the objectives of the Diploma Supplement. However, there was a number of issues widely discussed by experts dealing with digital student data management, for example in the context of the Groningen Declaration. These included the openness of the format, user-friendliness, and security issues including fraud, forgery and personal data protection. Following the guidelines given in the Terms of Reference, we also suggested that the transferability of the practice to all EHEA countries should become one of the utility criteria.

For measuring the **qualitative elements of utility**, we used the data gathered through interviews, surveys, and most importantly, case studies outlining the existing examples of the digital Diploma Supplement and other student records. The utility framework is outlined in the table below.

Table 19. Operationalisation of utility elements

Element of utility	Approach to analysing the element of utility	Qualitative operationalisation and data sources
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Element of utility	Approach to analysing the element of utility	Qualitative operationalisation and data sources
Impact on recognition, mobility and employment (usefulness)	<p>Estimate the impact by analysing the survey, interview and case study data.</p> <p>Estimate the impact from the perspectives of different stakeholders:</p> <ul style="list-style-type: none"> - <i>DS holders</i> - <i>HEIs</i> - <i>Employers</i> - <i>Recognition authorities</i> <p>Estimate the potential impact by using information gathered through the interviews, surveys, and most importantly, case studies.</p>	<p>High if:</p> <ul style="list-style-type: none"> - there are examples of existing good practices where the option in question or an equivalent solution already had a positive impact on recognition, mobility or employment; and - the interviewed and surveyed stakeholders and experts agreed that the option in question would be useful for the purposes of recognition, mobility and employment. <p>Low if:</p> <ul style="list-style-type: none"> - the interviewed and surveyed stakeholders and experts agree that the solution in question would not be useful for recognition, mobility, or employment; and - there are examples of existing practices where the option in question or an equivalent solution was implemented, but were of little or no use for the purposes recognition, mobility, or employment.
Openness of the format	<p>Identify whether the implementation of the option implies the use of any proprietary solutions (vs. open formats) by the issuing institutions, DS holders, and other actors.</p>	<p>High if:</p> <ul style="list-style-type: none"> - the proposed data format or specific software required to implement the solution in question is open, i.e. the format can be used by anyone, not restricted by copyrights, patents, trademarks or other restrictions, and may be used at no monetary cost. <p>Low if:</p> <ul style="list-style-type: none"> - the proposed data format or specific software required to implement the solution in question implies the use of proprietary solutions, i.e. the format is restricted by copyright, secure code of patent rights, and may be used at monetary cost only.
User-friendliness and flexibility of the format	<p>Identify whether the digitalisation options are easily understandable by the issuing institutions, the learners and the employers alike.</p> <p>The analysis of the user-friendliness will also include an estimation of whether the proposed solution is flexible in terms of the output format and content.</p>	<p>High if:</p> <ul style="list-style-type: none"> - the purpose and functions of the solution are clear and easy to understand for the intended users; - clear and accessible guidelines are available; and - the format is well known and widely accepted by the intended users. <p>Low if:</p> <ul style="list-style-type: none"> - understanding the purpose and functions of the solution requires specific knowledge; - guidelines are not available or require specific knowledge; and - the format is not commonly used or widely accepted by the intended users.
Security against fraud, unauthorised altering of the	<p>Estimate the security of the system, potential risks, and cost of risk mitigation and</p>	<p>High if:</p> <ul style="list-style-type: none"> - the proposed solution enables confidential transfer of content;

Element of utility	Approach to analysing the element of utility	Qualitative operationalisation and data sources
data, or forgery	prevention measures.	<ul style="list-style-type: none"> the proposed solution enables the identification and authentication of all users before allowing them access to the content; and the proposed solution ensures uninterrupted availability of content. the proposed solution has integral means to prevent loss of content confidentiality, loss of content integrity, and loss of content availability.⁷⁶ <p>Low if:</p> <ul style="list-style-type: none"> the security conditions mentioned above are not met by the proposed solution.
Personal data protection	Estimate whether the digitalisation options are able to provide a system where the personal data of the holder is sufficiently protected.	<p>High if:</p> <ul style="list-style-type: none"> the proposed solution has integral means to ensure appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organisational measures.⁷⁷ <p>Low if:</p> <ul style="list-style-type: none"> the proposed solution is not able to ensure, or requires additional means to ensure, appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage.
Implementation timeline (readiness for final use)	Estimate the time necessary to have the final, functioning version of the digitalisation. This will include analysis (e.g. whether the necessary technological solutions already exist or would need to be developed separately).	<p>Short if:</p> <ul style="list-style-type: none"> there is substantial evidence from the desk research, case studies, interviews and surveys that the technological solutions required to implement the proposed option are already commonly used by the stakeholders; there are examples of good practices where the solutions required to implement the proposed option did not require a significant amount of additional time and resources to implement; and the consulted stakeholders agree that the solution in question could be readily used by the stakeholders or would take a short time to implement, <p>Long if:</p> <ul style="list-style-type: none"> there is no evidence of the common use of the proposed solution or the proposed solution is still in development phase; there are examples of practices where the solutions required to implement the proposed

⁷⁶Based on: "Common Criteria for Information Technology Security Evaluation."

⁷⁷ Based on: "Directive (EU) 2016/680 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data by Competent Authorities for the Purposes of the Prevention, Investigation, Detection or Prosecution of Criminal Offences or the Execution of Criminal Penalties, and on the Free Movement of Such Data, and Repealing Council Framework Decision 2008/977/JHA."

Element of utility	Approach to analysing the element of utility	Qualitative operationalisation and data sources
		<p>option required a significant amount of additional time and resources to implement; and</p> <ul style="list-style-type: none"> - the consulted stakeholders agree that the solution in question would take a long time to implement and reach the intended stakeholders.
Other technical implementation challenges	Estimate whether there are any challenges to implementation of the options which were not covered by other points of utility analysis.	<p>Higher utility if:</p> <ul style="list-style-type: none"> - additional success factors (if any) identified during the desk research, case studies, surveys or interviews (not covered by other points of the utility analysis) outweigh the identified additional technical implementation challenges. <p>Lower utility if:</p> <ul style="list-style-type: none"> - potential implementation challenges (if any) identified during the desk research, case studies, surveys or interviews (not covered by other points of the utility analysis) outweigh the identified additional success factors.
Transferability of the solution to all EHEA countries (legal, technological, practical, perception aspects)	Analyse the legal environment, technological context, and (positive or negative) perception of higher education institutions or public authorities towards different options in different countries.	<p>High if the overall utility assessment is high, based on the combination of the criteria outlined above.</p> <p>To estimate transferability, we will also use the information on the legal conditions and technological context gathered from the case studies.</p>

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