



**One Block for Educational
Credentials (OBEC)**

GUIDING THE ROAD TO THE FUTURE





1506
UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO



The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the
Erasmus+ Programme
of the European Union



ABOUT THE PROJECT

OBEC (2020-1-SE01-KA204-077803) is a KA2 Strategic Partnership co-funded by the Erasmus+ of the European Union. Led by Swideas in Sweden, the project gathers partners in Croatia (Regional Development Agency of Sisak-Moslavina County - SIMORA), Italy (LAI-MOMO Società Cooperativa Sociale & Università degli studi di Urbino Carlo Bo), Belgium (EURADA - Association Europeenne Des Agences Developpement).

OBEC is an innovative project that aims to explore the potentials of Blockchain technology to promote competency development and recognition of skills and qualifications by creating an innovative system to issue and validate learning credentials on a trial basis. Through this effort, the project's goal is to encourage the professional and academic integration of migrants, exchange students, and individuals with informal and non-formal learning backgrounds.

By contributing to the educational and economic integration of these targeted groups, OBEC envisions to benefit individuals with migrant background, students, teachers, education institutions, and employers. Focusing on the key issue of lack of uniformity and transparency in systems of validation of credentials, it is expected that this effort will result in positive effects in the working context, promoting employability, empowerment, and accessibility to the labour market.

Abstract

Between 1 October 2020 and 30 September 2022, the consortium of the project “One Block for Educational Credentials” (OBEC) dove into the world of Blockchain technology and its uses in several different sectors. The goal of this 2-year project was no less than exploring what opportunities the technology could provide to the educational sector when it comes to issuing and verifying credentials in a trusted and transparent manner. This effort also aimed to assess whether this could signify an important benefit to people moving across countries, who could profit from both a quicker process to have their credentials verified and, thereby, a quicker access to the labour market. The present report outlines the project’s experience and the main learnt lessons, resulting recommendations, and relevant information to support further research, investments, and initiatives to introduce the use of Blockchain technology in the European educational sector. The experience of the OBEC project led to several findings, among which have been identified several challenges and obstacles that must be addressed and overcome before the technology can truly express its full potential in this regard. Furthermore, the project’s results shed light on factors of the technology that could trigger innovative and revolutionary changes.

For these to be achieved, the OBEC consortium has identified several recommendations, which include, among others, the need to: 1) broadly disseminate and make available aiding tools that might help individuals to integrate in the labour market to important stakeholders; 2) invest in the improvement in the comprehension of the available tools (ESCO system, the Europass CV, the Dublin Descriptors, and the diploma supplements) and their user-friendliness; 3) pay attention to the way in which each Member State implements the available systems; 4) invest in the successful standardization of credential systems among European countries; 5) employ the tools provided by the European Union to have a supra-national guarantee that costs of the use of Blockchain to issue and secure educational credentials are kept under control and that the privacy standards are respected – the development of the European Blockchain Service Infrastructure (EBSI) is pointed out as a factor that could help to avoid some of these issues and prompt standardization; 6) to address the privacy concerns, institutions could decide not to store sensitive and personal data on the Blockchain, using hash instead for instance, or to use permission chain for the storage, where you could at least control who does the validation; 7) to address the concerns about the cost, five options will be pointed out in the report; 8) enforce policies to push the agenda of unified credential systems that resemble the ones put forward by the European Commission; 9) push for the establishment of adequate evaluation procedures to achieve an ideal situation in which various kinds of skills/competences are certified and through investments of more resources in the study of good evaluation practices. Skills/competences could be certified by specifying the activities that were carried out to obtain them; 10) increase the number of investments made towards the dissemination and visibility of Blockchain technologies to address the perception issues, filling in the information gaps once the benefits of employing the technology are understood; 11) prioritize the creation of interoperability.

The above-mentioned recommendations are detailed in this report. These are accompanied by a description of the OBEC project’s activities and experience, as well as main learnt lessons.

Keywords: Blockchain, educational sector, Erasmus+ project, Key Action 2

Table of Contents

Abstract	I
List of Abbreviations and Terms	III
Chapter 1 - Introduction	1-1
Chapter 2 – Overview of Opportunities, Challenges, and Needs for Blockchain use in the Educational Context	2-3
2.1. <i>Skills/competences validation and recognition</i>	2-4
2.2. <i>Knowledge gaps, benefits, and challenges for the use of BC technology</i>	2-12
2.3. <i>Opportunities and challenges for the use of Blockchain in education</i>	2-16
<i>Concluding remarks</i>	2-18
Chapter 3 – Overview from the EU's Macro Level Perspective	3-19
3.1. <i>Verification of educational credentials in the European Union</i>	3-19
3.2. <i>Micro-credentials</i>	3-19
3.3. <i>Blockchain Strategy European Commission</i>	3-20
3.4. <i>The use of Blockchain technology in education</i>	3-21
3.5. <i>Legislation Blockchain Technology at European Level</i>	3-24
3.6. <i>Research into the use of Blockchain technology to recognise educational credentials</i>	3-25
<i>Concluding Remarks</i>	3-25
Chapter 4 – Collection of Case Studies	4-27
<i>Educational Sector</i>	4-27
<i>Inspirational case studies for the use of Blockchain in other sectors</i>	4-27
<i>Concluding Remarks</i>	4-53
Chapter 5 – The Individual Level Perspective	5-54
Chapter 6 – Main Lessons from OBEC's Trial Phase	6-56
6.1. <i>Overview of the options for platforms based on Blockchain technology and selection process</i>	6-56
6.2. <i>Brief analysis of the suitability of the tool and system utilizing BC technology on a broader context and on the long-term</i>	6-57
6.3. <i>Main lessons from the trial phase and recommendations</i>	6-58
<i>Concluding Remarks</i>	6-60
Chapter 7 – Advice from Experts	7-62
<i>Introduction</i>	7-62
<i>Technical insights</i>	7-62
<i>Perceptual Insights</i>	7-63
<i>Recommendations</i>	7-64
Chapter 8 – Conclusions and Recommendations	8-67
Chapter 9 Bibliography	9-73

List of Abbreviations and Terms

BC	Blockchain
CEFR	Common European Framework of Reference for Languages
CFU	Crediti Formativi Universitari
EBSI	European Blockchain Service Infrastructure
ECTA	Platform through which institutions can verify a student's education and learned competences based on Blockchain. Available here: https://obec.ecta.si
ECTS	European Credit Transfer and Accumulation System
EDU	Educational Institutions
ESCO	European Skills, Competences, Qualifications and Occupations
ICDL	International Computer Driving Licence
IO	Intellectual Output – this is a term that used to be utilized within Erasmus+ key action 2 Innovation applications to describe a block of tasks to be implemented within the project
ISCO	International standard classification of occupations
OBEC	One Block for Educational Credentials
VET	Vocational education and training

Chapter 1 - Introduction

Blockchain technology has been increasingly gaining space across several sectors, proposing innovative ways to bring about transparency, security, immutability of data, and decentralization, along with the promise of reduced maintenance costs. The use of this technology has broader public knowledge regarding the monetary sphere through the cryptocurrencies. However, the possibilities for its use are endless.

Blockchain is conceptually defined as a distributed ledger technology that allows peers to share information without the need for a centralized authority. It is based on the sharing of a consensus algorithm which is necessary to validate transactions, which are stored in blocks and assigned a timestamp. Through this system trackability, verifiability and security are guaranteed. It thus provides an innovative infrastructure that is ideal to secure, share, and verify learning achievements (Smolenski, 2016) in a transparent and secured manner while guaranteeing the individual's privacy and ownership. This potential has been highlighted in the EU's report 'Blockchain Now and Tomorrow' (ISBN 978-92-76-08977-3, EUR - Scientific and Technical Research Reports 2019).

The project One Block for Educational Credentials (OBEC) has sought to explore the possibilities of the use of Blockchain Technology within the educational sector, resorting to the notion of “smart contracts”, or decentralized “automated and self-enforcing digital contracts relying on tamper-proof consensus” (Cong & He, 2018) that are issued once previously determined conditions are met and verified. Beyond revolutionizing the educational sector per se, the project's goal was to boost free movement by bring about benefits especially to those people who face issues when moving across borders to study or to work, and to those who, coming from an informal or non-formal learning background, wish to pursue a career or further education. Bringing together the goals of social inclusion and digitalization, OBEC's findings and experience have a considerable potential to serve as lessons for future initiatives and to inspire innovation in the educational sector, as well as within the public sphere regarding the validation and recognition of educational credentials.

In the future, all public services will use blockchain technology. Blockchain is a great opportunity for Europe and Member States to rethink their information systems, to promote user trust and the protection of personal data, to help create new business opportunities and to establish new areas of leadership, benefiting citizens, public services and companies. – Mariya Gabriel, the Commissioner for Digital Economy and Society in 2017-2019¹

¹ European Commission, 2022. Available at <https://digital-strategy.ec.europa.eu/en/policies/blockchain-partnership>

Firstly, it is important to mention that it has been found that, as blockchain's more mainstream association is to cryptocurrencies, this often leads to a certain mistrust among the civil society, as many people are not fully aware of how the technology works and how to avoid issues related to its use. During our research phase, the introduction of how the technology could be used in the educational sector was faced both with intrigue and with scepticism. As a result, efforts related to promoting the project have not given strong emphasis to blockchain, rather focusing on the idea behind the project, its objectives, and the achievement that were sought. This reflection leads to the first conclusion that information about blockchain technology should be made more broadly and easily available, accompanied by efforts to build awareness on the potentials brought about by the technology, and focused on deconstructing the perspective that blockchain is only related to cryptocurrencies.

Based on the data collected throughout the project and on the experiences initiated within it, this document provides reflections on the usages of blockchain within the educational context in Europe, presenting the opportunities and challenges, as well as a set of case studies, good practices, and mentor's advice for practitioners. Its aim is to inspire policymakers and determine what investments and changes are necessary to drive improvements towards promoting integration and the introduction of blockchain technology in the educational sector in the European Union. Comprising information which can be used for the creation of a more inclusive and barrier-free educational context in Europe and in the world, this report has the potential to contribute to the empowerment of international learners and job seekers, as well as to the social and professional inclusion of all. Thus, this document has the main purpose of inspiring policymakers within the European Union to encourage the crystallization of a revolution within the educational context that can incite a worldwide process in which Europe could have a leading position.

Chapter 2 – Overview of Opportunities, Challenges, and Needs for Blockchain use in the Educational Context

There is no doubt that in contemporary times the labour market is becoming fast paced. Numerous surveys and reports have shown that younger generations have a high tendency to change jobs frequently². One of the reasons for this job hopping is that the millennial generation faces a period of uncertainty, where demands from society are constantly and rapidly changing. In this context, companies (with their employees) must be prepared to adapt in a timely manner. Being dynamic is of the utmost importance: workers must have the possibility to smoothly change jobs and to reskill and upskill themselves effortlessly. Moreover, their expertise must be recognized in short timeframes, allowing companies to place them in the correct occupations and to give them a chance to display their full potential and fruitfully contribute to the economic environment of which they are part of.

In such setting, educational institutions have the obligation to, first, provide students with the best possible environments in which to **develop all the skills required to develop this necessary dynamicity**, and then to **certify those same skills in a globally accepted way**. The latter point is especially important. Not only do employers have to find the employees that possess the adequate skills and competences to fulfil their job requirements, but they also must find them quickly. This means that they need to be able to assess swiftly whether a candidate they are interviewing is suited for a specific job. Today, as never before, the motto “Time is money” is on point. Long interviewing processes might hinder a company’s competitiveness and can put a lot of psychological pressure on the interviewees, who will have to endure numerous and strenuous interviews (especially considering the frequent job changes). This calls for technologies that can shorten those processes and allow a quick, although precise, evaluation of the candidates.

One of the major possibilities when trying to speed up hiring processes is to use **recognizable achievements**. If someone can demonstrate that they possess a certain skill without having to put the skill to the test, then the employer would save time during the evaluation process. This is what often happens with degrees, e.g., when someone exhibits to a potential employer an MBA from a major University. When such scenario occurs, the employer will know that *that* someone has excellent business administration skills, without having to test her through internships, apprenticeships and/or tests. This system works thanks to wide nets of trust between stakeholders. Major Universities guarantee that someone who obtained a degree through their institution possesses certain qualities that have been properly tested; employers trust that such Universities do indeed abide to their obligations as educational institutions and maintain their integrity during the evaluation of the students. The candidates trust that the way they have been taught and evaluated do indeed provide them with the skills and competences that they expected. Moreover, the employer trusts that the potential

² *How Millennials Want to Work and Live* (<https://www.gallup.com/workplace/238073/millennials-work-live.aspx?thank-you-report-form=1>), *Millennials or Gen Z: who’s doing the most job hopping* (<https://www.careerbuilder.com/advice/how-long-should-you-stay-in-a-job>), *A Grounded Theory of Millennials Job-Hopping* (<https://www.proquest.com/dissertations-theses/grounded-theory-millennials-job-hopping/docview/2150091092/se-2>), *Job Hopping Tendency in Millennials* (<https://www.nepjol.info/index.php/NCCI/article/view/24733>).

employee is indeed exhibiting a degree from the University she specifies and that it is not forged or manipulated in possible way. It is such web of trust that allow employers to save time in their hiring process and allow them to identify the best candidates for specific positions. Nonetheless, while successful in some instances, those automatisms fail in others.

The **OBEC project** explored three of those situations, e.g., those that involve students who participated in exchange projects, intra/extra-European migrants, and people who followed alternative, non-institutional, educational paths. In such cases, hints have been found that the above-mentioned web of trust fails, and issues consequently arise.

The aim of this chapter is that of showing how Blockchain technologies can help to provide solutions to the processes discussed above, by widening and improving the web of trust between various stakeholders. The chapter will be structured into three sections. In section one, the needs around the issue of validating and recognizing skills and competences in a transnational and trans-institutional context will be identified; the aim of the section will be that of highlighting what investments and changes are necessary to drive improvements towards promoting integration. In section two, knowledge gaps, benefits, and challenges existing in the legal and institutional framework to utilize BC technology will be identified; the aim of the section will be that of shedding light on the challenges this technology might face in the educational context and which potential solutions could be adopted to solve them. Finally, in the third section, opportunities, and challenges for the use of Blockchain in the educational context to provide certifications will be briefly discussed. Some concluding remarks will follow.

2. 1. Skills/competences validation and recognition

A major result obtained during the first Intellectual Output (IO1) of the OBEC project was to show that inside the target groups of the project (exchange students, migrants, and people with alternative educational backgrounds), two in every three individuals³ faced some problems in getting recognition for their skills or competences. Those numbers become especially alarming when it is considered that institutions often ignore them. In particular, there seems to be a discrepancy between the systems put in place by the European Union in order to solve those issues, and the effective use of those systems to solve the actual issues. This discrepancy is an issue, because, although the systems that have been developed could potentially solve the issues faced by the individuals, in practice, those individuals continue to face those skills/competence recognition problems.

According to the data gathered during the OBEC project, this discrepancy seems to be caused by an unwillingness by National States to abandon established practices to adopt supra-national ones. Both in the private and academic sector, institutions favour processes that have always been used in their national contexts, even if those processes generate issues when the individuals move to contexts outside the one of the institutions. This explanation of the discrepancy could indeed also explain why the institutions do not perceive the issues of the individuals as being present: until the individuals act inside the institutions, no problems arise;

³ This statistic is from a sample size of 93 individuals (among whom 62 reported having issues), i.e., those that sought recognition for their skills and/or competences in different circumstances. See the [IO1 Final Report](#) of the OBEC project for a reference and the thorough analysis of the data.

however, as soon as the individuals move towards other institutions (either at a national level or transnational one), those internal processes clash with the ones of the new institutions and practices.

Some examples could clarify the whole matter: at the European level, many systems have been developed to solve the issues faced by individuals during the hiring processes. Those systems are aimed at facilitating the presentation of the skills/competences possessed by those individuals and to ease the employers' tasks of evaluating whether the individuals do indeed possess the skills/competences reported. This is obtained mostly through clarity in the presentation of the skills/competences, and through the fostering of the web of trust between employers and educational institutions.

Custom examples of the former type of systems are (i) the ESCO system, (ii) the Europass CV format, (iii) the introduction of the Dublin descriptors and of (iv) the Diploma Supplements.

- i. The **ESCO system** is part of the Europe 2020 strategy and has the aim of providing a platform that put in contact jobseekers with potential employers, highlighting the skills and competences that are required by the former to fulfil the demands of the latter. The main advantage of the ESCO system is that it eliminates part of the language barriers that could affect the possibility of an individual to enter the job market of a foreign country. In particular, the ESCO system allows to provide more refined information about certain professional experiences that individuals could indicate in their CVs. What the ESCO system does is to break down a specific profession into skills, competences and qualifications that are characteristic of such profession, allowing employers to better understand the qualities of a potential employee.
- ii. The **Europass CV** offers a way to describe and organize the information about the competences and skills of an individual. Moreover, recently (2020) the European Commission employed the Europass framework to develop a set of software and services for education and training institutions to issue authentic, tamper-proof digital credentials (e.g., qualifications, diplomas, certificates). Europass Digital Credentials can therefore support 'paperless' processes and easier recognition and understanding of qualifications across the EU. Thanks to the Europass format, an individual will be able to identify the correct typologies of information to include in his/her CV and present them appropriately, without barriers caused by language and/or culture. For example, as soon as the individual recognizes a specific job s/he performed and/or skill s/he possesses, the Europass format allows him/her to select the specific information, taking care of further analysing the details through the tools previously described when the ESCO system was introduced. Moreover, the Europass format allows the individual to prepare standardized cover letters, helping them presenting themselves to potential employers.
 - a. More recently, through an initiative tailored towards vocational competences, the Europass gained a certificate supplement, which is a document that provides information that makes it easier for employers and educational institutions to understand vocational qualifications. It describes:

- i) the purpose of the qualification; b) its level; c) its learning outcomes; d) information on the relevant education system⁴.
 - b. Through another initiative to evaluate and certify/describe competences/skills, the EU provides an option to test the digital skills and acquire a detailed report with a description of their average level. The test can be found [here](#) and is based on the Digital Competence Framework. This way, they are able to identify their strong and weak areas.
 - c. It is important to note that, in April 2018 the EU adopted a proposal for the revision of the Europass framework. The goal was to simplify and modernise its tools and services and make Europass fit for the digital age. As part of this effort, ESCO skills and occupations are being used in the Europass in the Profile and in my skills and my interests sections⁵.
- iii. The **Dublin Descriptors** offer generic statements of typical expectations of achievements and abilities associated with awards that represent the end of a study cycle or level. The descriptors are phrased in terms of competence levels, and they enable to distinguish in a broad and general manner between the different levels of competence that an individual can achieve. A level descriptor includes the following five components: a) Knowledge and understanding of a topic, b) applicability of such knowledge and understanding, c) the ability of the individual to make judgements based on such knowledge and understanding, d) ability of communicating such knowledge, and e) skills acquired that are considered important from a life-long perspective.
- iv. The **diploma supplement** is a document accompanying a higher education diploma providing a standardised description of the nature, level, content, and status of the studies completed by its holder. The diploma supplement is designed as an aid to support the recognition of academic qualifications.

Systems (i) to (iv) all contribute in different ways to allow the individuals to display the skills/competences they possess in a clear and universally accepted manner and thus help matching the demands of the market with the offers of the individuals as employees. However, while all extremely useful, those systems are EU tools which are often either not known or simply neglected by individuals and employers alike, especially by foreigners.

According to the European annual report⁶, as of the end of 2020, only 17 Member States (~63% of the Member States) were in the process of mapping occupations. Moreover, among those only 5 (~19%) were in the process of mapping skills, and 4 (~15%) were in the process of adopting occupations and skills. True, such report also suggested that the numbers were increasing, as shown by the numerous organisations that decided to employ the ESCO system, but far more reach is needed before such system can become relevant for smaller businesses⁷.

⁴ The Europass Certificate Supplement, n.d. <https://europa.eu/europass/en/europass-certificate-supplement>

⁵ Europass, n.d. <https://esco.ec.europa.eu/en/escopedia/europass>

⁶ European Skills, Competences and Occupations classification: Annual Report 2020 (<https://esco.ec.europa.eu/en/publication/annual-reports>).

⁷ This is particularly relevant for two of the partner countries in the OBEC consortium. Italy and Croatia have economies mostly based on small to medium-sized companies, often managed at a family level, which struggle to get the full benefit from complex supranational infrastructures such as ESCO.

This seems to indicate that more Member States should take part in the process of mapping and adopting occupations and skills in their territory.

Many individuals either ignore or are not able to use the Europass format to produce their CV⁸. This can easily be deduced from comparing the statistics provided by the Europass website⁹ and those provided by Eurostat on unemployment¹⁰: according to such statistics, in May 2022, a little more than 13 million individuals are looking for a job in Europe (as per the definition of unemployment), but only roughly 4 million people¹¹ (according to data from July 2022) created a profile on the Europass website in 2021 (with slightly higher numbers expected in 2022). This huge discrepancy seems to suggest that those individuals seeking for a job do not, 2-7employ Europass to facilitate the preparation of their CVs. This is indeed problematic, since the Europass platform should be considered a major step in the direction of giving individuals the possibility of displaying their skills and competences in a clear and concise manner. It is therefore advisable to incentivize institutions to tell their member to use Europass more and, in general, the Europass' features that allow educational institutions to provide digital certification services should be integrated more into the formal systems adopted in each organisation.

Finally, the adoption of the Dublin descriptors and the Diploma supplements is often only suggested and not enforced; moreover, the quality and accuracy of the use of such systems is seldom checked, which causes the production of information that might be inaccurate and misleading¹². This is often due to the fact that Dublin Descriptors are only considered bureaucratic obligations rather than complimentary pieces of information for students; this generates a sense in which less attention is required in the preparation of the information to be inserted in such descriptors, with comparison to study programs (a weak proof of this can be obtained by observing that the Dublin Descriptors of different courses in different Universities often resemble each other and are presented with very vague indications, which is inconsistent with the intrinsic differences between those courses). It is therefore suggested that educators should be trained to properly understand the importance of the Dublin Descriptors and how to properly write them in accordance with the contents of their courses.

⁸ This explains why there exists many courses directed specifically to teach how to write a *Curriculum Vitae*, which, however, places the possession of such skill behind a paywall, not allowing less fortunate individuals to acquire such skill. This might indicate that interfaces that are more user friendly are advised.

⁹ <https://europa.eu/europass/en/statistics>

¹⁰ [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Unemployment statistics#Unemployment in the EU and the euro area](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Unemployment_statistics#Unemployment_in_the_EU_and_the_euro_area)

¹¹ Assuming that all those individuals are unemployed (which is an overestimation since it is likely that some users are transitioning through jobs, rather than being unemployed. Unfortunately, it was not possible to find more precise data on the Europass website), those represent only ~31% of the total unemployed individuals.

¹² This conclusion follows from anecdotal information obtain through various informal interviews with members of various Universities across Europe. A more thorough analysis should however be performed to verify that the anecdotal information is indeed representative of the current EU situation.

Coupling those examples together might explain why individuals continue to face problems in their ability to communicate information regarding their skills and competences even after all those extremely useful systems have been introduced.

Based on that, this guide suggests a few changes that could help addressing these issues and thereby promote a more inclusive, easily accessible system that facilitates the communication between educational system and labour market. Importantly, the suggestions are proposed as to promote the integration of foreign citizens (who bring their educational credentials and recognition of skills from outside of Europe) to be able to utilize their skills and competences in meaningful occupations while contributing to their new socio-economic contexts and reducing the risk of unemployment.

The first change that is therefore suggested in this guide is to **BETTER DISSEMINATE THE EXISTENCE OF THOSE AIDING TOOLS THAT MIGHT HELP INDIVIDUALS TO INTEGRATE IN THE LABOUR MARKET**. Investments should be made to improve the perception of those tools among important stakeholders, which will then have the task to promote them with the individuals that need them the most. Moreover, those investments should be directed towards an improvement in the comprehension of those tools and their user-friendliness. Finally, attention should be paid to the way each Member State implements such systems, with an emphasis on successful implementations that could be applied in other countries, although respecting each national difference.

Nonetheless, even admitting that individuals can communicate well which skills and competences they possess and are able to fruitfully employ the tools provided to them by the European Union, the second issue of establishing trustworthy relationships between employers and employees is still present. Such problem arises when an employer does not trust that an interviewee does indeed possess the skills and competences she claims to have. This can have two roots: either (i) the employer does not trust the potential employee and thinks that she forged the information that was provided concerning her skills and/or competences or (ii) the employer does not trust the provider of the certificates that the potential employee is submitting for her evaluation. In either case, the hiring process (or the fulfilment of a degree for an exchange student) could drastically slow down, with huge costs in terms in time, energies, and money. For those reasons, it is extremely important to adopt systems that can foster trust among the various stakeholders. During the first block of activities in the OBEC project (referred to as “intellectual output 1” or IO1), various certification systems have been analysed to obtain a good understanding of what made a system successful¹³. The result was that all successful standardized credential systems had in common four elements, which they all contained:

¹³ [IO1 Final Report](#).

1. *The identity of the individual that will receive and use the certifications provided through the standardized system* (it is safe to assume that this is needed to avoid abuses in the use of those certifications, e.g., by using someone else's certification or false certifications).
2. *The qualities of the individual that are certified by the standard credential system* (this is the main purpose of having such standard credential systems and, thus, it seems reasonable that all such systems include sections where the qualities that are certified are explicitly specified. In some cases, those qualities are also presented with a reference to international terminology, to fulfil both national requirements and international ones).
3. *The evaluation system that was employed to assess the fulfilment of the desired characteristics that allowed the production of the certificates. In particular, such part includes the scales employed in the evaluation and the assessment procedure that can determine the overall end score for the specific agent* (this seems to be needed in order to allow translations between different evaluation systems. In fact, only providing a specific scale of evaluation is useless if the evaluation criteria are not provided. Knowing that someone completed 30 university credits in a course has no meaning if there is no reference to how much work was required for such credits and how it was assessed that the student indeed put in that kind of work. Same goes with saying that a specific building falls into the A energetic efficiency class, if there is no reference to the scale of such classes and how the building was assessed).
4. *Direct comparisons to established European Standards* (the main reason behind this element of the standard credential systems seems to be that having a middleman can speed up translations between national systems of credentials. This is so because different standard credential systems at the national level might already have direct comparisons to European standards and, thus, by having such comparisons, two distinct national standard credential systems can be compared using transitivity).

All those elements contribute to foster a web of trust among stakeholders in the job market. As proven by the results obtained through language and digital competences certifications across the World (a prime example being the CERF level system for languages and the ICDL standards for digital competences adopted in Europe), those standardized certification systems help employers to rapidly assess whether an individual does indeed possess specific skills and/or competences.

In this sense, from an institutional point-of-view, there seems to be no major issues. Taking Higher-Education as an example, only 33% of Educational Institutions reported having problems with the recognition of the experiences completed by their student in organizations located outside their national borders. This is, however, in sheer contrast with what was reported by the students themselves (~67% reported having some issues). What seems to be the culprit in this case is the fact that once procedures from different national contexts and/or different organizations are automatically mapped one into the other, from an institutional perspective, no issues should ever arise. If, for example, a chemistry exam in Belgium is valued at 12 ECTS (European Credit Transfer and Accumulation System) then such exam would be equivalent to a similar chemistry exam in Italy that is valued at the same 12 ECTS. However, what is missed, is that often the European standard for educational credits is only a

middleman. Following the example, Italy still massively employs CFU (Crediti Formativi Universitari), while Belgium often employs study credits. While those National systems are similar in nature to the ECTS system, small, but important, differences might still be present. This has the effect of negatively impacting all those students that choose to follow paths that have not been already *institutionalised*, which find themselves lost in the bureaucracies of establishing those novel pathways.

Keeping intact the idea that National differences are important, to achieve a better European landscape for mobility of individuals, it is suggested that **MORE POLICIES SHOULD BE ENFORCED TO PUSH THE AGENDA OF UNIFIED CREDENTIAL SYSTEMS THAT AT LEAST RESEMBLE THE ONES PUT FORWARD BY THE EUROPEAN COMMISSION**. This can be achieved, among other ways, by promoting automatism between different organizations. If skills and competences are automatically recognized across all European countries, without any necessary intervention by administrative staff, then mobility would be improved. Transnational platforms employed to get those automatic recognitions might be useful tools to employ: if individuals are allowed to create digital profiles on transnational platforms (e.g., the ECTA platform tested during the OBEC project), then the skills and competences certified on those platforms will be considered valid throughout the territories that trust such platforms. At that point, the only issue would be that of establishing trust between the various organizations and the central transnational platform. This is where Blockchain technologies would help by providing transparent, secure, and trustworthy information to the various stakeholders.

A final important element to take into consideration is the following: certifying skills and competences is grounded on a proper evaluation of whether an individual does indeed possess those skills and competences. This simple claim hides an important consideration:

To achieve an ideal situation in which various kinds of skills/competences are certified and individuals can easily showcase those skills/competences to different potential employers, adequate evaluation procedures must be established.

This is no easy task. Especially when soft-skills and/or transversal competences are considered, finding proper evaluation procedures is difficult. Since being able to evaluate those is necessary if someone wants to be able to certify their presence, it is mandatory to identify good practices in the evaluation of those skills. This is important both to obtain a standard comprehension of what is exactly tested and whether that something is indeed properly targeted by the test, and to allow automatic and scalable evaluation procedures that could potentially cut *middlemen* during those evaluations. This is akin to the automatic procedures that can be found on platforms such as *Europass*¹⁴ or *LinkedIn*¹⁵, where some competences, e.g., digital skills, can be tested without the intervention of external institutions.

¹⁴ <https://europa.eu/europass/digitalskills/screen/home?referrer=epass&route=%2Fen>

¹⁵ <https://www.linkedin.com/help/linkedin/answer/a507663/linkedin-skill-assessments?lang=en> .

Those automatic procedures are extremely important, because they save resources, i.e., time and money, that individuals could invest elsewhere.

It is therefore suggested that **THE EU INVESTS MORE RESOURCES IN THE STUDY OF GOOD EVALUATION PRACTICES FOR VARIOUS SKILLS/COMPETENCES**. This should be obviously carried out with the support of the appropriate institutions depending on the group of skills/competences that are examined, e.g., Universities would be better suited to study transversal competences and VET school might be better suited to study job-related competences. In any case, those investments should be directed towards the preparation of guidelines to the evaluation of skills/competences, to obtain standards that could be applied in the various National Countries.

2.2. Knowledge gaps, benefits, and challenges for the use of BC technology

During the whole duration of the OBEC project, the partnership explored the possibility of employing Blockchain technology (BC) to improve the recognition of the competences/skills of individuals across the partners' national countries.

The idea behind this choice was that of making use of the intrinsic properties of BC to help individuals to obtain the two objectives indicated in the previous section, e.g., to present information in ways that highlight the specific skills/competences that the individuals possess and to improve the trust that employers have towards the reliability of this specific information. In this sense, BC was an obvious choice in the technological sector: BC are transparent, secure, and trustworthy. They are transparent because each node of the distributed ledger on which the information is stored has an integral copy of such information; they are secure because to modify or add data to the distributed ledger, all members of the ledger must reach a consensus; it is trustworthy because information is immutable, and traces of all operations operated in the distributed ledger permanently remain available.

However, while in principle optimal for the task, during IO1 of the OBEC project it was noticed that there were both some technical issues and some public conception issues with the use of this technology in the educational sector. From a technical perspective, there were two classes of problems noticed, which will be further explained in the following paragraphs:

- I. Cost
- II. Privacy. From a public conception perspective, there were, again, two classes of problems noticed:
 - a. Ties with cryptocurrencies
 - b. Lack of usefulness of the technology.

Although those issues were recognized as such by both private and public institutions, the importance of the issues was perceived differently by the two. Public institutions (mainly universities) focused more of the cost and lack of usefulness of the technology, while private companies highlighted the potential issues with privacy and the ties the technology has with cryptocurrencies.

Concerning the technical issues of the cost and privacy of applying BC technology to the educational sector, those strictly depend on the type of BC technology that can be employed to implement the certification of skills/competences. There are two main choices in this sense, each with its-own pros and cons. The first choice is to employ a fully decentralized, permissionless public BC network, e.g., *Ethereum*¹⁶; the other choice is to employ a permissioned private BC network, which would limit some of the features of the public

¹⁶ <https://ethereum.org/en/>.

network, but it would gain some other advantages. During the OBEC project, it was observed that, ideally, public BC networks were preferable, mostly because no centralized authority could have control over the information present on the Blockchain. This improved the sense of transparency, security, and trustworthiness of such information, increasing the usefulness of the certification obtained through any platform based on those public Blockchains (indeed, the tested ECTA platform was based on Ethereum). However, the choice of using a public Blockchain rather than a private one, brought out some issues that were pointed out both by universities and private companies.

The former reported that employing BC technologies to certify the competences developed by their students might have too big of an economic impact. This increase in cost would be caused by at least two factors: a) the cost of information storage and b) the cost of creating new blocks on the Blockchain to store the information of the students¹⁷. Factor (a) depends on the fact that every node participating in the public Blockchain would have to store information indefinitely; this imposes heavy storage constraints and university applications might not be able to afford so high data storage redundancy. Factor (b), on the other side, would be dependent on the cost of the Cryptocurrency tied to the public Blockchain (in OBEC's case, the cost of Ether). Note that universities would have to certify hundreds of skills and competences¹⁸ for thousands¹⁹ of students enrolled in their study programs. This would mean that a university would have to upload onto the Blockchain hundreds of thousands of logs per year, which might not be feasible when the prices of cryptocurrencies are extremely high.

On the other hand, private companies reported that employing BC technologies to certify the competences developed by students might cause privacy issues. This is due to the combination of a mandatory requirement of the certification and an intrinsic characteristic of the public Blockchain network. The first element is that the certificates must include the identity of the individual that will receive and use those certifications; the second element is that every node on the network has a record of the entire database, thus they would potentially have access to sensible information connected to the student, violating their privacy. Not only, but students should also have the right to be forgotten, which would be revoked by the immutability of the Blockchain. For instance, if a university stores information about the marks received by students, each node of the Blockchain would be indefinitely able to check those marks, even if the students decide to change their careers and start a new

¹⁷ Note that the data for the OBEC project was collected during the first months of 2021, a period in which there have been huge spikes in the prices of Cryptocurrencies. The issue might therefore be perceived differently in different time periods. Nonetheless, tying the cost of a certification to the behaviour of the stock-market might still be a move that very few Universities are willing to perform.

¹⁸ This is estimated by assuming that during a study program a student would follow at least 20 courses (during a Bachelor program of at least 180 ECTS) and that each of those courses would allow the student to develop at least 5 skills/competences. Those numbers are obvious underestimations, but they keep into consideration also shorter study programs (e.g., Masters).

¹⁹ On average there are 6.422 students enrolled in each European University. This average is calculated based on the numbers provided by Eurostat (17.5 million students enrolled in tertiary higher education: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tertiary_education_statistics) and by UniRank (2725 officially recognized Universities in Europe: <https://www.4icu.org/Europe/#::~:~:text=How%20many%20Universities%20are%20there,high%20education%20institutions%20in%20Europe>).

study program. This seemed to suggest that the best approach was to employ enterprise private Blockchain networks rather than fully public ones. However, this is only partially true.

Even though in private Blockchain networks some of the cost and privacy issues are solved, other problems arise. Mainly, pursuing the road of using private BC technologies runs the risk of having a multitude of different private networks being developed by different institutions. This, in turn, would create problems when trust and interoperability are considered, since employers would have to create ties with different systems, each with its-own characteristics. Moreover, the goal of promoting integration and improve communication between parties would not be achieved. Therefore, even following the path of employing private Blockchain networks in a liberal way seems to fail.

THE POTENTIAL SOLUTION THAT IS SUGGESTED IS TO EMPLOY THE TOOLS PROVIDED BY THE EUROPEAN UNION TO HAVE A SUPRA-NATIONAL GUARANTEE THAT COSTS ARE KEPT UNDER CONTROL AND THAT THE PRIVACY STANDARDS ARE RESPECTED. IN PARTICULAR, THE DEVELOPMENT OF THE EUROPEAN BLOCKCHAIN SERVICE INFRASTRUCTURE (EBSI)²⁰, COULD HELP TO AVOID SOME OF THE ISSUES RAISED ABOVE.

Given that the nodes of the Blockchain network would be represented by the Member States privacy issues would be partially mitigated. Moreover, given the partial control the EU would have over the network, there would be a mitigation of the costs incurred in using the network (assuming the stock market would not be able to influence the value of the underlying cryptocurrency). Moreover, interoperability of the applications based on EBSI would be guaranteed through the promotion of the European Blockchain Standards. Those standards are currently under study by the EU, which collaborates with various stakeholder to research, propose and evaluate different typologies of standards that should be applied across all different technologies that rely on Blockchain²¹.

Concerning the public conception, the issues are slightly different in nature. Again, public and private institutions focused on two different aspects, which, however, could be tackled together.

On the one side, private companies reported that some of their clients had suspicion about BC technologies due to the ties they have with cryptocurrencies. Cryptocurrencies have a bad reputation of being entities which cannot be regulated and are volatile assets pray of the stock market. Those characteristics foster a sense of unreliability about cryptocurrencies, unreliability which is then transferred to BC technologies.

²⁰ <https://ec.europa.eu/digital-building-blocks/wikis/display/EBSI/Home> ; See [IO1 final report](#) for more information.

²¹ See [IO1 final report](#) for more information.

On the other hand, public institutions reported that the students who received digital certificates for the completion of their study still asked for paper copies of the certifications²². It was further noted that those requests were more frequent in older populations of students. This seemed to be connected to the fact that students (especially older students) did not perceive the digital certificates as useful. They simply wanted old-fashioned paper copies of the certifications, which they could attach to their CVs during interviews.

Even though those issues seem minor with respect to the technical issues, ignoring them might greatly hinder the widespread use of BC technologies in the educational sector.

IT IS THEREFORE SUGGESTED TO INCREASE THE NUMBER OF INVESTMENTS MADE TOWARDS THE DISSEMINATION AND VISIBILITY OF BC TECHNOLOGIES. FIRST, IT MUST BE MADE CLEAR THAT BC TECHNOLOGIES AND CRYPTOCURRENCIES ARE NOT THE SAME THING, MEANING THAT THERE MIGHT BE USEFUL BC-BASED APPLICATIONS THAT INDEPENDENT FROM THE VOLATILITY OF THE CRYPTOCURRENCY MARKET. THEN, INDIVIDUALS MUST BE MADE AWARE OF THE ADVANTAGES OF EMPLOYING BC TECHNOLOGIES IN VARIOUS ENDEAVOURS, FOCUSING OF THE POSITIVE ASPECTS THOSE TECHNOLOGIES BRING TO SOCIETY. THE OBEC PROJECT IS ONE EXAMPLE OF SUCH POSITIVE ATTEMPT TO MAKE AN APPLICATION OF BC MORE UNDERSTANDABLE, BUT MUCH MORE MUST BE DONE. IN THIS SENSE, ALL RELEVANT STAKEHOLDERS MUST TAKE PART IN THE TASK, EACH WITH ITS UNIQUE SET OF INDIVIDUALS TO EDUCATE.

²² An interesting case which was reported was that of a student that received a digital certificate for a program he completed and then proceeded to print such certificate, framed it, and attach it to the wall of his office.

2.3. Opportunities and challenges for the use of Blockchain in education

In this section it will be discussed what are the opportunities and challenges connected to the use of BC technologies in the educational sector. Given the nature of this section, some overlapping with the previous section will be present. Nonetheless, some independent interesting points might be raised on the specific use of BC technologies by educational institutions such as universities and VET schools.

As far as opportunities are concerned, employing BC technologies could greatly enhance the mobility possibility of students across European countries. This is due to various characteristics that such technologies would enable.

FIRST, STUDENTS WOULD HAVE THE POSSIBILITY OF AVOIDING BUREAUCRATIC PROCEDURES IN GETTING RECOGNITION FOR THE SKILLS/COMPETENCES THEY DEVELOPED DURING THEIR STUDY PROGRAMS.

Assuming that a BC infrastructure is in place, a student would be able to complete a study program anywhere in Europe, be evaluated by such institution, and then get recognition for the skills they developed through a digital certificated (often an open badge). This certificate would then be automatically accepted by all institutions that are part of the Blockchain on which the certificate was issued. This would mean, among other things, that students participating in exchange study programs would not need to interact with administrative offices to obtain official recognition for the activities they completed abroad, thus easing they transition between different institutions. At the same time, the automatic and transparent nature of BC technologies would save time and money to the administrative offices of the institutions involved. This would follow from the fact that the students would not be allowed to forge information and thus claim to have completed activities which they did not indeed complete²³. To check a student's career, the administrative staff would only need to check the digital certificates possessed by the student (which could be saved into a personal portfolio, e.g., the student's digital wallet) and they would get instantaneous trustworthy information about them.

SECOND, ASSUMING THAT THE INSTITUTIONS PARTICIPATING IN THE BC NETWORK ALL AGREED ON THE STANDARDS OF EVALUATION TO APPLY, ONCE A STUDENT GETS RECOGNITION FOR A SPECIFIC SKILL/COMPETENCE, THEY MIGHT GET AUTOMATIC RECOGNITION FOR SUCH SKILL ALSO FROM OTHER INSTITUTIONS PARTICIPATING IN THE NETWORK.

This would greatly enhance the consideration given to those certifications by various employers, which would be in a position to use the credibility and authority of local institutions to judge the qualities possessed by an individual they are interviewing. This has obvious positive effects on the mobility of individuals across Europe.

THIRD, FORCING INSTITUTIONS TO PARTICIPATE IN THE PRODUCTION OF SMART CONTRACTS FOR THE EVALUATION OF SKILLS/COMPETENCES WOULD ALSO FORCE THEM TO BETTER UNDERSTAND AND CLARIFY THEIR EVALUATION PROCEDURES.

²³ While this seems like a minor problem, it should be noted that according to the *Florian Mantione Institute Report* from 2021, 29% of applicants are claiming false diplomas or misleading qualifications, which constitutes a huge problem.

A case example reported during one interview with a private company²⁴ can help to clarify the point: during such interview, the CEO of the company reported that his clients, initially sceptical about applying BC to their logistic processes, realized that the practice of building smart contracts showcased many problems in their processes that they did not even realize that were existent. There are two reasons for this: first, smart contracts can be checked for issues with automatic checking tools; moreover, they apply the procedures automatically, without the possibility of having human interventions that can make smaller corrections. Note that while the correction might seem minor at one step, many minor corrections might hide bigger problems and inefficiencies along the whole process. In this sense, smart contracts would make explicit those inefficiencies and would highlight those major compound problems right away, giving organisations the possibility to correct those issues and avoid those inefficiencies. Analogously, this could be applied in the educational sector, by improving evaluation procedures and avoid major differences between different educational systems.

As far as challenges are concerned, the major problems are the ones highlighted in the previous section, i.e., the cost and privacy technical issues and the public perception issues, each with its own potential solutions. As tested by the partners in the OBEC project during the testing phases, there are also other important challenges to face.

FIRST, IT MUST BE DECIDED WHICH BADGES (IN CASE OPEN BADGES ARE EMPLOYED AS CERTIFICATIONS) SHOULD BE AWARDED FOR WHICH SKILLS.

This is already a major challenge, since it is not clear at which point to draw the line between coarse-grained skills/competences (e.g., being financially savvy) and fine-grained ones (e.g., being able to write a financial balance). An obvious potential solution to this problem is to employ the ISCO-08 codes as used by the ESCO system, thus conforming to European standards for skill/competence recognition.

SECOND, IT MUST BE DECIDED WHERE THE BADGES WILL BE KEPT BY THE STUDENTS.

The repository chosen must be secure enough to allow control over the access to the information contained within such repository, but not complex to the point where the students and the potential employers (or other educational institutions) must endure complicated validating procedures to access her information. ECTA is a good example of a repository which is easy to use and secure enough to warrant some level of privacy to the users²⁵.

THIRD, IT MUST BE DECIDED WHICH BC NETWORK TO USE.

This topic has already been discussed in the previous section and as was reported there, the suggestion is to develop private BC networks between educational institutions based on EBSI.

FINALLY, IT MUST BE DECIDED WHICH EVALUATION PROCEDURES TO EMPLOY TO VERIFY THE POSSESSION OF THE SKILLS/COMPETENCES CERTIFIED THROUGH THE BC.

²⁴ [Chainvine](#). See the [case studies](#) of the OBEC project for a reference.

²⁵ See the [chapter](#) of this guide dedicated to ECTA for further reference.

This is especially important when the network is expected to extend beyond national borders, since different evaluation procedures might be employed in different countries. This challenge calls for more analysis and study, to understand whether it is possible to obtain standards and, in case it is, which ones should be employed.

Concluding remarks

In this chapter, various aspects concerning the recognition and certification of skills/competences have been analysed and potential applications of BC technologies to those problems have been discussed. Suggestions that have been developed during the OBEC project have been presented and it is hoped that some, if not all, of them could prove useful in improving the applicability of BC technologies and in helping individuals to increase their chances of becoming better citizens.

While the task of solving the issues faced by individuals while migrating through Europe is not an easy one, the partnership who worked on the OBEC project believes that the knowledge developed during the project could help to bridge the gap towards a definitive solution. Even though it is not the definitive answer, applying BC technologies to the educational sector is surely a step in the right direction.

Chapter 3 – Overview from the European Union's Macro Level Perspective

This chapter is aimed at discovering the European Union's perspective on the general thematic of the project. First, an overview of the legislative process of recognising educational credentials is provided. Thereafter, this chapter looks in further detail at the Blockchain strategy of the European Union and more specifically the use of Blockchain in the educational sector. Finally, the conclusion summarises the general stance of the European Union's perspective on OBEC thematic and outlines the future steps in the process of recognising educational credentials with Blockchain technology.

The EU policy for Blockchain & DLT Technologies has been working along five actions:

1. Public sector as a trailblazer
 - a. Within this action is the [European Blockchain Partnership](#), which has been focused on the development of the European Blockchain Service Infrastructure (EBSI). Among other things, the EBSI has been working on providing technical solutions to develop a trust model to exchange verifiable credentials
2. Legislation & Regulatory Sandboxes
3. Supporting R&D
4. Closing the Knowledge Gap
5. Supporting Global Cooperation

3.1. Verification of educational credentials in the European Union

Contrary to popular belief, the European Union does not guarantee standard recognition of academic certificates. The main legislative framework for the recognition of such diplomas on European territory is the Lisbon Recognition Convention of 1997 (LRC) which outlines the foundation of the recognition procedures in the European region (Nuffic, 2020). European Union member states are free to implement any rule, in accordance with EU law, they deem fit to recognise educational credentials from abroad. This often results in a situation where individuals are requested to produce a “statement of comparability” issued by the ENIC/NARIC centre (European Commission, 2022). This process is often, timely, costly and an all-around barrier for OBEC's target audience to integrate faster into the destination country. The European Union suggests individuals use the Europass format including the Diploma Supplement to speed up the process. However, this does only apply to certain countries. Undoubtedly the ENIC/NARIC institutions apply technology when compiling the statements of compatibility. However, no specific mention has been made concerning the use of Blockchain to fulfil such comparisons.

3.2. Micro-credentials

Besides Blockchain technology, another key element of OBEC's methodology is the use of credentials and micro-credentials. Especially micro-credentials are aimed at certifying specific learning outcomes that span over a set amount of time (European Commission, 2022). Micro-credentials are an effective tool to upskill or reskill individuals to bridge the skill gap for labour market needs.

In contrast to processing the recognition of educational credentials that solely lies with the Member States, the Council of the European Union recommended a European approach to micro-credentials in June 2022. Recommendation 2022/C 234/02 pleads to have “common standards” that ensure “cross-border comparability” (European Commission, 2022). The Council proposes the following:

- To “enable individuals to acquire the knowledge, skills and competences they need to thrive in an evolving labour market” (Council of the European Union, 2022).
- To “support the preparedness of micro-credential providers to enhance the flexibility and transparency of their learning offer to empower individuals to forge personalised learning and career pathways” (Council of the European Union, 2022).
- To “foster inclusiveness and equal opportunities” (Council of the European Union, 2022 & European Commission, 2022).

To reach these objectives, the Council recommends the member states introduce a common definition of the term micro-credential, among other actions (Council of the European Union, 2022). According to the Council and Commission, this shall be achieved so that: “micro-credentials can be developed, used and compared in a coherent way among the Member States, stakeholders, and the different providers” (Council of the European Union, 2022 & European Commission, 2022).

Though the aims of the introduction of such an EU approach to micro-credentials are similar to OBEC’s outcomes, the recommendations made by the Council of the EU might also have negative implications. Article 5 of the Council recommendation underlines that micro-credentials will not replace traditional qualifications (Council of the European Union, 2022). Furthermore, OBEC’s methodology, namely the Blockchain is not mentioned as a tool to ensure cross-border comparability and transparency of these credentials. It is advisable to remain updated on the latest developments regarding the Council recommendation 2022/C 234/02 to be conscious of the steps that are taken in relevant fields.

3.3. Blockchain Strategy European Commission

The fact that the European Union has no structure in place for the recognition of educational credentials using Blockchain technology does not rule out the EU’s ambition regarding Blockchain technology. On the contrary, the European Commission aims to become a “leader in Blockchain technology” (European Commission, 2022). The Commission would like to attract “significant platforms, applications and companies” by setting a “golden standard” by embracing European values and ideas in its legal and regulatory framework (European Commission, 2022).

One of the pillars of the abovementioned golden standard is the development of a “pan-European public service Blockchain”, which is of particular relevance to the OBEC project. Notably, it is the public services that often verify educational credentials. These developments can be perceived as an opportunity for OBEC’s target groups and the use of Blockchain to recognise educational credentials in general.

To successfully develop an all-encompassing European Union public service Blockchain infrastructure, legal certainty is of utmost importance. At this point, the Commission has not mentioned that they would support the use of the public service Blockchain to accredit educational credentials. Therefore, the legal certainty that is referred to mainly applies to consumer and financial protection instead of ensuring the legality of issuing educational credentials through Blockchain technology.

Besides the development of the Blockchain technology itself and its legality, the Commission also aims to support Blockchain skills development by supporting educational programmes. These programmes are mainly targeted at acquiring skills and competences that the Blockchain market requires for it to be competitive.

Finally, the European Commission mentions interacting with the stakeholders in the market, academia and the broader Blockchain community. The Commission does so through two institutions, the International Association of Trusted Blockchain Applications (INATBA) and the European Blockchain Observatory and Forum (European Commission, 2022).

Get to know the European Union's initiatives in Blockchain

WHAT IS THE EUROPEAN BLOCKCHAIN PARTNERSHIP (EBP)?²⁶

It is an initiative that seeks to develop an EU strategy on blockchain and build a blockchain infrastructure for public services. All EU Member States, Norway and Lichtenstein and the European Commission have joined forces to form the European Blockchain Partnership. Its focus has been to build the European Blockchain Services Infrastructure (EBSI).

The European Blockchain Partnership (EBP) helps avoid fragmentation of the blockchain landscape by fostering close collaboration between EU countries. The Partnership supports interoperability and the broad deployment of blockchain-based services. It offers a regulatory-compliant environment in full compliance with EU laws and with clear governance structures and models to help blockchain grow and flourish across Europe.

By using blockchain themselves, European policy makers gain first-hand knowledge of how the technology works, where it can best be applied, and what its potential and risks are. The EBP serves as both a technological and regulatory sandbox, hopefully leading to better, more informed regulation on the technological and use case front.

²⁶ Read more about it: <https://digital-strategy.ec.europa.eu/en/policies/blockchain-partnership>

WHAT IS THE EUROPEAN BLOCKCHAIN SERVICES INFRASTRUCTURE (EBSI)?²⁷

It is a joint initiative from the European Commission and the European Blockchain Partnership and a blockchain network of distributed nodes across Europe to support important applications.

The vision is to leverage blockchain to accelerate the creation of cross-border services for public administrations and their ecosystems to verify information and to make services more trustworthy. Since 2020, EBSI has been deploying a network of distributed nodes across Europe, supporting applications focused on selected use cases.

It is expected that the EBSI will contribute to more efficient and more accessible cross-border government services in Europe. EBSI is actively working to promote Verifiable Credentials, “making digital information easy to verify, and almost impossible to fake”. However, it acknowledges that “reducing the time and cost of verification is a challenge that cannot be met with blockchain alone”. For this reason, it also supports technologies that make it possible for Public Administrations and Businesses to easily verify and trust information received directly from Citizens (or Businesses). EBSI utilizes Verifiable Credentials to allow citizens to share their educational, professional, and other information with governments and businesses.

WHAT IS THE INTERNATIONAL ASSOCIATION OF TRUSTED BLOCKCHAIN APPLICATIONS (INATBA)?²⁸

It is an initiative that facilitates positive change in the blockchain ecosystem by supporting and promoting their members as part of their work. INATBA serves as the bridge between public and private entities in the blockchain ecosystem and works to promote global blockchain adoption across diverse fields such as law, finance and education.

INATBA maintains a permanent and constructive dialogue with public authorities and regulators for global convergence of regulatory approaches. In doing so, INATBA works to promote an open, transparent and inclusive global model of governance for blockchain and other distributed ledger technology infrastructures that reflect the shared interests of Member and Advisory Board stakeholders. In line with the goal of reaching global blockchain adoption, INATBA supports the development and adoption of interoperability guidelines, specifications and global standards for the development and acceleration of trusted sectorial blockchain and DLT applications in specific sectors.

²⁷ Read more about it: <https://ec.europa.eu/digital-building-blocks/wikis/display/EBSI/What+is+ebsi>

²⁸ Read more about it: <https://inatba.org>

WHAT IS THE EUROPEAN BLOCKCHAIN OBSERVATORY AND FORUM?²⁹

It is an initiative from the European Commission to accelerate blockchain innovation and the development of the blockchain ecosystem within the European Union and so help cement Europe's position as a global leader in this transformative new technology. Its mission is the following:

- Monitor blockchain initiatives in Europe
- Produce a comprehensive source of blockchain knowledge
- Create an attractive and transparent forum for sharing information and opinion
- Make recommendations on the role the EU could play in blockchain

Its official website collects information about initiatives in the EU and the most recent reports on the EU Blockchain Ecosystem latest developments by country. The 2022 report can be found [here](#). The following is stated in the report regarding the recent developments in the partner countries in the OBEC project:

Belgium

Belgium can boast a vibrant crypto-assets community, with a distinct focus on Fintech start-ups. Due to its proximity to European Union decision-making headquarters, the country is an attractive location for international companies and several well-established companies and VC funds serve the continuous growth of the cryptocurrency ecosystem in the country. The number of blockchain start-ups in Belgium, has significantly increased. Belgium was the first country in the EU to spin up a second EBSI node. As of May 2022, the Financial Services and Markets Authority (FSMA), requires the region's crypto exchanges and custodial wallet services to register.

Croatia

Croatia has a small, but growing, ecosystem of blockchain start-ups and communities. There are a handful of cases for adopting cryptocurrencies as a payment method in Croatia. In May 2020, the country's financial supervisor approved a bitcoin investment fund, even in the absence of any specific country-level legislation specific to crypto assets. In a span of 2 years, Croatian universities have incorporated blockchain courses in their curriculums while there are also organised research initiatives related to blockchain.

Italy

Italy has a number of state-sponsored pilot initiatives aiming at testing blockchain applications in government, as well as a large number of private pilots, mostly by financial institutions, while football fan tokens are on the rise and are significantly contributing to blockchain adoption in the country. The country was one of the first in the world to recognise the legal validity and enforceability of smart contracts in 2019. According to a ruling by the Revenue Agency, issued in July 2021, the tax authorities reiterate the equivalence of cryptocurrencies to foreign currencies.

²⁹ Read more about it: <https://www.eublockchainforum.eu>

Sweden

Sweden has a developed and diverse blockchain ecosystem with notable initiatives. Riksbank, the country's central bank, was amongst the world's earliest examples of research on a CBDC, called the e-krona. Other notable pilot projects of public interest include a blockchain-based land registry and a number of applications in the financial services industry. The number of blockchain start-ups launched and the millions raised by blockchain ICOs have slightly decreased compared to 2020. The Swedish government assigned a special committee to investigate needs for legislative changes in eliminating barriers to digital development in the public sector in 2017, however the investigation did not result in any legislative amendments related to crypto assets or blockchain.

3.4. The use of Blockchain technology in education

To further foster and develop the public service Blockchain, the European Commission is the involvement in the Commission the European Blockchain Services Infrastructure (EBSI). EBSI is an initiative by the European Commission, the European Blockchain Partnership and the EU Member States that aims to “accelerate the creation of cross-border serviced for public administrations and their ecosystems” (EBSI, 2022). In essence, this partnership aims to verify data and increase the trustworthiness of the services conducted using Blockchain technology (EBSI, 2022).

EBSI also aims to use its public service Blockchain in the process of recognising educational credentials. The partnership developed the Verifiable Credentials lifecycle (VC lifecycle), which is a document that aims to provide stakeholders with an overview of the steps and requirements to be able to participate in the exchange of Verifiable Credentials (EBSI, 2022). Therefore, one can conclude that the first steps towards the recognition of educational credentials through Blockchain technology are taken by the European Commission.

3.5. Legislation Blockchain Technology at European Level

Even though the European Commission has introduced a Blockchain strategy including the first steps towards its application in the educational sector, it is important to stress that at the very moment of the writing of this report, no specific legislation is aimed at applying Blockchain technology to recognise educational credentials in the European Union (Graux & Vandezande, 2022).

Most legislation is directed at data protection rather than the recognition of educational credentials via Blockchain technology. The basis of this legislation is regulation 2016/679 on the protection of natural persons concerning the processing of personal data and on the free moment of such data. Finally, Graux and Vandezande underline that if legislators aim to introduce Blockchain technology to recognise educational credentials it is important for them to base their systems for the recognition of credentials using Blockchain technology on this very regulation (Graux & Vandezande, 2022).

3.6. Research into the use of Blockchain technology to recognise educational credentials

Another indication of the increased interest in the topic from the European Commission is the support of research into this topic. Such research includes the research paper by Grech and Camilleri with the Joint Research Centre commissioned by the European Commission on how blockchain can transform education. In their research paper, Grech and Camilleri outlined three main conclusions on how Blockchain technology could positively impact education.

1. The first aspect the researchers refer to is the increasing stability and strengthening of national education record-keeping systems resulting from the immutable nature of Blockchain technology (Grech & Camilleri, 2017).
2. secondly, Grech and Camilleri refer to a significant decrease in bureaucracy for both issuers and receivers of educational credentials (Grech & Camilleri, 2017).
3. Finally, the report states that BC technologies enable “smart contracts” where actions can be undertaken after certain conditions have been met automatically (Grech & Camilleri, 2017).

Furthermore, Grech and Camilleri provide the Commission with numerous steps they could undertake to support the process of involving Blockchain technology in education. Such recommendations include setting up expert committees on the topic so that policymakers are informed of the latest developments (Grech & Camilleri, 2017). Grech and Camilleri underline that the educational institutions and learners should be corresponded to impart knowledge on the benefits of the use of Blockchain technologies in education (Grech & Camilleri, 2017).

Moreover, the standardisation of this process is vital, and it is of utter importance that policymakers urgently research how to establish commonly agreed standards for educational records and how those can be linked to educational credentials (Grech & Camilleri, 2017). Finally, Grech and Camilleri advocate for the establishment of an expert committee that informs policymakers on the latest developments of Blockchain in education.

Concluding Remarks

Though cross-border mobility is a highly valued aspect of the European Union, the recognition of educational credentials is not a standardised process. On the contrary, it is a costly bureaucratic burden for many individuals. No specific reference has been made to Blockchain technology to optimise cross-border recognition processes thus far.

Unlike standard educational credentials, there is an increased awareness of the modernisation of the cross-border recognition of micro-credentials by EU institutions. However, neither Blockchain technology is mentioned, nor will it replace the standard accreditation process.

Though no specific legislation addresses the use of Blockchain technology to accredit and recognise educational credentials, the European Commission has increasingly shown interest in the topic. On Blockchain technology in general, the Commission has expressed the desire to become a frontrunner when it comes to the use of Blockchain in their activities and public services across the Member States in general. This aspiration came to fruition through the

creation of initiatives such as the European Blockchain Services Infrastructure (EBSI) that are exploring the possibilities that Blockchain has to offer in this field.

Furthermore, the European Commission continuously supports research into the use of Blockchain in the public service sector such as the recognition of educational credentials. Research such as the paper written by Grech and Camilleri outlines the benefits of Blockchain technology in the educational process. Therefore, one could conclude that the European Commission is aware of the benefits of the use of Blockchain technology for the issuing and recognition of educational credentials.

Though the European Commission is effectively aiming to create an infrastructure for OBEC's methods i.e., a public service Blockchain and the recognition of micro-credentials, it does not combine both Blockchain and accreditation of credentials in one framework as of yet.

Therefore, it would be recommended to initiate and or maintain dialogue with the European Commission on the subject to establish a secure basis for the use of Blockchain technology in education.

Chapter 4 – Collection of Case Studies

The OBEC guiding material gathers case studies portraying inspirational ideas for the uses of Blockchain technology across several sectors. The case studies will be presented in this chapter which seeks to:

- Inform about tools and methods that can be resourceful in overcoming the issue of validation and recognition of skills and competences.
- Share success stories and investigate challenges and opportunities around Blockchain technology

This case studies within this chapter will be organized as follows:

Educational Sector

- European Union – p. 28
- International – p. 37

Inspirational case studies for the use of Blockchain in other sectors

- European Union – p. 42
- International – p. 49



1506
UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO



BLOCKCHAIN IN PRACTICE

Educational Sector

European Union





EDUCATIONAL
SECTOR

EUROPEAN
UNION

COUNTRY: SLOVENIA

SECTOR: EDUCATION

Innovation: ECTA offers a platform in which both educational institutions and students can create profiles and interact to verify education and competences that are directly made available on the student's profile.

Blockchain use: With ECTA we can embed various competencies or references (certificates, education, grades, work history, projects, experience) into blockchain: this means that competences will be transparent, credible, immutable, and non-fungible – a minted competency is an NFT token (non-fungible token), which offers the holder digital rights of ownership and credibility. The blockchain could potentially be other than Ethereum, should they support the required functionalities.

The platform has been used during the OBEC project to test the potentials of blockchain in certification recognition.

Source: <https://obec.ecta.si/help>

ECTA for Educational Institutions (EDUS)

ECTA is a platform for standardization and simplified issuance of competencies that can be used in different ways for different levels of integration, with ECTA portal being only one of the ways of integration. Through ECTA, the issuance of competences in the blockchain can be used by the institutions that issue competences/certificates etc. In addition to that, the following can also be achieved through ECTA:

- companies can monitor the development of their employees,
- leading partners can monitor the development of their stakeholders,
- schools can monitor the educational process and progress of their students
- and in general, institutions can keep track of the development of any recipients of competencies.

The main upfront time investment for the institution is to translate all their available courses into a ECTA friendly format. Their students or alumni can, from their freelancer account on the platform find their institution and ask them to verify their completed education.

Within the ECTA platform, the concept of directory and assignment of competencies has been developed for the purpose of establishing qualified users. As such, the concept is also a solution proposal for establishing a global directory of competencies for the future, creating them, assigning them to users, independent verification and, in borderline cases, deprivation of competencies to users.



EDUCATIONAL
SECTOR

EUROPEAN
UNION

COUNTRY: ITALY

SECTOR: EDUCATION

Innovation: In December the Blockcerts project, presented by the Universities of Padua and Milan-Bicocca with the technological collaboration of Cineca, was awarded the silver medal at the prestigious QS Reimagine Education Awards in the "Best Innovation in Blockchain Technology" category.

Sources:

Cineca webpage:

<https://www.cineca.it/temi/blockchain>

Interview with the Aldini Valeriani Foundation, which is a training professional institution that used the training badge system recognized by the blockchain platform developed by Cineca.

See their website:

<https://www.fav.it/impres/corso/formazione-generale-lavoratori/>

Cineca Blockchain Lab

Cineca develops tools to support digital learning and teaching in universities and professional schools, which cover the entire process of digital content production and certification of skills.

Cineca thinks blockchain technology is useful to be used in the educational sector because:

- Several entities in an equal relationship must provide and access data or resources (no middleman).
- The trace of the operations must be enforceable against third parties, with the certainty that nothing has been canceled or modified (trust).

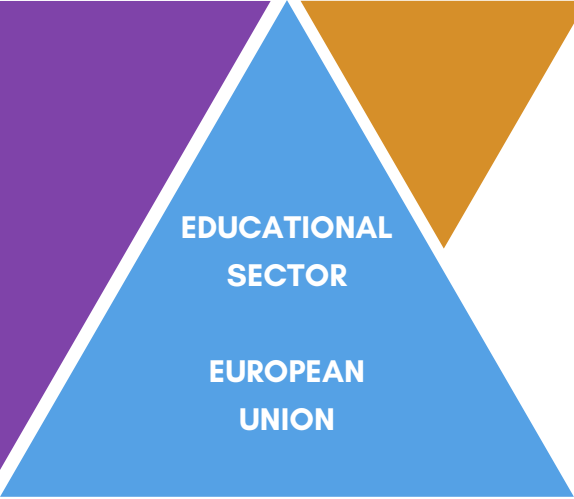
Blockchain use: The evolution of Bestr as a digital Credentialing platform was announced in January 2019, with the Universities of Milan-Bicocca and Padua.

In June 2019 the first Blockcerts degrees for Italian graduates were released.

Cineca launched a Blockchain Lab at the beginning of 2017, to investigate the opportunities offered by technology and identify - beyond the hype - the possible points of utility for consortium members and for the country.

See the video at the end of this link:

<https://www.cineca.it/temi/blockchain>



Buck-e

COUNTRY: BELGIUM

SECTOR: MOBILITY/EDUCATION

Innovation: The Buck-e project is innovative in the sense that it directly targets pupils instead of their parents. Furthermore, the rewards provided to students encourage them to spend them on local initiatives that have a positive impact on the community.

Blockchain use: The project applies a so-called private blockchain which is a “network of duplicated databases” that can be duplicated for each municipality that participates in the project. This way the platform can be shared by multiple municipalities simultaneously by sharing and processing data. Stakeholders may also decide on the redeemability of rewards awarded in other participating municipalities (Pommée, 2018).

The Belgium IT consultancy Fairville together with the innovation lab of Belgian bank Belfius developed a platform that local governments can use to encourage citizens to make sustainable mobility solutions (Buck-e, 2022). In the Flemish communities of Bonheiden, Peer and Crisnée, school children were encouraged to commute to school by bicycle or foot. Every time a student walked or cycled to school, a digital currency is awarded. This reward can then be spent at local partners such as “libraries” or “swimming pools” (Beenen, 2018).

Buck-e uses an application for both the pupils as schools and authorities that have access to a dashboard that outlines the number of km walked or cycled by pupils and the amount of CO2 emissions saved that would have otherwise been produced by parents driving their children to school (Pommée, 2018). This is calculated by a sensor on the bicycle or backpack that registers the movement of the pupil determining the rewards awarded to pupils.

Blockchain technology ensures safety, privacy and integrity of the use of the data such as the number of km spent walking or cycling and the quantity of CO2 emissions that were saved doing so (Beenen, 2018).

A significant decrease in traffic accidents has been reported in the areas of participating schools since the project started. Moreover, 30 tons of CO2 emissions were saved by pupils walking or cycling to participating schools (Beenen, 2018).

The currency rewarded to pupils also boosts local companies and is directly transferred into euros.

Sources:

[Beenen, W. \(9 de October de 2018\)](#)

[Buck-e. \(2022\)](#)

[Pommée, U. \(2018\)](#)



Co-funded by the
Erasmus+ Programme
of the European Union





EDUCATIONAL
SECTOR

EUROPEAN
UNION

COUNTRY: SWEDEN

SECTOR: EDUCATION

The one technology that let trusted organisations issue animated, blockchain- secured Diplomas, Certificates, Awards and Badges.

Innovation: TRUE is the only platform that currently allows institutions to create customized documents that can be issued using Blockchain technology.

Source: <https://trueoriginal.com/>

TRUE original has been active since 2020, offering a new document standard, which can be validated and proven as real originals. Through TRUE, institutions and organisation can generate and issue customised documents, badges and credentials that are secure, verifiable, and transparent. After being issued a certification through TRUE, the recipient gains full control over their credentials, being able to password protect the document, share it with third parties, and directly add the document to their certifications on LinkedIn.

Blockchain use: Blockchain technology secures, protects, and allows the documents to become easily verified and trusted.



EDUCATIONAL
SECTOR

EUROPEAN
UNION

Università di Milano Bicocca & Università di Padova

COUNTRY: ITALY

SECTOR: HIGHER EDUCATION

Innovation: The case study is innovative because it was one of the first application of Blockchain technologies for the production of educational credentials at the University level in Europe.

Blockchain use: The project utilizes Blockchain technologies to produce University Degrees through the Bestr platform by Cineca. It utilizes the blockcert protocol and it allows students to get their titles checked by anybody around the world without any intervention by the Universities' offices.

Università di Milano Bicocca and Università di Padova are two Italian universities which established in 2017 (testing phase) one of the first Blockchain certified University Degree in Europe. Such project helped such universities to win the silver medal at the International Oscars for Education (2019), in the category "Best Innovation in Blockchain technology". They were the only Italian institutions which received a prize.

In order to set up the certification process, the two universities partnered with Cineca (see the other case studies in this report) and they employed the blockcert protocol by M.I.T. Media Labs (see the other case studies in this report). The idea was to provide to the students university degrees which were portable and completely safe from falsification and modification.

The validity of such degrees can be verified by anyone around the world without the requirement of intervention by the universities' offices, thus allowing potential employers to rapidly check whether a student they wish to employ does indeed possess the relevant certifications.

Sources:

[UNIPD, 2020](#)

[UNIMIB, 2019](#)



Co-funded by the
Erasmus+ Programme
of the European Union





EDUCATIONAL
SECTOR

EUROPEAN
UNION

COUNTRY: CYPRUS

SECTOR: EDUCATION

Innovation: UNIC claims to be the first university to explore the potential of Blockchain in education through several paths related to accepting cryptocurrency payments, developing educational material on topics connected to cryptocurrencies and Blockchain technology and issuing accredited academic certifications through Blockchain using Blockcerts as an open standard for Blockchain educational certificates.

University of Nicosia (UNIC)

The University of Nicosia was established in 1980 and its main campus is located in Nicosia, Cyprus. It also has study centres in Athens, New York and Bucharest. This university is a private institution offering more than 100 on-site and distance learning programs.

In 2014, UNIC started offering a Master of Science in Blockchain & Digital Currency and accepting Bitcoin for tuition payment. It was the first university in the world to do so. Besides, since 2017, UNIC is able to publish the diplomas of its graduating students on the Bitcoin Blockchain, offering instant online verification of degree authenticity.

Blockchain use: The university:

- accepts Bitcoin for tuition for any degree program
- teaches a university-level course on cryptocurrency, delivered as a MOOC called 'Introduction to Digital Currencies'
- offers an accredited academic degree program – a Master of Science in Digital Currency & Blockchain – taught online in English
- issues academic certificates onto the Bitcoin Blockchain, using its own in-house software platform.

Sources:

[UNIC, n.d.](#)

[Wikipedia, n.d.](#)

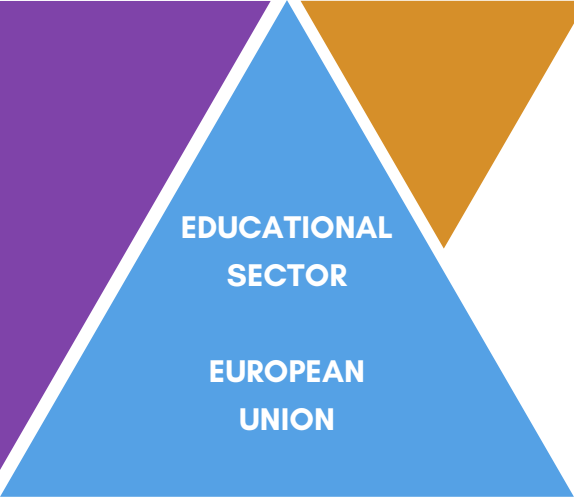
[UNIC, n.d.2](#)

[JCR Science for Policy Report, 2017](#)



Co-funded by the
Erasmus+ Programme
of the European Union





The first blockchain directed at the educational sector

COUNTRY: ESTONIA

SECTOR: EDUCATION

Innovation: DISCIPLINA is developing the first blockchain to create verified personal profiles based on academic and professional achievements. DISCIPLINA doesn't use any other blockchain, and is being developed for the demands of the educational and recruiting fields, taking into account the specificity of their activity.

Blockchain use: DISCIPLINA uses blockchain to maintain a unified register of academic achievement and qualifications for universities. The company's decentralized algorithm automatically assigns a score to someone based on his or her achievements and qualifications. Universities can use those scores to determine individualized learning plans based on what the student has or hasn't learned and achieved.

DISCIPLINA is a multifunctional blockchain for the projects in educational and recruiting spheres. It provides the transparency of work and creates conditions of maintaining confidentiality and reliability of information added by system participants

The DISCIPLINA platform released the Alpha version of its blockchain platform so universities and students can become familiarized with the app. The company's Student App enables students to view their educational history. The Educator App offers profiles on professors, teaching styles and course offerings.

On the platform, students will be able to create a single profile where users will store their verified data on both educational and professional achievements. DISCIPLINA will store the whole history of academic achievement of a person in blockchain, generating their personal score. It will allow recruiters to simplify the candidate search by their fields of expertise and skills required.

PoS Consensus Algorithm: to check the validity of transactions in public chain, so-called «Witnesses» will use a consensus algorithm based on Proof-of-Stake technology, which provides the high speed and low price of transaction. The Witnesses, as in other cryptocurrencies, will be rewarded for the launch of each block with commission fees from transactions made in that block. The probability that the Witness will become the block-leader is proportional to the number of tokens on his account.

Sources:

[Alpha DISCIPLINA, 2018-2022](#) [DISCIPLINA, n.d.3](#)

[DISCIPLINA, n.d.1](#)

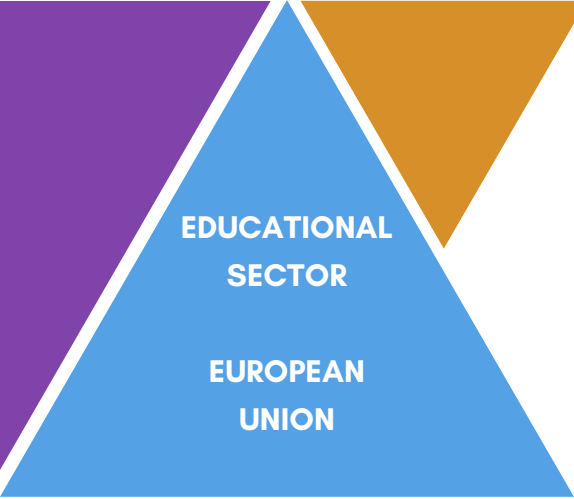
[DISCIPLINA, n.d.2](#)

[Daley, 2022](#)



Co-funded by the
Erasmus+ Programme
of the European Union





COUNTRY: REPUBLIC MALTA

SECTOR: EDUCATION & GOVERNMENT

Innovation: Although for now these Maltese project focuses on providing certified education to learners, Malta intends to do much more than that by expanding the use of Blockchain credentials to many other areas. Hence, Malta is using the education certification as a pilot for further developing a more holistic system later on, with the goal of becoming a “Blockchain island”.

Blockchain use: Since July 2017, Malta has a Parliamentary Secretary within the Office of the Prime Minister (OPM) to develop national initiatives related to the digital economy. The pilots on education certification are part of this wider framework, as the first trials and examples of praxis. There are many potential e-government projects that would also benefit from the issuing of certificates on the Blockchain. The Maltese OPM identified the following areas to which Blockchain could be applied: Health Care; Land Registry; Notarial Acts; Life Events (Births, Marriages, Death Certificates); Address Points; Police Conduct; Court Case outcomes; Driving Licenses and e-Democracy Events.

Malta

“Blockchain Island”

Malta aspires to become a “Blockchain island”. Nevertheless, they decided to start this path through the educational sector by allowing Maltese citizens to own their education certificates.

In January 2017, the Ministry for Education and Employment (MEDE) signed a Memorandum of Understanding (MOU) with the, back then, Learning Machine Group (LM), now named Hyland Credentials. The MOU coincided with the conclusion of a conference held on the 19th and 20th of January 2017 as part of Malta's Presidency of the Council of the EU.

The MOU signalled the intention to develop and implement a Malta pilot of LM's nation-state technology platform, which is based on the Blockcerts open standard.

MEDE believes that the strategic deployment of Blockchain technology signals Government's commitment to provide learners and workers with maximum ownership and portability of their own official records of learning achievement. The main objective of the pilot is self-sovereignty in order to empower Maltese citizens to own their credentials by leveraging on the affordances of the Blockchain, acknowledging them as fully contributing, skilled members of the 21st century workforce and as lifelong learners. The secondary objective is to continue with ongoing initiatives to internationalise and cross-reference credentials secured from Maltese institutions within EU frameworks.

Sources:

[JCR Science for Policy Report, 2017](#)

[Blockchain Council, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union





1506
UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO



BLOCKCHAIN IN PRACTICE

Educational Sector

International





EDUCATIONAL
SECTOR

INTERNATIONAL

COUNTRY: UNITED STATES

SECTOR: RESEARCH & EDUCATION

Innovation: In June 2017, MIT used Learning Machine Certificates (now known as Hyland Credentials). This is a commercial solution developed over Blockcerts through which diplomas for two cohorts of students at MIT's Media Arts and Sciences and the Sloan School of Business were issued.

This is the first issuance of such certificates and the first example of recipient-owned diplomas.

Blockchain use: The MIT Media Lab utilized Blockchain technology for issuing diplomas to recognize the learning achievements of their students.

MIT Media Lab

The MIT Media Lab is a research and academic organization that was founded in 1985 and it is part of the Massachusetts Institute of Technology. There, Media Lab designers, engineers, artists, and scientists aim to develop technologies and experiences that enable people to understand and transform their lives, communities, and environments.

MIT promotes and encourages an interdisciplinary research culture that brings together diverse areas of interest such as social robotics, physical and cognitive prostheses, new models and tools for learning, community bioengineering, and models for sustainable cities. Faculty, students, and researchers work together on hundreds of projects across the mentioned disciplines.

MIT strongly supports the idea of giving recipients more control over the certificates they earn, without having to rely on third-party intermediaries such as universities and employers to store, verify and validate credentials, often at an additional cost. They are now using Blockchain technology and cryptography together and they contributed to the development of Blockcerts.

As explained on their website blockcerts.org, "Blockcerts is an open standard for creating, issuing, viewing, and verifying Blockchain-based certificates. These digital records are registered on a Blockchain, cryptographically signed, tamper-proof, and shareable. The goal is to enable a wave of innovation that gives individuals the capacity to possess and share their own official records."

Sources:

[MIT Media Lab, n.d.](#)

[Blockcerts, n.d.](#)

[Wikipedia, n.d.](#)

[Hyland, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union





EDUCATIONAL
SECTOR

INTERNATIONAL

COUNTRY: UNITED STATES

SECTOR: EDUCATION

Innovation: Parchment offers services including district record services, transcripts, diplomas, verification. Learners can order transcript and other credentials, track delivery statuses and store them in a Credential Profile.

Blockchain use: Parchment offers digital credential services to students, academic institutions and employers. K-12 educators use the company's blockchain to upload any important developmental progress. Higher educational institutions use the platform to review academic merit, process applications and produce immutable diplomas. Additionally, students have full-time access to all educational information and can easily share academic achievements with future employers.

Blockchain on educational credentials, transcripts, and diplomas

Parchment is a platform that offers digital credential services to students, academic institutions and employers. They provide learners, academic institutions and employers the ability to innovate, request, verify and share transcripts, diplomas, and other credentials in simple and secure ways.

Parchment recently partnered with x2VOL. The company creates immutable documents that include a log of service hours and students' personal reflections on their learning experience to give future universities and employers a holistic look at a student's academic and personal journey.

Our award-winning technological platform enables the issuance, sharing, collection and verification of authenticated academic credentials across a global network of high schools, universities, licensing boards, and employers.

Sources:

[Parchment, n.d.](#)

[Parchment, n.d.2](#)

[Daley, 2022](#)



Co-funded by the
Erasmus+ Programme
of the European Union





EDUCATIONAL
SECTOR

INTERNATIONAL

**COUNTRY: UNITED
KINGDOM**

**SECTOR: EDUCATION &
WORK EXPERIENCE**

Innovation: APPII's platform not only provides verification of credentials and experiences through blockchain, but also ensures the security of the users. Together with Applied Blockchain, they developed an application to integrate Know Your Customer (KYC) providers for verification, issuing and storing digital signatures, biometrics, and integrating Applied Blockchain's 'Privacy' component to ensure compliance with data protection and privacy standards.

Furthermore, the platform included a web and mobile version with an intuitive user experience for the ID verification process and storage and management of digital keys for educational institutions and employers to verify a user's experience.

APPII

APPII is a technology and verification software company that develops simple, trusted, and secure biometric applications and solutions suitable for use across different industries.

As for the education sector, APPII partnered with Applied Blockchain to make use of blockchain to verify credentials. They verify the academic credentials of students and professors by combining blockchain, smart contracts and machine learning. The system also works for collecting work experience, allowing employers and recruiters to quickly access verified information about the candidates.

Blockchain use: APPII's platform uses blockchain and digital signatures as a way to create a single immutable record of an individual's experience/certification.

In this way, educational institutions and employers that engage in the network can verify a user's experience with a digital signature that is stored against their record on the blockchain.

To utilize APPII and its platform, users have to create a profile and fill out their academic CV, including education history and transcripts. Then, through blockchain, APPII verifies the user's background and locks his or her information into its blockchain.

Sources:

[APPII, n.d.](#)

[Daley, 2022](#)

[APPII, n.d.2](#)

[Bultin, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union





EDUCATIONAL
SECTOR

INTERNATIONAL

COUNTRY: JAPAN

SECTOR: EDUCATION

Innovation: One of the most innovative aspects of the Sony platform is its ability to keep students' information safely on ledger, once it is verified by the blockchain. Besides, its capacity to support the storage of students' experiences helps the education institutions to organise their data in a more efficient and effective way.

Blockchain use: Education and academic institutions can utilize the Sony platform to store their students' information safely and permanently on blockchain technology. They only need to add the student's information, credentials and achievements to the platform, which then verifies all the data and keeps it perpetually on blockchain. At the same time, the institutions can then access this information quickly from the ledgers where it is stored.

Sony Global Education

According to Sony "Our mission is to create a new educational infrastructure that goes beyond educational content or services, and becomes the foundation of human resources development so that everyone can compete and learn from one another.". Although it all started in Japan, Sony is expanding its business globally to provide platforms for a wide range of educational products, services and data.

One of the platforms that Sony developed was a blockchain platform that enables different institutions to add individual academic achievements, certifications and other student information on a ledger in order to maintain trustable, transparent, irrefutable records on students who have transferred or furthered their education.

Sources:

[Daley, 2022](#)

[Sony Global Education, n.d.](#)

[Bultin, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union





1506
UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO



BLOCKCHAIN IN PRACTICE

Other Sectors

-

European Union



Land registration in Sweden – a collaboration between the public and private sectors

OTHER
SECTORS

EUROPEAN
UNION

COUNTRY: SWEDEN

**SECTOR: LAND
REGISTRATION**

Innovation: The innovative aspect of this case study resides in the fact that it uses new Blockchain technology for processes (in this case land registration) that have always been conducted by humans and that now can be computerized. This will bring several advantages such as saving time, allowing more transparency or easing the access to certain titles/credentials.

Blockchain use: It utilizes Blockchain technology by registering land property through proof-of-concept and smart contracts, which will allow their verification and permanency on the chain.

In June 2016, ChromaWay announced a proof-of-concept Blockchain solution for land registration, in partnership with the Swedish National Land Survey (Lantmäteriet), the consulting firm Kairos Future and the telecommunications company Telia. Together, they demonstrated how Blockchain technology and smart contracts can make land registration (in this case in Sweden) more secure by minimizing the risk associated with manual handling and transferring of land documents or contracts. Telia developed the proof-of-concept using its identity verification technology on top of a new smart contract system developed by ChromaWay, compatible with both public and private Blockchain. Kairos Future, coordinated and managed the process and developed an accompanying report. Lantmäteriet provided sponsorship and feedback for the project. The project could make an important impact to save time on land registration registry, which currently can take months from signing a contract to registering a sale in a real estate transaction. With blockchain, this could take only a few hours.

The current phases of the project are:

- Phase 1: developing a theoretical understanding of what blockchain technology is, how it works, and why it would be relevant in the context of the Land Registry Authority.
- Phase 2: responding to the needs and demands of title owners and the Government by developing appropriate technology.
- Phase 3: conducting experimentation, with the goal of developing a working and efficient Proof of Concept

An important challenge that might be raised is how the transition to adopt blockchain technology would involve changes to the Swedish regulatory landscape as digital signatures for registering or purchasing properties are currently illegal.

Sources:

[GovChain, n.d.](#)

[Entreprenörskapsforum, 2016](#)

[Bitcoin Trending, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union



The world's first decentralized photography platform

OTHER
SECTORS

EUROPEAN
UNION

COUNTRY: SWEDEN

SECTOR: PHOTOGRAPHY & COPYRIGHT

Innovation: YouPic ensures photo ownership by attributing rights on the blockchain. Users can attach a usage license to allow others to buy their photos, or to make their content completely private. YouPic used lattice of blockchain, meaning that each account has its unique blockchain and only that account can create blocks on its chain.

Blockchain use: YouPic utilizes blockchain to secure photo ownership and copyrights, to create smart contracts to define licensing terms and facilitate sale transactions, and to track how the creators' work is used to track unauthorised usage. It therefore explores the decentralization and transparency offered by the Blockchain Technology.

YouPic was funded in 2012 in Gothenburg, Sweden, and has over 3 million users worldwide. Branded as an alternative photography platform to Instagram, photographers and photo enthusiasts are able to sell photo licenses directly to the media houses through the use of blockchain. Sales and contract agreements occur through the use of YouPic's token, YouPic-Coin.

Its interface is a combination of Twitter and Instagram, and it is easy to use. Its primary purpose is to share and repost photos, while including some social functions such as critiquing, resharing, favouriting, and exploring.

The platform utilises blockchain from the creation of the license of the photo, to tracking its usage, ensuring compliance with licensing terms and guaranteeing transparency and decentralization with lower transaction fees. According to their website, "Everything from media registration to copyright dispute handling is decentralized, allowing anyone to integrate existing or new services and platforms with the blockchain. By using a lattice of blockchains together with proof of stake, the network can operate without mining and constantly low transaction fees."

The platform thus connects content creators with consumers in an open, decentralised way, with no royalties or feed for licensing transactions. Transparency is also ensured by easily accessible signatures regarding copyright that are stored on blockchain, which allow anyone to view and use licensing information. In case of disputes regarding the ownership of a photo, YouPic support a decentralised jury composed of people and AI work who work together.

Sources:
[Phililips, 2018.](#)
[Billing, 2018](#)

[Maiorca, 2021](#)
[Sam, 2021](#)
[YouPic, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union



Estonia – the world’s most digital country, secured by Blockchain

OTHER
SECTORS

EUROPEAN
UNION

COUNTRY: ESTONIA

SECTOR: GOVERNMENT & PUBLIC SPHERE

Innovation: Estonia was the first country in the world to use Blockchain in production systems and has become more digitalized country in the world. The extent to which Blockchain and digital technologies in general are used in the country are both innovative and inspirational.

Blockchain use: Blockchain is used to secure data from national registries in the country, enforcing the integrity of government data and systems.

Since 1997, Estonia has highly invested in digital technologies provide public services online, creating the e-Governance. The goal was to deliver services better and faster, improving outcomes and reducing costs. Today, 99% of public services are available to citizens as e-services.

The country has started using blockchain back in 2008 and was the first Nation-State in the world to use blockchain technology in production systems in 2012 with the Succession Registry kept by the Ministry of Justice. The technology used in Estonia is KSI Blockchain, also used by NATO and the U.S. Department of Defence. The technology today backs several e-services in Estonia, such as the e-Health Record, e-Prescription database, e-Law and e-Court systems, e-Police data, e-Banking , e-Business Register and e-Land Registry. For instance, in the health system, the e-Health Record uses an electronic ID-card system based on blockchain technology to ensure data integrity and mitigate internal threats to the data. This allows misuse of data to be detected and to prevent major damages to a person’s health.

Estonia has also developed expertise in the cybersecurity infrastructure. While data breaches are discovered in an average of seven months, KSI Blockchain can detect them instantly.

On KSI, data never leaves the system, and only hash is sent to blockchain service. No data is stored on the KSI Blockchain, which can provide immutability for the data. Finally, it protects data with a “digital defence dust” that allows the system to easily identify changes in the data based on the tracks left in the pattern of the defence dust.

Sources:

PWC, 2019

E-Estonia, n.d.



Co-funded by the
Erasmus+ Programme
of the European Union





OTHER
SECTORS

EUROPEAN
UNION

Flype – Innovating in decentralised delivery of parcels by individuals

COUNTRY: SWEDEN

SECTOR: SUPPLY CHAIN & LOGISTICS

Innovation: Flype addresses the problem of international delivery by using blockchain technology and exploring peer-to-peer interactions to eliminate logistics and unnecessary costs and promote cheaper deliveries. This is secured by blockchain based smart contracts in order to overcome the lack of trust towards unknown individuals. Flype further provides decentralized peer-to-peer insurance, offering immediate compensation, and real time tracking.

Blockchain use: The technology is used to base smart contracts that create trust among the individuals involved in the international delivery. Through it, real-time tracking and peer-to-peer insurance is provided.

The start-up Flype explores the concept of sharing economy to promote a decentralized delivery of parcels by individuals based on blockchain technology. Its promise is to provide a “seamless, low cost, same-next day delivery”.

Flype utilizes a peer-to-peer structure for a marketplace which connects people who want to send packages internationally with travellers, who can use the platform to sell and perform deliveries to where they are travelling to. Anyone can thus perform an international delivery and earn money through it. The idea is that packages are picked up from their senders, and accurate and on-time deliveries are guaranteed thanks to their route optimization algorithm. With the goal of providing a delivery platform with zero logistics while being faster, cheaper, and more environmentally friendly.

Flype won the Top Idea Award at the 2018 Venture Cup in Sweden, a prestigious award to start-up companies in the country. It has already tested a prototype service with successful feedback.

Sources:

[Flype, n.d.](#)

[Alexis, 2019](#)

[Touza, n.d.](#)



Co-funded by the
Erasmus+ Programme
of the European Union





OTHER
SECTORS

EUROPEAN
UNION

COUNTRY: CROATIA

**SECTOR: PRIVATE & PUBLIC
SECTOR (DIFFERENT
FIELDS/USERS)**

Innovation: COTRUGLI BaaS is based on HashNET which is an innovative blockchain based infrastructure for new business models, products, and services. It can be used by blockchain based organization, but also conventional businesses and public services on their way to digital transformation. Blockchain as a Service (BaaS) is a type of blockchain service that allows customers to use COTRUGLI Blockchain Infrastructure to develop, host, and adopt their own blockchain applications, smart contracts, and other relevant functions on the blockchain while the service provider manages all the required tasks and activities to keep the infrastructure running.

Blockchain use: It deploys essential resources and leverages the required technology and infrastructure to set up and maintain Blockchain connected nodes on behalf of the customer.

COTRUGLI Blockchain as a Service (BaaS)

COTRUGLI Blockchain as a Service (BaaS) is a service (under COTRUGLI Business School) that is offering organizations/institutions help to create its competitive advantage on a market through blockchain technology. COTRUGLI BaaS is a fully managed blockchain service that enables users to grow and operate blockchain networks with simplified network formation, management, and governance. This service eliminates the burden of building, managing, and growing the network so users can focus on things that are important to them.

Benefits of this service are: cost savings, easy to use, focus on customization, staff & resource optimization. Users (industries) of BaaS include for instance supply chain & logistics, government, and oil & gas industry.

COTRUGLI Business School also have “Blockchain Based Diploma Verification System”, i.e. blockchain based platform for diploma verification that is secure, fast, and scalable by using blockchain technology to provide end-to-end system security. This system generates QR codes for easy check of digital certificates. It works in a way that person upload a document (diploma), confirm the upload, and click on “Add to blockchain” button which is going to deploy the document’s digital signature to the smart contract. After (successful) deployment, there is a “Success notification” of the transaction by which person can locate the certificate and make a transaction on the blockchain. Final step is verification of the document and upload of the diploma so it can be validated.

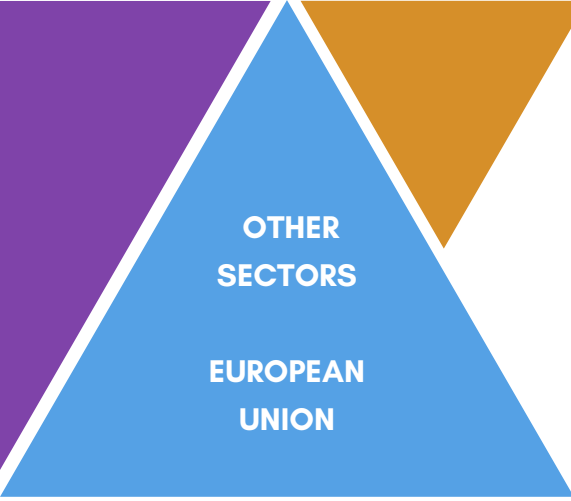
Sources: <https://cotrugli.tech/>;

Mr Tadej Slapnik, COTRUGLI Business School’
lecturer, CEO of Tolar HashNET, Principal at
European Blockchain Hub



Co-funded by the
Erasmus+ Programme
of the European Union





Port of Antwerp

COUNTRY: BELGIUM

**SECTOR:
TRANSPORTATION**

Innovation: This experience modernises a process that has been applied for decades. Instead of paper certificates, the trial aims to issue Blockchain certificates. This way, the importation process decreases bureaucracy for all stakeholders from importers, authorities and ultimately the customers.

Blockchain use: The project applies Ethereum Blockchain because this software is reliable and widely used (Aussems, 2017). The authorities in the country of origin of the products publish the certificate of origin and phytosanitary certificates on Blockchain. The receiving authorities can easily verify the information because of the safety of the technology.

The port of Antwerp and T-mining started a trial-based project using Blockchain for multiple purposes in handling freight in Antwerp's port.

First, the port of Antwerp has initiated a project testing the use of Blockchain to authenticate certificates of entry to the port of ships carrying fruits and vegetables. The use of Blockchain automates and digitalises the flow of certificates of origin and phytosanitary certificates. This guarantees the safety of fruit and vegetables to the forwarding partner (Port Technology, 2018).

Previously certificates were sent by courier which was very costly and poses a large bureaucratic burden. Because Blockchain technology is secure and impossible to tamper with, the process of import can be handled more quickly by the authorities. Furthermore, the technology guarantees the global authenticity of the certificate.

Second, the port of Antwerp started a trial related to the security of the imported containers on the port premises. Instead of providing all truckers with a standard code to pick up containers from the port, T-mining introduced a Blockchain secured system with specific entry codes. Lengthy customs processes and bureaucracy will be decreased. Finally, the use of Blockchain for entry to the port premises makes the process less vulnerable to security risks and corruption (Sluijs, 2017).

Both trials are based on automatisisation and security transforming the sector into a more efficient and secure environment.

Sources: [Aussems, M. \(2017\)](#)

[Port Technology. \(2018\)](#)

[Sluijs, C. \(2017\)](#)



Co-funded by the
Erasmus+ Programme
of the European Union





1506
UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO



BLOCKCHAIN IN PRACTICE

Other Sectors

-

International





OTHER SECTORS

INTERNATIONAL

COUNTRY: SWITZERLAND

**SECTOR: IT CONSULTANT
AND RESEARCH
INSTITUTION**

Innovation: The case study is innovative because it tries to detach itself from traditional blockchain platforms (e.g., Ethereum and/or Bitcoin) while maintaining all the positive characteristics of a fully-public blockchain. This can help to reduce the costs (and maintaining it stable and away from the financial market fluctuations) of using Blockchain during the certification of educational credentials.

Quadrans Foundation

Quadrans Foundation is a company that developed the Quadrans blockchain platform. The aim of such company is to deploy resources to entities and initiatives that can help to ensure their long-term success. The main resource that they provide is their Blockchain platform, which could be employed for various aims.

Quadrans Foundation's main goal is to build a global, open, inclusive, public, decentralized and independent infrastructure. Thanks to their seven years (as of 2022) of research and development, Quadrans Foundation is in the position to support projects to empower the community and to develop open ecosystems.

Among the activities they carry out to achieve their goals there are: i) research support; ii) Blockchain education in schools around the world.

Blockchain use: The project built its-own Blockchain that improves the structure and performance of businesses, institutions and public organizations. Quadrans infrastructure runs on two elements designed to serve as utilities - Quadrans Coin and Quadrans Token.

The creation of new smart contracts requires the use of Tokens and Coins. The amount varies according to the storage capacity and computing power required to execute them. Quadrans protocol is designed to encourage an ethical and efficient use of the system.

Sources:

<https://www.quadrans.io/>



Co-funded by the
Erasmus+ Programme
of the European Union





OTHER SECTORS

INTERNATIONAL

COUNTRY: UNITED KINGDOM

SECTOR: SUPPLY CHAIN/ LOGISTIC MANAGEMENT

Innovation: The case study is innovative because it was one of the first projects that employed BC technology in the supply chain and logistic sector, improving the quality of such sectors and making them more trustworthy and secure.

Blockchain use: Chainvine utilizes Blockchain in two distinct ways:

- i) Blockchain is employed to track the events that are related to the transport of goods across different countries, securing that each step is transparent, safe and trustworthy.
- ii) Blockchain is also employed to construct smart contracts that could track a company's operations.

CHAINVINE

Chainvine is a digital platform that manages supply chain data across different industries in a high secure manner. They allow suppliers to track their orders across borders and improve the trustworthiness of their business. They also support clients to set up and manage smart contract infrastructures in order to automatize and make every passage of a company's operations transparent and compliant to norms and regulations. This reduces the cost of trust for the company.

Chainvine was born from an idea by Oliver Oram in 2015, who thought about the idea behind the company after reading an article about a wine fraudster that managed to exploit the poor situation of the global supply chain infrastructure. The solution proposed by Oliver was to use Blockchain technology to track all movements related to supply chain, thus inhibiting the possibility of falsifying data and, in turn, to fraud the different stakeholders in the supply chain. The two years that followed, the idea behind Chainvine was tested and the platform on which it was based was refined. In 2018 Chainvine secured its first major investment. At the current moment, Chainvine is expanding its market and aims to scale the project through trial demos.

Sources:

<https://chainvine.com/>



Co-funded by the
Erasmus+ Programme
of the European Union





OTHER
SECTORS

INTERNATIONAL

COUNTRY: BRAZIL

**SECTOR: LAND
REGISTRATION**

Innovation: Serpro is the first company trying to collaborate with Brazil's governmental entities in order to solve a problem that has deep social and environmental consequences:

Fraud in land property registration enables companies to easily access the fertile Amazon Forest to destroy it and plant monocultures or extract natural resources, removing the right of autochthonous people to own and care for the land they live in while destroying natural habitats.

Blockchain use: This case study uses Blockchain technology to create, validate and recognise land property in Brazil in a way that is trustable and practically unhackable.

Serpro

Serpro, based in Brazilia, is the largest Information Technology company providing services for the public and private sectors in the world.

In January 2018, Serpro launched a blockchain platform that regulates land titles. Currently, there is no centralized management of land purchasing in Brazil, leaving in charge over 3,400 private agencies to negotiate land titles across the large nation. Reuters estimates there are over 5 million landless families in Brazil, half of the country's population lack land property rights, and in the Para state, there is four times more land registered than land that exists.

The system is confusing and widely abused, experts say, with double allocations and corruption in the maintenance of records and transfer of title deeds fuelling land conflicts.

Blockchain technology could provide a solution to this fraud and corruption problem by developing land titles in a trustable, verifiable and transparent system that does not allow double allocations and enables people to own their land titles.

Concluding Remarks

The case studies presented in this chapter are relevant to the learning journey initiated by the OBEC project and serve both to illustrate initiatives that are currently in place to utilise BC through a diversity of approaches, as well as to inspire developments in this regard.

The OBEC case studies collect 21 different applications of Blockchain technology, 12 of which are in the educational sector, from universities to private companies that started developing alternatives to issue and verify credentials. Firstly, it is worth mentioning the case study that served as inspiration to the OBEC project concept: the MIT Media Lab utilization of Blockcerts to creatively develop a system based on Blockchain technology that enables institutions and, potentially, other entities or organisations to issue diplomas and certificates to students, who then become the owners of their education at no cost. In addition to it, some of the other collected case studies, such as ECTA and DISCIPLINA, go beyond the focus on the document to offer students the opportunity of creating a profile where their learning trajectories can be stored and easily shared and verified. Other examples presented here, are particularly relevant for institutions to create and issue diplomas and other documents to students, such as TRUE, which offers students the option of adding their certification to their LinkedIn profile.

These are innovative examples of how blockchain can be used to facilitate the process of issuing, receiving, and sharing educational credentials in a transparent and trusted manner while giving the recipients ownership over their information and certifications.

In short, the experiences of the OBEC project and the testimonies collected from the participants of the activities showed that the achievement of such a system at large scale would particularly benefit immigrants, exchange students, and individuals with alternative learning backgrounds. This is true not only because their competences and skills would be easily available for verification, but also because it would enable the recognition of learning experiences that are currently not easily recognized either for having been acquired in a different country or through non-formal/informal institutions. This conclusion further corroborates the need for the development of initiatives such as the ones illustrated by the OBEC case studies in a cross-border, transnational, and further-reaching manner.

The OBEC case studies further demonstrate opportunities for the utilization of blockchain in different sectors for the purpose of facilitating transparent, trusted, and secure transactions. These include its utilization in the supply chain, in land registry, and to secure copyrights. Moreover, the identification of initiatives around the use of Blockchain could not be complete without mentioning the example of Estonia, a country that has deeply explored Blockchain as a technology that can guarantee trust and safety to data in several areas of the public sphere. This experience can be extended to other countries to entrust the same principles of immutability, trust, and safety to citizens' information.

The OBEC case studies thus provide a selection of examples to inspire further developments in the use of blockchain that can benefit, among others, bureaucratic processes, individual security, and transparency of information to avoid issues such as green washing and misinformation.

Chapter 5 – The Individual Level Perspective

In this chapter, some of the experiences of participants of the trial phase of the OBEC project training material will be outlined. The goal of this effort is to understand the educational and professional history of the participants and to examine how the lack of recognition of professional and training experiences gained in foreign countries can negatively affect the life path of a migrant person who is trying to build a new life in a new country.

The stories presented below speak of lives dedicated to sacrifice and study to learn a skilled work. The people who shared their stories hold real, useful skills that are not valued, due to outdated regulations and bureaucratic impediments when moving abroad.

In Italy and in Europe in general, the demand for skilled workers is growing and at the same time the number of migrants with useful training and professional experiences is also considerable.

To foster a positive evolution of our society it is therefore necessary to enhance the skills of each person to not only integrate all people in economic activities, but also to strengthen the economy of our countries, which will increasingly need migrants to support their economic and social growth.

Lai-momo cooperative organised an introductory tailoring course for foreign women living in Bologna, Italy. Some of the students were interviewed by the staff and declared that they suffered daily the negative effects of the lack of a common system for the recognition of study certificates and skills.

Leila, Iran

After her transfer to Italy, her professional qualification was not recognized.

In Iran she graduated from the university of languages, specializing as an interpreter and translator of the English language. Then she started working as a translator for events and conferences and as a high school English teacher.

Five years after her arrival in Italy, she has still not managed to validate her qualification and for this reason she has decided to restart studying from the first year of university.

It will be a very difficult path psychologically and physically, as by now she must devote most of her time to her family and to looking for a job.

Alexandra, Chile

Alexandra, a woman from Chile, holds a degree in dental medicine in her home country.

After coming to Italy for love, she realized that she could not work as a dentist in her new country. Nevertheless, she decided to stay close to her children born in Italy and her Italian husband.

She is currently working part time as an administrative at the University Dental Clinic of Bologna.

It is difficult, after having studied and worked for many years in Chile as a specialized professional, to think of having to start everything from scratch in Italy. Due to the lack of recognition of her education, she has had to adapt to another type of job, leaving aside the work that fascinates her and for which she studied throughout her youth.

Warin, Thailand

Warin comes from Thailand and has graduated in her country from the University of Economics, with the specialisation "business and economics", which included lessons in English.

In Italy her degree is not valid and for this reason companies are not considering her applications for job positions that include a degree in economics. Therefore, for the moment her curriculum only includes a high school diploma obtained in Italy.

In the future she would like to continue her studies to look for a job in the economic field, but meanwhile she would like to work as a seamstress for some company in the area.

Chapter 6 – Main Lessons from OBEC’s Trial Phase

6.1. Overview of the options for platforms based on Blockchain technology and selection process

There are three known platforms that use Blockchain technology for issuing educational credentials, namely ECTA, EBSI Diploma and Cotrugli Diploma. They all have some similarities, but they also differ significantly in the level of functionalities.

ECTA is a platform for standardization and simplified issuance of competencies that can be used in different ways for different levels of integration. The main upfront time investment for the institution is a possibility to translate all their available courses into an ECTA friendly format that is compliant with ESCO classification. This greatly improves educational institution’s time spent confirming students later. On the other hand, students or alumni can, from their account on the platform, find their educational institution and request them to provide their student ID, information about duration of studies, completed program, etc. Based on the study programs the students will have the appropriate competency tokens minted and the institution will keep a link to the alumni, which will provide them with valuable insight. ECTA can embed various competencies or references (certificates, education, grades, work history, projects, experience) into Blockchain, which means that competences will be transparent, credible, immutable, and non-fungible. A minted competency is an NFT token (non-fungible token), which offers the holder digital rights of ownership and credibility.

EBSI Diplomas, like ECTA, supports requesting a credential for a given digital identity, as well as authentication of public entities via digital signature. It also supports storing the credentials privately using a self-sovereign wallet and it records the transaction of presentation on the distributed ledger. The main aim is to encourage the use of academic certificate records in European Union to provide transparency and trust between schools/universities, students, and employers. The use case leverages digital identity, distributed ledger, and mechanism for digital verifiable credentials/presentations. The Diploma use case contribute to the student mobility and international cooperation in EU member states. Its main benefits include elimination of fraudsters, facilitation of students’ mobility and increase of employers’ trust.

Cotrugli Diploma Verification System is another example of a Blockchain-based Diploma verification system. Its main characteristics are security, speed, and scalability of Blockchain-based diploma verification. End-to-end system security is achieved by using power of Blockchain. One additional functionality, that other two platforms don’t have is a possibility to generate QR codes for easy checking of digital certificates. This QR code is placed on a physical version of diploma, which enables finding more information about issued diploma. One of the main benefits of this platform is also to disable frauds and to increase employers’ trust.

To conclude, there are three different platforms that utilize Blockchain technology to issue educational credentials. All three platforms enable users to deploy educational certificates or diplomas on Blockchain network, where they can request, issue, store and access them. ECTA platform additionally enables users to issue, share and access their competencies to access ECTA’s competency registry and incentivize users for learning and gaining their competencies through tokenization. All platforms have clear benefits based on Blockchain, but among three

of them ECTA platform stands out regarding the range of possibilities it offers. Compared to EBSI Diploma and Cotrugli Diploma, ECTA offers issuing, sharing and accessing of competences, as well as competency registry and incentivizing learning with tokenization. This is added to standard features of all three platforms which include deploying educational certificates and diplomas on Blockchain networks, as well as possibility to request, issue, store, and access diploma/educational certificate.

In this context Cotrugli Diploma is a narrowly specialized platform tied exclusively to Cotrugli business school and its educational program, without the ability to support student mobility through profiles of different educational institutions. That leaves the choice between ECTA and EBSI Diploma.

The EBSI Diplomas use case encourages the use of academic certificate records in European Union to provide transparency and trust between schools/universities, students, and employers. The use case leverage digital identity, distributed ledger, and mechanism for digital verifiable credentials/presentations. The Diploma use case contribute to the student mobility and international cooperation in EU member states. However, the main advantage of ECTA versus EBSI Diplomas is seen in possibility that ECTA has an option to issue, share and access competencies. That way listed programs of educational institutions are accompanied with belonging competencies, which makes recognizing diplomas and certifications much easier, giving a better insight into the knowledge that a student has gained.

6.2. Brief analysis of the suitability of the tool and system utilizing BC technology on a broader context and on the long-term

The suitability of the ECTA system is evident in the time it saves for the institution to confirm credentials of its students. The main upfront time invested is evident in the translation of all available courses of the educational institution in ECTA friendly format. This greatly reduces time needed for confirmation of students later. The first step is to create a list of programs they offer, as well as appropriate competencies tied. At the very beginning, the institution has the choice to copy the main ECTA platform competency definitions into its system or to define them from scratch. When the competencies and programs are imported and linked, the rest may easily follow.

This functionality for timesaving is further emphasized with the option to automatize the entire process of verification, which can be achieved with help of institutions' own database of its students and their merits. There is another clear benefit in this process, as that way there is no need for any 3rd party actors and it also a way to remove unnecessary bureaucracy from the education system.

From students' perspective, the platform is well suited for their needs for credentials confirmation. They can, from their freelancer account on the platform, find their institution and ask them to provide their student ID, duration of studies, completed program, etc. Students will further collect in their profiles the competencies that are connected to their completed education. This way, students can easily demonstrate the competencies/skills they hold and the means through which they have been acquired.

All this is made available through Blockchain technology, which makes competencies transparent, credible, immutable, and non-fungible – a minted competency is an NFT token (no n-fungible token), which offers the holder digital rights of ownership and credibility. This brings authenticity, decentralized trust, less bureaucracy, direct interaction and, above all – security into issuing process of the educational credentials.

On a broader context, this solution based on Blockchain technology enables solving of problem of verification of students from vulnerable groups i.e., expats from countries from which educational certificates are not easily recognized by the NARIC. Other example of a broader suitability is a possibility for educational institutions to have ability to keep track of their alumni after they leave their institution and join a workforce. One of the main goals of an educational institution is to provide their pupils with skills and competencies that will allow them to find a job after they leave their institution; ECTA offers a valuable insight into market trends, and this can in turn help them align the curriculum with the needs of the industry. All this will be possible because of the credibility and transparency that Blockchain enables.

Credibility, transparency, and security also bring a possibility to use this Blockchain-based platform long-term, as more and more people will be aware of its benefits.

6.3. Main lessons from the trial phase and recommendations

The trial phase was organized by all partners and their experiences are outlined below.

6.3.1. EURADA – Belgium

In Belgium, two modules were organized on the platform Zoom. The Erasmus+ team opted for remote teaching, due to the COVID-19 measures, including social distancing, still being in place when the course was organized. The first module “Create your Business Idea and Plan” (M1) took place between 8 and 10 March 2022. The second module (M2) took place between 15 and 17 March 2022. A total of 57 learners applied for the courses. The course “Creating your Business Plan” attracted 42 registrations. The course “Working in a Circular Economy Context” had 45 registrations. A total of 11 trainers were involved in both courses overall. Most of them expressed their satisfaction with the course. Multiple trainers expressed interest in participating in future courses. The interviewed trainers were rather intrigued by the use of Blockchain technology to issue and store the educational credentials tied to the courses. Some of the trainers, however, also expressed their ambiguity about the topic. They mentioned finding it difficult to comprehend the technology and its use. Questionnaire entries indicate that most participants’ expectations have been met, namely, a percentage of 77.8. Another 11.1% mentioned that most of their expectations have been achieved and 1 person stated that their expectations have been partly met. The course materials were perceived as positive. A hundred per cent of respondents stated to have learned new information during the training courses. Most participants praised the all-around approach to the topics together with the interactive nature of the course.

6.3.2. SIMORA – Croatia

The testing phase was organized in Novska, in the Business incubator and DIH PISMO, owned by SIMORA. Testing was conducted in person from January 17th until January 28th, 2022. The trial phase included testing of: Program Blender (graphics in gaming) - 10 days, 8 hours per day, Program Unity (programming in gaming) – 10 days, 8 hours per day. There were 35

participants in the trial phase. The number of participants (learners) in Blender was 18. The number of participants (learners) in Unity was 17. Two trainers participated in the trial phase. For Unity, the trainer believes that participants do not have initial knowledge of Unity, but initial knowledge of gaming. The trainer believes that all participants will successfully complete the training and that they will further create interest in Unity. For Blender, the trainer believes that students have no prior knowledge because this education is designed to teach students new knowledge. The trainer believes that students will successfully complete this training and that students are very motivated since they chose this training themselves. Through post-evaluation questionnaires, participants in both trainings said that in the future they would like Unity training and Blender training to be connected in a way to create cooperation between participants, i.e., to create some joint activities in programming and video games. If that happened, the participants pointed out that they would be very pleased to extend the duration of both trainings so that they could gain as much new knowledge and skills as possible. As for the ECTA platform, a small number of participants said that they need a little more time to learn how to make optimal use of the ECTA platform.

6.3.3. Lai-momo – Italy

Lai-momo organised a basic tailoring course in Bologna, Italy. The lessons lasted a total of 30 hours from 21.02.22 to 04.03.22. The course's goal was to teach how to use the electric sewing machine to carry out activities traditionally required by companies that work in this field. The course was organized and held by a teacher specialized in this field and with many years of experience in teaching Italian for foreigners. The lessons were in fact attended by 11 foreign women living in Bologna. In the teacher's opinion each student was well motivated and attended the lesson with interest and attention. They were interested not only in the course content but also in the objective of the project. All the trainees said that they had learnt new skills and that their expectations for the course have been achieved. Five of them suggested to implement a further class to teach advanced skills. Eight trainees said to be "very satisfied" of the format of the course, of the trainer's ability to transfer information and of the trainer's ability to implement the course, while three of them answered to be "satisfied". Seven trainees said to be neutral about the assessment format of course, while four of them declared to be satisfied.

6.3.4. UNIURB – Italy

The University of Urbino implemented the training through three distinct modules, each focused on different but related topics. The three modules were: 1) Ethical and Moral Issues of Artificial Intelligence; 2) Logic and 3) Critical Thinking. The module on Ethics and Moral Issues of Artificial Intelligence lasted 18 hours and it was delivered in a mixed format (in-person lectures that were streamed on Zoom). The module was entirely taught in Italian and contained numerous moments of discussion between the students. The module on Logic and Critical Thinking lasted 36 hours and it was delivered in a mixed format (in person lectures that were streamed on Zoom). Due to the high demand from the students, the same module was also delivered a second time. The module was entirely taught in Italian and was mainly structured through frontal lectures. Different lecturers were involved in the teaching, to explore different teaching methodologies and approaches to evaluation procedures. The modules had a total of 50 unique students. Both lecturers and students understood the importance of the ECTA platform and found it easy to navigate. The lecturers thought it was

easy to explain to the students how to ask for the certification of their competences through the ECTA platform. It was recognized that Blockchain technologies are extremely useful in providing secure and trustworthy grounds for the certification of competences. One of the identified challenges was that the ECTA platform does not include competence taxonomies that are in use in other European projects, which made it hard to align standard indicators used for the modules (Dublin Descriptors) with the Bloom's taxonomy employed on the platform. Additionally, the learners expressed some doubts on whether they would be able to successfully complete the procedures on ECTA without the tutorial provided by the lecturers. Some also expressed some doubts on the fact that private companies might not trust the certification delivered by the ECTA platform since it is still not well known. Lastly, some concerns were raised in terms of the energy footprint of employing Blockchain technologies and also on the potential financial burdens that might arise.

6.3.5. SwIdeas – Sweden

In Sweden, four modules were initially developed. The modules covered the following topics and had the duration as follows: M1: Working in a Circular Economy Context: Upskilling your Business and your CV – 12 hours, M2: Soft Skills for Responsible Entrepreneurial Mindset – 7 hours, M3: How to start a business in Sweden – 3 hours, M4: How to build a business plan – 3 hours. These modules were organized in 8 different sessions of around 3 to 3.5 hours each and carried out online between the 25th of January and 16th of February 2022. Four trainers participated in the OBEC training in Sweden. 102 people signed up for at least one of the OBEC sessions in Sweden and 47 people joined at least one session. The testing phase in Sweden was successful. The minimum duration of 24 hours of training and of 10 participants were met and exceeded. The learners were engaged and mostly actively participated in all sessions. The interactive activities that were included in the sessions were highly appreciated. The trainers felt that their expectations were met both regarding what they would like to transmit to the learners through the sessions, and the extent of participation and engagement from the learners. However, the rate of participants who have signed up to receive a certification through ECTA was considerably low, which demonstrates that further information about the benefits of Blockchain and perhaps a specific training is needed.

Concluding Remarks

In the long-term, there are some opportunities that ECTA can offer based on its functionalities and features.

Firstly, an option for incentivised learning can be implemented as new teaching techniques. In other words, educational institutions can import their whole curriculum and gamify certain aspects to boost student participation, achievements and incentivise learning. Additionally, tokenisation has become a part of the Blockchain and with ECTA, EDUs will be able to incentivise students for knowledge production since ECTA can also be construed and used as a knowledge-sharing platform based on Ethereum smart contracts. As on a social media site, book readers, students and authors can gather to discuss a novel or other writing. The big difference is they're awarded Tokens/badges/NFTs — in other words, incentivized — for engaging with content through sharing, discussing, and writing. The tokens can then be used to buy academically relevant things such as eBooks, Journals, and subscriptions. EDUs can also issue participation certificates that serve as a permanent score report/competencies, which can help participants with future educational or professional applications.

Secondly, there are also various issues that arise between students and teachers that could be mitigated with the use of the blockchain: Blockchain's immutable ledger technology creates a timestamped list of the events that have transpired in real-time. This is helpful with verifying students' transcripts, showing a complete report card and keeping the students honest about their progress. Having a student submit their homework via blockchain ensures that they cannot "lose" their homework or claim the teacher lost it. Teachers and administration can engage in smart contracts with students, i.e., a digital agreement that stipulates an assignment or test parameters, due date, and grading deadline.

Finally, what is all the more important is that EDU institutions can create an immutable document that include a log of service hours and students' personal reflections on their learning experience to give future universities and employers a holistic look at a student's academic and personal journey - basically in addition to grades and competencies, students can get a more complete digital certificate from their EDU, that can finally include all the other non-quantifiable aspects of education - validation and verification of formal and non-formal accomplishments. With all this student-centric approach and benefits, their standing among their competition will surely improve by joining ECTA, and their status of being the desirable University for future oriented students as well.

As there are clear options to fully utilize ECTA's possibilities and fully engage its potential to become relevant educational tool, there are also certain challenges. One of the main challenges is to "convince" educational institutions, students, and other users of ECTA's main benefits to start using it. If the platform manages to gain a reasonable number of users in its early stage of existence, then it will be easy to attract more users. In this context, it is crucial to show and elaborate all the advantages of Blockchain as there is a lot of confusion on what that technology exactly is.

One of the possible challenges also include rapid changes in technology, which the platform must be immune to. But since Blockchain is still in its early stage of development and utilisation, this does not seem like something that can have a great impact on the ECTA.

Chapter 7 – Advice from Experts

Introduction

In order to gain some insights into the technical and social aspects of the OBEC project, various experts from different disciplines and backgrounds have been interviewed and contacted throughout the project.

Particularly, nine experts have participated in interviews for the purpose of gathering their opinions and suggestions to improve the OBEC project and to point out possible pathways for the future of the use of Blockchain technology in the educational sector. Of those experts, one has a background in history and ethics of technology³⁰, three are involved into business applications of Blockchain technology³¹; and five are involved into technology applications in higher education³². Furthermore, reflections were shared from six³³ experts participating in the project's final event hosted by EURADA in Brussels, Belgium.

According to their expertise, those experts were asked to provide their insights on two major aspects related to Blockchain technologies and the OBEC project in general. Those aspects were selected due to their problematic nature and were identified through the analysis carried over during IO1. Such aspects are:

- 1) The technical difficulties related to the application of Blockchain technologies.
- 2) The perception related to Blockchain technologies (in particular the social perception of such technologies).

This report contains a summary of the recommendations provided by such experts.

Technical insights

Three technical issues were identified during IO1 concerning the technical difficulties in applying Blockchain technologies to the recognition and certification of skills/competences:

1. **Scalability issues:** some interviewees were not sure whether it was possible to evaluate and certify different skills/competences, therefore causing problems in case the use of Open Badges (with an underlying Blockchain base) was extended to all potential courses in an educational institution. Moreover, they expressed doubt about the inter-recognisability of those certified skills since different

³⁰ Stephanie Dick: <https://www.sas.upenn.edu/~sadick/>

³¹ Sebastien Pirlet: <https://www.linkedin.com/in/sebastienpirlet/> ; Tadej Slapnik: <https://si.linkedin.com/in/tadej-slapnik-59683747> ; Davide Costa: https://it.linkedin.com/in/davide--costa?trk=public_profile_browsemap .

³² Alessandro Aldini: <https://www.uniurb.it/persona/alessandro-aldini> ; Leonardo Vescovo: <https://it.linkedin.com/in/leonardo-vescovo-pdc> ; Maurizio Casiraghi: <https://www.unimib.it/maurizio-casiraghi> ; Paolo Cherubini: <https://www.unimib.it/paolo-cherubini>; Juho Lindman: <https://www.gu.se/en/about/find-staff/juholindman>

³³ Pierre Marro (Senior Officer, DG CNECT); Gabriele Marzano (Senior Executive, Regione Emilia Romagna); Tim Miller (Co-Founder & CEO, Certif-ID); Stefano Tirati (Vicepresident, EFVET); Alen Lipus (ECTA developer, Quama); Alessandro Aldini (Associate Professor, University of Urbino)

educational institutions might consider different teaching activities as relevant for the development of the skill/competence.

2. **Cost & Sustainability issues:** the cost of Blockchain infrastructures can be divided between development and maintenance costs. Although the development cost could be high, the maintenance is believed by experts not to require a high investment, which could also be reduced by the fact that the European Union has already been investing money in this. Some interviewees however expressed doubts about the possibility of sustaining the use of Blockchain technologies for large instances of their activities. This was mostly due to the huge financial fluctuations tied to cryptocurrencies, which would impact the possibility of certifying all the skills/competences of individuals without placing a financial burden on the institutions and/or the individuals themselves. This issue could also be exacerbated by the fact that Blockchain technologies do not allow their users to correct wrong information that was added to the chain. This would mean that if the administrative offices of such institutions committed a mistake, in order to correct such mistake, the institution would incur in further costs to upload the correct information. It is noteworthy that the cost of the use of Blockchain depends on how you use it and which kind of Blockchain is used.
3. **Privacy issues:** some interviewees had concerns about the fact that personal information would be stored along with the competences/skills certified in digital setting, where such information would be accessible by different parties without the consent of the individuals themselves.
4. **Trust:** Experts agreed that there is the concern about creating trust among the stakeholders/parties who will be involved in the process of issuing and verifying the credentials.

Perceptual Insights

Two perception issues were identified during IO1 concerning the difficulties in applying Blockchain technologies to the recognition and certification of skills/competences:

1. **Ties to cryptocurrencies and finance:** it was noticed during IO1 that the public draws a strict connection between Blockchain technologies and cryptocurrencies. This was considered problematic because individuals tend to transfer the bad reputation of cryptocurrencies and their financial nature to the Blockchain technologies themselves. Environmental concerns were also raised regarding the energy use associated to the use of blockchain technology.
2. **Legal & Usefulness issues:** it was noticed during IO1 that the public was doubtful about the legal regulation connected to the use of Blockchain technologies and about the real usefulness of such technologies in the first place. Importantly, there is currently a lack of regulation which feeds resistance in relation to its use. It has also been noted that one of the challenges to use blockchain technology is that there are other technologies available and, faced with resistance related to the perception issues (the environmental aspect and the association with Bitcoin), there might still be a preference to use other technologies rather than blockchain. Experts further agree that the legal framework poses bigger challenges when compared to the

technological challenges. This represents an obstacle against which the European Commission has a pivotal role to play in pushing forward legislation and regulatory tools that would ensure security in the use of the technology – for instance, establishing how/under which circumstances to use a smart contract.

Recommendations

As a potential solution to technical problem, a few recommendations were identified:

RECOMMENDATION 1: the experts' opinion was that skills/competences could be certified by specifying the activities that were carried out to obtain the skills/competences. In this case, what would be certified is not the skill/competence per se, but the activity completed by the individuals to gain the skill/competence. This would also help companies to discriminate between skills/competences obtained in an educational setting from those obtained through practice on the job market. Moreover, the experts' suggested to dedicate some studies to the various skills/competences to gain insights into the feasibility of having good evaluation techniques connected to those skills/competences. On this matter, the OBEC project already partially fulfilled this kind of study and analysis through the training phase of IO2. However, the partnership believes that more studies must be done in order to get a clear picture on the matter. Another input shared by the experts is that blockchain represents a good solution to establish trust and support interoperability. However, it does not present a solution to every issue. For this reason, perhaps other technologies can be combined to overcome the issue of establishing evaluation methods to skills/competences.

RECOMMENDATION 2: the experts' opinion was that in order to combat the costs and thus allow Blockchain-based applications to be sustainable, five potential options are available.

1. **Option 1:** evaluating institutions might keep their current operating systems and do a parallel deployment of Blockchain structures to issue to students the verifiable credentials. This would likely be a less costly option which would also be an opportunity to test the operability of these systems. This could also be a chance to test the cost-saving opportunities of the system, or this could maybe provide some revenue, for instance for providing easier recruitment in the long term.
2. **Option 2:** evaluating institutions might choose to employ Blockchain infrastructures only partially for the registration of the profiles. This would mean that, for example, a university would employ its internal databases to stock the information regarding one of its students; then, once the student decides to move outside the University, a digital badge would be created and uploaded into a Blockchain to certify all the competences and skills that the student developed throughout his/her studying experience. This solution would mean that the University would only need to incur into the costs of employing the Blockchain infrastructure fewer times and would also decrease the likelihood of uploading incorrect information that has to be corrected.
3. **Option 3:** evaluating institutions might employ supranational Blockchain infrastructures (e.g., a European-based Blockchain infrastructure). In this case, the supranational agency would have to guarantee that the costs of employing its infrastructure are controlled and maintained under a certain threshold. The downside of such solution would be that the Blockchain would partially be under the control of such supranational agency, instead of being completely public as with, e.g., Ethereum.

However, assuming that such Blockchain is big enough, this control might be limited. Another solution in this direction would be that of employing Blockchain technologies based on the Proof of Cooperation concept, rather than the traditional ones based on the Proof of Work concept. Those novel technologies (as of 2022) employ cryptocurrencies that maintain equal value to a reference real-world currency, thus avoiding some of the market fluctuations tied to traditional cryptocurrencies. Employing those technologies would therefore assure that the costs of employing the technology are indeed stable.

4. **Option 4:** evaluating institutions could decide to keep in the Blockchain only the hash as information, which would reduce the cost of these operations.
5. **Option 5:** evaluating institutions could decide to create a distributed ledger by themselves (either based on the concept of Blockchain or not). By creating such ledger, the consortium of evaluating institutions would ensure that they are in direct control of the costs, thus being completely independent from any form of fluctuation in the cost of employing such technology. This would obviously mean that the size of the ledger would be limited, and this might create issues of monopoly in the certification of certain skills/competences.
 - o As far as technical problem (3) is concerned, many experts expressed their doubt that the problem is indeed a problem. Many claimed that the private/public key duo would suffice to avoid leaks in private information. Individuals would be able to choose who has access to their information, thus allowing them to provide such information only to potential employers and/or services they are employing.

RECOMMENDATION 3: the experts' opinion was that in order to combat the privacy concerns, there are currently two options: 1) institutions could decide not to store sensitive and personal data on the Blockchain, using hash instead for instance; 2) institutions could decide to use permission chain for the storage, where you could at least control who does the validation.

As potential solutions to perception issues, the following are noted:

RECOMMENDATION 4: As a potential solution to perception issue (1), the experts' opinion was to present the solutions offered by the technologies before making any claim on the nature of such technologies. This would mean that the public would understand the strength of the technologies well before creating the tie between Blockchain and cryptocurrencies. Once the benefits of employing the technology are understood, then it would be possible to fill in the information gaps to let the users know that what was presented is an application of Blockchain technologies to their specific problems. For instance, an educational institution could explain to their students the idea behind an open badge and why it might be useful for them. This would be done way before telling them that such open badge is based on Blockchain technologies. It should also be noted that one of the experts³⁴ claimed that this is not an issue: he reported that the very fact that his enterprise employs Blockchain is what brings him some of his clients. He explained this by referring to the fact that in recent years, there has been a

³⁴ Davide Costa: Quadrans Foundations.

huge hype on those type of technologies, thus creating interests in their application to various fields.

RECOMMENDATION 5: As potential solution to perception issue (2), the experts' opinion is that the initial doubts related to the technology are only a normal element to be expected. Some claimed that this is normal with many technological advancements and that time would possibly solve the issue. Obviously, supranational, and national governmental institutions must put their effort in to provide a proper legal framework. However, this is already part of the European agenda, as shown by the analyses carried out during IO1.

Furthermore, to Juho Lindman, associate professor of informatics in the Department of Applied IT at the University of Gothenburg (Sweden) and the director of the University of Gothenburg Blockchain Lab, there are currently two routes when we talk about Blockchain technology being used within the educational sector and for certification/recognition of skills. One is the more structured way, in which one route identity provider would support this transition providing a proof of identity, or through the private sector, directly bypassing parts of the university structure that we already have in place. Lindman recognizes the value and uniqueness of the OBEC experience in recognizing both routes while also testing this, going beyond the idea to the practice, and seeing the whole process through. Another consideration is that, besides investments from the European Union, there is still a lot to do in terms of how the micro credentials should look like, what would be issued there, and who would be doing the issuing and who would be doing the verification. There is also the risk that universities would each go on their own, competing among each other. In this case, the universities would not be interested in creating interoperability, investments would be needed from recruiters to access each university's system.

Based on this reflection, the following recommendation has emerged:

RECOMMENDATION 6: the way forward would be to prioritize the creation of interoperability. Juho Lindman points out that it is difficult to see how we can achieve that exactly what if we run several different infrastructures. With this in mind, it might be better to opt for a unified alternative instead of having several parallel versions of the same thing in place, which would not be helpful for students or users of those systems. Thus, the recommendation is that whether through the European Union or the EBSI, there should be a structure in place to create interoperability.

Other Reflections and Inputs

Experts expressed a belief in the fact that the challenges that currently exist to blockchain in relation to its perception are likely to be overcome once the demand increases and the industry pushes this forward. One expert mentioned that the labour market currently needs talents with certain skills, and this is already creating the demand for a system that makes it easier to connect students/talents and recruiters through verifiable credentials.

It is noteworthy that, in relation to the energy and sustainability concerns, in September 2022, Ethereum completed a merge that is expected to cut "Ethereum's energy consumption by 99.988% according to the analysis published by the research company Crypto Carbon Ratings Institute (CCRI)". More can be read on the subject [here](#).

Chapter 8 – Conclusions and Recommendations

Throughout this document, a series of challenges, opportunities, and initiatives around the use of Blockchain technology have been outlined. While the OBEC project has signified a limited experience that was localized to the context of the partner countries and to the EU context, the methodology of the project fundamentally assumed an international perspective that both was founded on the needs of third country immigrants and recognized initiatives implemented in other parts of the world. The project sought to explore how the cutting-edge Blockchain technology could be applied in the educational sector to make it easier for immigrants, exchange students, and individuals with alternative learning backgrounds to recognize their skills and competences and to thus integrate their countries' labour markets and pursue their professional aspirations. That said, it is important to highlight that, while OBEC supported that facilitating this process is essential to promote quick and successful inclusion, several factors currently present important challenges to the achievement of this objective. Further, obstacles have been identified for the integration of Blockchain technology to promote this goal.

To start with, though several obstacles have been named regarding the European context alone, these become even more pronounced in a transnational context. Achieving trust between countries and creating a unified, standard, or even equivalent educational system among different nations is a challenge that is not likely to be overcome soon. As each country's system is tightly embedded in their governments and cultures, it is hard to predict a time in which they will be ready to let go of their systems for the goal of creating a system in which all countries would have equivalent educational standards and structures. Moreover, it is still unclear whether renowned universities would be willing to integrate themselves in a standardised system. Consequently, in the meantime this means that individuals will continue to move across countries bringing with them very different grade systems, duration of studies, evaluation standards, and curricula.

Nevertheless, this challenge does not mean that inclusion cannot be facilitated by putting in place a structure that makes it easy for individuals to have ownership over their own learning trajectories, diplomas, certifications, and consequent skills and competences.

In light of this, the OBEC consortium recognizes that the establishment of this structure in a worldwide level is still far from being achieved, given the difficulties of countries to trust foreign institutions and diplomas. However, the OBEC experience has proven that blockchain technology represents a valuable resource to initiate the unravelling of a culture of trust and transparency among educational institutions, one that can benefit every individual in all parts of the world.,

Further, the consortium agrees that the European Union is strategically positioned to initiate this process, giving the already existing initiatives and investments in the development and maintenance of supra-national tools that promote interoperability and support equivalence among different countries' educational systems. This has been supported by initiatives such as the ESCO system, the Europass CV, the Dublin Descriptors, and the diploma supplements, detailed on [Chapter 2](#) of this document.

This strategic position is also associated to the fact that several initiatives that utilise blockchain in the educational sector have been identified in the European Union. As highlighted on [Chapter 3](#), although the European Union currently has no structure in place for the recognition of educational credentials using Blockchain technology and lacks a specific legislation aimed at applying the technology to recognise educational credentials (Graux & Vandezande, 2022), the European Commission aims to become a “leader in Blockchain technology” (European Commission, 2022). This is supported by the introduction of the European Blockchain Services Infrastructure (EBSI), which, among other goals, aims to use its public service Blockchain in the process of recognising educational credentials. Therefore, although still facing challenges, the European Union already counts with a basic structure that can be explored to facilitate inclusion through improved transparency, accountability, and trust among institutions.

In order to support this process, the OBEC Consortium has identified a selection of recommendations, previously outlined on this report and described below.

RECOMMENDATION 1: The existence of aiding tools that might help individuals to integrate in the labour market should be broadly disseminated and made available to important stakeholders, which will then have the task to promote them with the individuals that need them the most.

RECOMMENDATION 2: Investment should be directed towards an improvement in the comprehension of the available tools (ESCO system, the Europass CV, the Dublin Descriptors, and the diploma supplements) and their user-friendliness.

RECOMMENDATION 3: Given that member states continue to use different systems (e.g., Italy still employs CFU (Crediti Formativi Universitari), while Belgium often employs study credits), attention should be paid to the way in which each Member State implements the available systems, with an emphasis on successful implementations that could be applied in other countries, although respecting each national difference.

RECOMMENDATION 4: Successful standardized credential systems must include four elements:

1. The identity of the individual that will receive and use the certifications provided through the standardized system (it is safe to assume that this is needed to avoid abuses in the use of those certifications, e.g., by using someone else’s certification or false certifications).
2. The qualities of the individual that are certified by the standard credential system (this is the main purpose of having such standard credential systems and, thus, it seems reasonable that all such systems include sections where the qualities that are certified are explicitly specified. In some cases, those qualities are also presented with a reference to international terminology, to fulfil both national requirements and international ones).
3. The evaluation system that was employed to assess the fulfilment of the desired characteristics that allowed the production of the certificates. In particular, such part includes the scales employed in the evaluation and the assessment procedure that can determine the overall end score for the specific agent (this seems to be needed in order to allow translations between different evaluation systems).

4. Direct comparisons to established European Standards (the main reason behind this element of the standard credential systems seems to be that having a middleman can speed up translations between national systems of credentials).

RECOMMENDATION 5: To avoid the concerns raised in regard to cost and privacy when it comes to the utilization of Blockchain to issue educational certifications, it is suggested to employ the tools provided by the European Union to have a supra-national guarantee that costs are kept under control and that the privacy standards are respected. In particular, the development of the European Blockchain Service Infrastructure (EBSI), could help to avoid some of these issues.

The development of the EBSI is also recommended to avoid the concerns raised with the use of private Blockchain networks which, while solving some of the cost and privacy issue, might bring other challenges. These challenges are described as follows:

1. Mainly, pursuing the road of using private BC technologies runs the risk of having a multitude of different private networks being developed by different institutions
2. This, in turn, would create problems when trust and interoperability are considered, since employers would have to create ties with different systems, each with its-own characteristics
3. Moreover, the goal of promoting integration and improve communication between parties would not be achieved.

Therefore, the use of EBSI to avoid the liberal route and prompt certain levels of standardisation and equivalence between the systems could present a favourable solution.

RECOMMENDATION 6: Regarding the privacy issue in particular, other solutions are the following: 1) institutions could decide not to store sensitive and personal data on the Blockchain, using hash instead for instance; 2) institutions could decide to use permission chain for the storage, where you could at least control who does the validation.

RECOMMENDATION 7: Regarding the cost issue, on the other hand, five options are recommended:

1. **Option 1:** evaluating institutions might keep their current operating systems and do a parallel deployment of Blockchain structures to issue to students the verifiable credentials. This would likely be a less costly option which would also be an opportunity to test the operability of these systems. This could also be a chance to test the cost-saving opportunities of the system, or this could maybe provide some revenue, for instance for providing easier recruitment in the long term.
2. **Option 2:** evaluating institutions might choose to employ Blockchain infrastructures only partially for the registration of the profiles. This would mean that, for example, a university would employ its internal databases to stock the information regarding one of its students; then, once the student decides to move outside the University, a digital badge would be created and uploaded into a Blockchain to certify all the competences and skills that the student developed throughout his/her studying

experience. This solution would mean that the University would only need to incur into the costs of employing the Blockchain infrastructure fewer times and would also decrease the likelihood of uploading incorrect information that has to be corrected.

3. **Option 3:** evaluating institutions might employ supranational Blockchain infrastructures (e.g., a European-based Blockchain infrastructure). In this case, the supranational agency would have to guarantee that the costs of employing its infrastructure are controlled and maintained under a certain threshold. The downside of such solution would be that the Blockchain would partially be under the control of such supranational agency, instead of being completely public as with, e.g., Ethereum. However, assuming that such Blockchain is big enough, this control might be limited. Another solution in this direction would be that of employing Blockchain technologies based on the Proof of Cooperation concept, rather than the traditional ones based on the Proof of Work concept. Those novel technologies (as of 2022) employ cryptocurrencies that maintain equal value to a reference real-world currency, thus avoiding some of the market fluctuations tied to traditional cryptocurrencies. Employing those technologies would therefore assure that the costs of employing the technology are indeed stable.
4. **Option 4:** evaluating institutions could decide to keep in the Blockchain only the hash as information, which would reduce the cost of these operations.
5. **Option 5:** evaluating institutions could decide to create a distributed ledger by themselves (either based on the concept of Blockchain or not). By creating such ledger, the consortium of evaluating institutions would ensure that they are in direct control of the costs, thus being completely independent from any form of fluctuation in the cost of employing such technology. This would obviously mean that the size of the ledger would be limited, and this might create issues of monopoly in the certification of certain skills/competences.
 - o As far as technical problem (3) is concerned, many experts expressed their doubt that the problem is indeed a problem. Many claimed that the private/public key duo would suffice to avoid leaks in private information. Individuals would be able to choose who has access to their information, thus allowing them to provide such information only to potential employers and/or services they are employing.

RECOMMENDATION 8: More policies should be enforced to push the agenda of unified credential systems that resemble the ones put forward by the European Commission. This can be achieved, among other ways, by promoting automatisms between different organizations. If skills and competences are automatically recognized across all European countries, without any necessary intervention by administrative staff, then mobility would be improved. Transnational platforms employed to get those automatic recognitions might be useful tools to employ: if individuals are allowed to create digital profiles on transnational platforms (e.g., the ECTA platform tested during the OBEC project), then the skills and competences certified on those platforms will be considered valid throughout the territories that trust such platforms. At that point, the only issue would be that of establishing trust between the various organizations and the central transnational platform. This is where Blockchain technologies would help by providing transparent, secure, and trustworthy information to the various stakeholders.

In order to support efforts in this regard, four additional points are recommended:

1. First, it must be decided which badges (in case open badges are employed as certifications) or micro credentials should be awarded for which skills. This is already a major challenge, since it is not clear at which point to draw the line between coarse-grained skills/competences (e.g., being financially savvy) and fine-grained ones (e.g., being able to write a financial balance). A potential solution to this problem is to employ the ISCO-08 codes as used by the ESCO system, thus conforming to European standards for skill/competence recognition.
2. Second, it must be decided where the badges will be kept by the students. The repository chosen must be secure enough to allow control over the access to the information contained within such repository, but not complex to the point where the students and the potential employers (or other educational institutions) must endure complicated validating procedures to access their information. ECTA is a good example of a repository which is easy to use and secure enough to warrant some level of privacy to the users.
3. Third, it must be decided which BC network to use. In relation to this point, the suggestion is to develop private BC networks between educational institutions based on EBSI.
4. Finally, it must be decided which evaluation procedures to employ to verify the possession of the skills/competences certified through the BC.

RECOMMENDATION 9: Adequate evaluation procedures must be established to achieve an ideal situation in which various kinds of skills/competences are certified and individuals can easily showcase those skills/competences to different potential employers. This was supported by the experts who were interviewed for this report. For this to be achieved, it is suggested that the EU invests more resources in the study of good evaluation practices for various skills/competences. This should be carried out with the support of the appropriate institutions depending on the group of skills/competences that are examined, e.g., Universities would be better suited to study transversal competences and VET school might be better suited to study job-related competences. In any case, those investments should be directed towards the preparation of guidelines to the evaluation of skills/competences, to obtain standards that could be applied in the various National Countries.

The experts' opinion was that skills/competences could be certified by specifying the activities that were carried out to obtain the skills/competences. This would also help companies to discriminate between skills/competences obtained in an educational setting from those obtained through practice on the job market. Moreover, the experts' suggested to dedicate some studies to the various skills/competences to gain insights into the feasibility of having good evaluation techniques connected to those skills/competences.

RECOMMENDATION 10: In order to overcome the suspicion of individuals in regard to the utilization of Blockchain technology, it is suggested to increase the number of investments made towards the dissemination and visibility of BC technologies. First, it must be made clear that BC technologies and cryptocurrencies are not the same thing, meaning that there might be useful BC-based applications that independent from the volatility of the cryptocurrency market. Then, individuals must be made aware of the advantages of employing BC

technologies in various endeavours, focusing of the positive aspects those technologies bring to society. The OBEC project is one example of such positive attempt to make an application of BC more understandable, but much more must be done. In this sense, all relevant stakeholders must take part in the task, each with its unique set of individuals to educate.

The experts' opinion was that, while this suspicion is normal, a solution could be to present the solutions offered by the technologies before making any claim on the nature of such technologies. This would mean that the public would understand the strength of the technologies well before creating the tie between Blockchain and cryptocurrencies. Once the benefits of employing the technology are understood, then it would be possible to fill in the information gaps to let the users know that what was presented is an application of Blockchain technologies to their specific problems.

RECOMMENDATION 11: the way forward would be to prioritize the creation of interoperability. According to Juho Lindman, it is difficult to see how we can achieve that exactly what if we run several different infrastructures. Thus, it is suggested to opt for a unified alternative instead of having several parallel versions of the same thing in place, which would not be helpful for students or users of those systems. Thus, the recommendation is that whether through the European Union or the EBSI, there should be a structure in place to create interoperability.

Chapter 9 Bibliography

Chainvine (n.d.) Available at: <https://chainvine.com/>

Council of the European Union (2022, June, 27) Official Journal of the European Union. Council recommendation of 16 June 2022 on a European approach to micro-credentials for lifelong learning and employability. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2022:243:FULL&from=EN>

EBSI. (2022). EBSI's Verifiable Credentials Lifecycle. Brussels: European Commission. Available at: <https://ec.europa.eu/digital-building-blocks/wikis/display/EBSIDOC/Verifiable+Credentials+Lifecycle>

EBSI. (2022). What is EBSI. Available at: <https://ec.europa.eu/digital-building-blocks/wikis/display/EBSI/What+is+ebsi>

European Commission. (2022, February 14). Blockchain Strategy. Retrieved from <https://digital-strategy.ec.europa.eu/>: <https://digital-strategy.ec.europa.eu/en/policies/blockchain-strategy#:~:text=Blockchain%20technology%20allows%20people%20and,without%20a%20third%2Dparty%20authority>

European Commission. (2022). *A European approach to micro-credentials*. Retrieved from <https://education.ec.europa.eu/>: <https://education.ec.europa.eu/education-levels/higher-education/micro-credentials>

European Commission. (2022, May 12). *Recognition of academic diplomas*. Retrieved from europa.eu: https://europa.eu/youreurope/citizens/education/university/recognition/index_en.htm#shortcut-2

Eurostat (September 2020) Tertiary education statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tertiary_education_statistics

UniRank (2005-2021) Universities in Europe - Higher Education in Europe. Available at: <https://www.4icu.org/Europe/#:~:text=How%20many%20Universities%20are%20there,higher%2Deducation%20institutions%20in%20Europe>
<https://ec.europa.eu/digital-building-blocks/wikis/display/EBSI/Home>

Graux, H., & Vandezande, N. (2022, February 24). *VERIFIABLE CREDENTIALS IN THE EUROPEAN LEGAL LANDSCAPE*. Retrieved from <https://www.timelex.eu/>: <https://www.timelex.eu/en/blog/verifiable-credentials-european-legal-landscape>

Grech, A., & Camilleri, A. F. (2017). *Blockchain in Education*. JRC Science for Policy Report. Retrieved from <https://op.europa.eu/en/publication-detail/-/publication/fe2e2bc8-c500-11e7-9b01-01aa75ed71a1/language-en>

- Nuffic. (2020). *The European Recognition Manual for Higher Education institutions*. The Hague: Nuffic. Retrieved from <https://www.nuffic.nl/sites/default/files/2020-08/the-european-recognition-manual-for-higher-education-institutions%20%281%29.pdf>
- Gallup (2022) How Millennials Want to Work and Live. Available at: <https://www.gallup.com/workplace/238073/millennials-work-live.aspx?thank-you-report-form=1>
- Career Builder (5 October 2021) Millennials or Gen Z: who's doing the most job hopping. Available at: <https://www.careerbuilder.com/advice/how-long-should-you-stay-in-a-job>
- Rivers, Deborah L. Walden University ProQuest Dissertations Publishing (2018). A Grounded Theory of Millennials Job-Hopping 10976526. Available at: <https://www.proquest.com/dissertations-theses/grounded-theory-millennials-job-hopping/docview/2150091092/se-2>
- Pandey, D. L. (2019). Job Hopping Tendency in Millennials. NCC Journal, 4(1), 41–46. <https://doi.org/10.3126/nccj.v4i1.24733>. <https://doi.org/10.3126/nccj.v4i1.24733>
Available at: <https://www.nepjol.info/index.php/NCCJ/article/view/24733>
- European Skills, Competences and Occupations classification: Annual Report 2020. Available at: <https://esco.ec.europa.eu/en/publication/annual-reports>
- Europass (n.d.) Europass Statistics. Available at: <https://europa.eu/europass/en/statistics>
- Eurostat (June 2022) Unemployment Statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Unemployment_statistics#Unemployment_in_the_EU_and_the_euro_area
- Europass (n.d.) Test your Digital Skills. Available at <https://europa.eu/europass/digitalskills/screen/home?referrer=epass&route=%2Fen>
- The Europass Certificate Supplement, n.d. <https://europa.eu/europass/en/europass-certificate-supplement>
- Europass, n.d. <https://esco.ec.europa.eu/en/escopedia/europass>
- LinkedIn (2022) LinkedIn Skill Assessments Available at: <https://www.linkedin.com/help/linkedin/answer/a507663/linkedin-skill-assessments?lang=en> .
- Etherum (n.d.) <https://ethereum.org/en/> .
- EBSI (n.d.) Experience cross-borders services with EBSI, The first public sector blockchain services in Europe. By the European Commission and the European Blockchain Partnership. Available at: <https://ec.europa.eu/digital-building-blocks/wikis/display/EBSI/Home>
- OBEC Project IO1 Final Report (2021). Available at: https://static1.squarespace.com/static/61adb62dfdb4382551ce7fe3/t/61e897324715dd7951456812/1642633019425/Final%2BReport_summary%2Bproofread%2B16-07.pdf

Test your Digital Skills, n.d. <https://europa.eu/europass/en/test-your-digital-skills>

The Verge, 2022. "Ethereum just completed The Merge — here's how much energy it's saving".
<https://www.theverge.com/2022/9/15/23354619/ethereum-cryptocurrency-merge-energy-electricity-greenhouse-gas-emissions-reduction>



CONTACT US



MARCO MONDATORI:
M.MONDATORI@LAIMOMO.IT
FILIPPO MANTIONE:
F.MANTIONE@LAIMOMO.IT



1506
**UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO**

MIRKO TAGLIAFERRI:
MIRKO.TAGLIAFERRI@GMAIL.COM



INFO@SWIDEAS.SE
ABDALLAH SOBEIH:
ABDALLAH.SOBEIH@SWIDEAS.SE
JULIA MOREIRA:
JULIA.MOREIRA@SWIDEAS.SE



ANDREJA ŠEPERAC:
ASEPERAC@SIMORA.HR



MARTA SERRANO:
MARTA.SERRANO@EURADA.ORG
JIP LENSSEN:
JIP.LENSSEN@EURADA.ORG

Co-funded by the
Erasmus+ Programme
of the European Union



The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.