**INTERVIEWS**

Interview 1: Public Organisation, Education, Executive Position [●]

Interview 2: Public Organisation, Higher Education, Executive Position [●]

Interview 3: Private Organisation, IT, Manager Position [●]

Interview 4: Private Organisation, IT, Manager Position [●]

Interview 5: Private Organisation, Higher Education, Manager Position [●]

Interview 6: Private Organisation, ICT, Executive Position [●]

Interview 7: Public Organisation, Education, Manager Position [●]

1. **What are the potential applications of blockchain in higher education?**

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| 1. Student records (including diplomas and certificates)  2. File storage (including courses and curricula) – The blockchains are smart-contract capable. The courses can be programmed into the blockchain and executed automatically when some conditions/criteria are met.  3. Blockchain in research – the researchers can publish the results and they can monitor their research’s reuse, including how often a work is cited and used as teaching materials.  4. Digital identity  5. Adoption of crypto currency |
| Potential applications for blockchain in higher education are related to:  • Improving record keeping and digital certificates  • Increasing efficiency in administrative processes (payments, smart contracts etc.)  • Supporting the growth of MOOC initiatives  • Creating a disruptive model for the education industry |
| The blockchain technology can bring great value in higher education with a high degree of impact on research. Even though blockchain has been around for a while, there are still many use cases where this technology can be used. Fields like medicine or public administration can benefit a lot from it, opening the door for students to many new areas of study.  At the same time, blockchain can be used in research, for knowledge and data sharing. Releasing research papers can now be done through blockchain, this way the original identity of the authors and their ideas can be kept successfully while also ensuring decentralization of the information.  Another potential application is the monetization of the blockchain. In a research blockchain, tokens can be created and distributed among the publishers that they can resell. This can create a new revenue stream for researchers and institutions, helping the funding of the research which is a problem worldwide. |
| - keeping track of all student grades throughout the years of study and beyond.  - registration of other professional information: volunteer activities within the university, participation at scientific events, obtained prizes / scholarships.  - automatic generation of professional information (diploma) to the industrial and scientific community.  - Automatic generation of student contracts for university. |
| Possible use-cases for blockchain in higher education:  • Verifiable Credentials for university diplomas and micro-credentials  • Intellectual property management - scientific papers, (open) research data, open educational resources  • Funding tracking from higher level authorities  • Students’ payments, grants management, students’ services (e.g. academic records, transcripts), credit transfer, learning portfolios  • Pedagogical enhancement: anonymous marks/student performance comparison leading to personalised learning, reputation, proof of learning  • Tokenization of learning, virtual universities. |
| Potential applications of blockchain in higher education:  Issue and storage of certificates and diplomas  Identification of solutions  Protection of intellectual property  Formation of an academic passport (portfolio)  Payment for studies with a cryptocurrency  Accreditation of educational institution  Administration of the educational process |
| Blockchain technologies are becoming more and more popular as are the applications in higher education. Such applications can vary from bachelor to master and PhD programs. For bachelor programs applications include introductory coursers and implementation in software developed for bachelor thesis.  For master programs applications include specialty coursers, topics for research and analysis for master thesis.  For PhD programs applications include specific research in domains such as cryptology, security, smart contract and internet of things. |

1. **What relevant data or units of learning would be on the blockchain?**

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| 1. The use of blockchain – challenges.  2. Security and the blockchain technology.  3. Smart contracts. |
| Common practice is to only store a hash of the information, no personal or sensitive data. The actual records are stored in a database or other types of systems, while verification of the data is done by rehashing with the hash from the blockchain. |
| Blockchain can be used successfully in research. When it comes to data, multiple parties can add data points related to a study in blockchain, while also ensuring transparency and ownership of the data. At the same time the data can be used by all who have access to the blockchain while also ensuring traceability.   Besides data sharing, the studies and research papers can be part of the blockchain to ensure ownership of the study. The traceability of the data and the fact that it can not be modified ensures that researchers can publish their studies without the risk of being copied and not having the proof to showcase their ownership. |
| The data related to the university activity, meaning all discipline marks (including partial activities - laboratory during the semester activity), volunteer activity, awards and distinctions. |
| The data are connected with the specific use case. Anyway, on the blockchain there are not registered sensitive/personal data. A common practice is to store a hash of the information. A copy of the information can be stored on IPFS (InterPlanetary File System) or other similar services and verification is done by rehashing and validating with the blockchain. |
| - blockchain-based e-learning platform using the HyperLedger framework to improve transparency and trust by automating academic credentials and evaluation processes.  -academic records, research results and credentials, stored secure and safe on blockchain;  -smart contracts, creating greater efficiencies for teachers;  -certificates and diplomas.  full record of learning trajectory, trusted certiﬁcation of learning results and decentralized sharing of education resources. |
| Business networks  Assets  Ledgers, Transactions and Contracts  Blockchain architecture  Enterprise Blockchain  Regulation and Security |

1. **One of the most critical components of a block on the blockchain is the quality of data, what are the quality assurance standards to ensure that the data is accurate, verifiable, and meaningful?**

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| For aught I know - There are no special standards for quality assurance related to the blockchain technology. There are the usual standards. |
| The very concept of blockchain, as a decentralized database of transactions, shared and synchronized across multiple nodes, guarantees the quality of data. Each node owns an identical copy of the record, and records are automatically updated when new data are inserted. Consensus is a key concept used in the implementation of the blockchain technology. This means that for new data to be added in the blockchain, all participants must reach consensus to accept or reject it. Once approved, data is stored into the ledger as a collection of blocks and cannot be altered. |
| The quality standards will need to be discussed and agreed by all the users of the blockchain. In order to have data of high quality we need the following: no missing data points, description for all of them, source of data, timestamps, signature of the collector. All of those will make the data meaningful and traceable. |
| Blockchain technology involves interoperability of data. Therefore, each data element should have a trustee accountability for data quality, should be understandable and available to all users. Not last, blockchain technology ensures data protection from unauthorized use and disclosure. |
| There are already multiple research studies, reports and standards for the Blockchain/DLT technologies.  The reports of the EU Blockchain Observatory are kindly recommended:  <https://www.eublockchainforum.eu/reports>  <https://www.eublockchainforum.eu/knowledge> |
| Standardization in Blockchain domain  ISO/TC 307/WG 2 Security, privacy and identity  ISO/TC 307/WG 3 Smart contracts and their applications  ISO/TC 307/WG 5 Governance  ISO/TC 307/WG 6 Blockchain Use cases  ISO/TC 307/WG 7 Interoperability  DIN. 3104:2019-04 Blockchain-Based Validation of Data. 2019.  Available online:  <https://www.beuth.de/de/technische-regel/din-spec-3104/301837615>  (accessed on 20 April 2020). |
| NISTIR 8202 - Blockchain Technology Overview  ISO/TR 23455:2019 Blockchain and distributed ledger technologies—Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems |

1. **What are some compelling reasons for using blockchain in higher education? Are there any reasons NOT to use blockchain in higher education?**

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| Some reasons:  1. Security  2. Functionality  3. Novelty  No, there are no reasons NOT to use blockchain in the higher education, but take into consideration:  1. resistance to change |
| The main benefits of the blockchain technology [3]:  • Decentralization: Unlike traditional database systems which store information on a central server, blockchain removes this single point of failure issue through decentralization.  • Distributed and scalable: For a distributed ledger configuration, the backend is a network of computers, each storing data. This distribution ensures availability and fast access to the system.  • Security and transparency: The entire blockchain concept emerged from the need for a secure and stable framework, thus data protection, security and cryptography are core features of this technology.  • Data immutability and integrity: The decentralized and distributed architecture ensures data immutability and integrity, given that data cannot be altered unless all parties in the blockchain reach consensus, increasing trust between users.  I don’t see any reasons why blockchain should not be used in higher education. |
| The purpose of higher education is to provide individuals with the right tools and knowledge in order to be able to succeed in their future careers while also pushing the boundaries of our collective knowledge through research.  By using blockchain, which is a technological trend nowadays, we can prepare students to meet the industry expectations, while also familiarizing themselves with the concept and its applications and impact. Research can be shared in a blockchain network making it accessible in a secure way.  Using the latest trends in technology in higher education we can also push for new initiatives in research. Blockchain is an universal concept that can be applied to most of the industries, this way the impact it can have on research grows exponentially.  While it has many benefits, there is also a downside to the blockchain. The resources used for computational power and storage are really high and may have a negative impact on the environment. This is one problem that needs to be solved as blockchain usage grows. |
| Some reasons to apply blockchain technology in higher education are:  - Accessibility and availability of data depending on users’ rights (authority).  - Data security (protection)  - Data integrity (an information may be changed with the consent of all owners/users)  There is no reason why the blockchain technology cannot be used in higher education. |
| The integration of blockchain in universities has different perspectives:  - The creation of research teams for blockchain, in connection with the other emerging technologies of the 4th Industrial Revolution.  - The development of study programs to prepare specialists for this domain  - The implementation of decentralized applications for different use-cases.  The compelling reasons comes from the advantages of the blockchain technology with multiple use-cases presented under the first question: self-sovereignty, trust, transparency and provenance, immutability, disintermediation, collaboration.  I see no reason for not to use blockchain in education.  Of course, the use could happen only if dedicated and informed teams have such initiatives in universities, collaborating with other institutions/projects and experienced companies, knowing studies, standards, European and national policies and strategies in this domain, participating in different communities of practice, in training programs and in specific MOOCs. |
| Compelling reasons for using blockchain in higher education  By using blockchain, the processes of teaching and learning can be improved across key dimensions like:  Empowerment for learners (self-sovereignty)  Security and efficiency enhancement for educational institutions, businesses, and learners  Record-keeping uses such as digital credentials and intellectual property management, Streamlining of diploma verification  Fast and reliable student payments.  Trust and transparency integration  Integration of trust and transparency for sharing processes, skills, and competences  Some possible disadvantages of blockchain  Some Blockchain solutions consume too much energy  blockchain is not a distributed computing system  blockchains are not scalable as their counterpart centralized system.  data is immutable – it is not possible to go back, reversely  -blockchains are sometimes inefficient |
| Compelling reasons for using blockchain in higher education are related to its applications and technology adoption in cryptocurrency, enterprise systems and smart contracts.  There is no reason not to include blockchain in higher education programs. |

1. **What are the most significant hurdles that higher education will need to overcome before blockchain sees broad adoption?**

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| 1. Resistance to change  2. Funding  3. Training |
| blockchain sees broad adoption?  - Lack of relevant experience or skill gap  - Lack of knowledge or understanding  - Considering that the technology is not yet validated enough  - Lack of collaboration between entities  - Lack of national strategy related to blockchain |
| The biggest hurdles that higher education will need to overcome are related to legislative reglementation (each state has different laws that will need to regulate the usage and adoption), getting traction (creating the right product and use cases for their needs) and teaching the individuals involved in education to use it (not all the people are technology aficionados, so they will need help and courses) .  All of the above create an even bigger hurdle that needs to be overcomed, which is funding. Universities will need to invest in this new technology and find the right funds. |
| Any new technology requires a period of preparation and adaptation. Therefore, the users may have difficulty in adopting technology due to a lack of understanding of concepts and their application, since they have different skills and competencies. Although the lack of practice can be an impediment. |
| The broad adoption of blockchain could happen only with the participation of higher education, which has a significant and challenging role in facilitating and accelerating the awareness, knowledge and integration of this technology in different domains, in building informed strategies and policies.  The most important hurdles come from the inertia, conservatism, lack of information, knowledge, collaboration of the academia, managers and teachers themselves. |
| Higher education will need to overcome before widely adopting blockchain some of the following issues:  -legal EU’s General Data Protection Regulation (GDPR) may impose limitations on how personal data is transacted on the blockchain.  -still the legislation regarding the “personal data” remains vague  -scalability.  -the relatively slow speed of blockchain transactions may impose bottlenecks when it comes to scaling blockchain-in-education solutions worldwide.  -Data privacy and security - ensuring privacy while providing security on the blockchain may be very difficult to achieve.  -Market adoption- Lack of trust in the technology and lack of knowledge on how to harness the potential of blockchain-in-education solutions may lead to a slow market adoption of such innovations.  -Innovation- The relative immaturity of blockchain technologies may influence the success rate of blockchain-in-education solutions. |
| The most significant hurdles that higher education will need to overcome before blockchain sees broad adoption are related to training of teachers and focus on research areas related to blockchain technology |

1. **With every new tech adoption that has broad implications, there are “winners” and “losers” who falls into these categories; Who are the biggest winners and losers? Does the benefit to the winners outweigh the impact on the losers?**

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| Winners:   1. High schools and the entire education system 2. Banking system 3. Health system   I do not see the Losers… it is a new technology and it can be a plus for the majority of domains… |
| For each envisaged use case, a careful analysis should be conducted to validate the need / benefits of blockchain adoption. |
| As with every new technology, implementing it and using it requires financial resources and organizational and legislative flexibility in order to adopt it. Being one of the early adopters is expensive, but at the same time will give an advantage in terms of experience and knowledge to the users.    As we’ve seen in the past, organizations from highly developed countries have the needs to adapt faster. They will be the winners (e.g. universities in top 50 worldwide). As they are also the trend setters, they will use this to their advantage to impose the new technologies to the rest. The losers will be the ones who will start to adopt the new trends later. As the time passes the difference will be bigger, increasing the gap between the top organizations and the rest.    Even though adoption may not be equitable, the benefits of progress and innovation outweigh the concept of winners and losers, as the improvement will be beneficial to everybody. |
| The winners should be all users interested in the distributed of relevant information, including students, companies or other departments of the university.  I don't think there exists some losers. |
| A winning blockchain ecosystem depends on the factors underlined by the report “EU Blockchain Ecosystem latest developments”, Nov 2020 - <https://www.eublockchainforum.eu/reports>. |
| Winners -Businesses and customers will surely save time and money and enjoy better transparency and traceability.  -but, at the same time, the public ledger technology could make data privacy even harder to protect and leave more workers without a job.  For those companies winning through cutting costs, job loses will be the negative effect for thousands.  The benefit of the winners is able to outweigh the impact on the losers if the financial resources for salaries payment represent an important percent from the company's profit |
| Biggest winners are organizations that adopt blockchain technologies as early as possible.  Losers will prove to be organizations that do not see a benefit in adopting the technologies.  In the current market and technology environment the benefit to the winners outweighs the impact on the losers. |

1. **Building on the previous question, there are potential equity, access, and accessibility implications, how do we ensure that blockchain doesn’t marginalize these populations?**

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| The governments should have clear politics in this field to ensure equity, access, and accessibility. |
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| In order to improve accessibility to this technology so we don’t marginalize populations, the trend setters need to share their knowledge free and in a timely manner with the rest.  The opportunity of partnerships between different institutions can mitigate those risks. Once a blockchain is started, having more users (institutions and researchers) can decrease the differences while also speeding up the adoption for both parties. |
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| Because this analysis/interview focuses on education domain, trainings, entrepreneurship or digital entrepreneurship courses can be offered for the persons affected by job loss. These persons can be stimulated to gain access at European funds to create start-ups. together with access to start-up funding resources. |
| Access to opensource technologies and open data. |

1. **Is blockchain in higher education just hype?**

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| No, I do not think. |
| No, it is a technology with relevant benefits in enterprise applications, including higher education. |
| So far, the blockchain technology has been found to be the most effective in the cryptocurrencies space. There are still many industries and use cases that are researched and explored in order to implement it, higher education being one of them. As with all trends, at the moment it is a hype. Transforming it into certainty with clear benefits will take time and investments from people and organizations. |
| Blockchain technology can be really applied in higher education with important benefits. |
| As specified before, the broad adoption of blockchain could happen only with the participation of higher education, which has a significant and challenging role in facilitating and accelerating the awareness, knowledge, and integration of this technology in different domains, in building informed strategies and policies. |
| Blockchain not just hype in education, because there are great future possibilities for wide applications of this technology  It is useful to point out that blockchain can also make things which are not working so well, to work better, such as: copyright protection, traceability issues;  -Certificates and identity management;  -Digital Credentials, Open Source achievements and results property rights  -Enhancing and motivating lifelong learning etc.  Learning achievements of students that can be shared trustfully among institutions on a single platform. |
| No. Blockchain is an important technology. |

1. **Where do we go from here? Who needs a seat at the table?**

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| Probably the passage of time will place the domain where it belongs ... with little steps go forward! We need knowledge of the field - through courses and awareness of the benefits offered. |
| Governmental institutions and authorities, academia, companies, blockchain communities. |
| In order to go forward and take use of this technology, organizations need to start and implement multiple use cases for blockchain, even test them as prototypes to get the first conclusions and get peer reviewed. Once we have clear results and benefits a clear plan and strategy needs to be implemented at multiple levels. Directions need to come from universities but in agreement and with sponsorships from the governments and the specialized institutions of the EU. Another key factor is the public-private partnership that needs to be created so that both can benefit from the blockchain adoption. |
| Companies, governmental institutions, blockchain community. |
| Academia and research institutions, companies, governmental bodies, communities in the field. |
| Blockchain “presents two great opportunities:  1- improved efficiency in education, with lower costs and a better customer experience.  2- taking advantage of its disruptive aspect, as a source of new revenue. In this second sense, high education institutions can act in a collaborative academic environment, in order to increase the efficiency of the teaching act and knowledge providing to the students |
| Technology companies  Research Institutes  Higher Education Organizations  Professional Organizations  Standardization Organizations |

1. **What are your observations about blockchain adoption in Romania / Czech Republic / Norway / Iceland in general and in the education field in particular?**

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| In general and particular:   1. We need time to understand the benefits 2. We need training 3. We need the will |
| Although there is no specific national legislation, support and strategy for blockchain, Romania has a growing number of experienced companies (eg Modex, Elrond), innovative startups and projects, active accelerators – encouraging the adoption of blockchain. Moreover, there are also numerous educational programs including blockchain.  There are a few blockchain pilot projects running in Romania, among which also issuing university diplomas and micro-credentials on the European Blockchain Services Infrastructure (EBSI), as a result of the ongoing project "EBSI4RO: Connecting Romania through Blockchain" (ebisi4ro.ro, 2021-2023).  An exhaustive study about the Romanian Blockchain Ecosystem is accesible here: https://ebsi4ro.ro/romanian-blockchain-ecosystem/. |
| In Romania, the blockchain landscape is evolving at a fast pace along with the whole IT&C industry. Unfortunately this happens mostly in the private sector. Companies like Elrond or Redplatform are just a couple of successful examples of companies that have been able to create viable products using the technology. The start-ups and companies investing in blockchain are growing steadily. There is also a national NGO agency that sponsors the adoption of it (https://asociatiablockchain.ro/) .  In terms of education, considering that the educational field is mostly public sponsored, there hasn’t been great progress in terms of adoption. But we can see in technical universities (University Politehnica of Bucharest) that students are learning about the concept and researching it in bachelor, masters and PhD projects. |
| In Romania, blockchain technology has been capturing the attention of more and more companies. There is also the Romanian Blockchain Association who organizes events related to the transformation and digital change, analyzes the prospect of blockchain adoption in the market an its impact on the global economy.  Some projects were initiated, among which EBSI4RO: Connecting Romania through Blockchain (developed by The Executive Unit for the Financing of Higher Education, Research, Development and Innovation (UEFISCDI) and the Polytechnic University of Timișoara (UPT)). This project aims to create a sustainable ecosystem for accelerating digitization and facilitating the knowledge and adoption of Blockchain technology and the European Blockchain service infrastructure. |
| Despite there are not yet any specific national legislation, support and strategy for blockchain, Romania has a growing number of experienced companies, innovative startups and projects, active accelerators, many communities and events, and also numerous educational programs, initiatives and policy proposals.  There were registered also a few innovative government projects and there are funded projects for developing blockchain strategies and applications.  Also Romania is one of the pioneering countries which will issue university diplomas and micro-credentials on the European Blockchain Services Infrastructure (EBSI), starting with this year, as a result of the ongoing project "EBSI4RO: Connecting Romania through Blockchain" (ebisi4ro.ro, 2021-2023).  A large study related to the Romania Blockchin Ecosystem can be found at <https://ebsi4ro.ro/romanian-blockchain-ecosystem/>. |
| Blockchain Romania Association is a non-governmental organization established in March 2018. The projects of the Blockchain Romania Association are meant to:  -popularize and inform the people about the advantages of this disruptive technology;  -offer to institutions, organizations, individuals and economic agents possibilities to develop a legal framework specific to blockchain operation;  -offer education and learning opportunities for safety using safety the Blockchain technology;  -highlight the attributes of a blockchain crypto-economy.  In the education filed Romanian universities already started courses and programs such as:  -connecting Romania through blockchain;  -entrepreneurship in Blockchain;  -issue and storage of certificates and diplomas |
| Blockchain adoption in Romania is in accordance with market trends. Popular applications include cryptocurrencies and smart contracts. |

1. **How do you intend to check the relevant skills / competences when recruiting for a dedicated project / job linked to blockchain application in higher education (in Romania / Czech Republic / Norway / Iceland)?**

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| For now:  1. Checking the knowledge in the field  2. The use of some systems with blockchain technology (if applicable)  3. Case studies (if applicable) |
| Education and previous experience. |
| Taking into consideration that blockchain skills are very nieched and professionals with a high experience using it are not so many in the market yet, we need to expand the set of skills required for hiring, and leaving blockchain as a nice to have. The main competences are the following: cloud computing, web development (backend and frontend) and experience working with highly scalable products. |
| The most relevant skills can be the domain practice. |
| Formal and informal studies (MOOCs, webinars) in the domain and participation in previous projects and in communities of practice are important when recruiting.  The most relevant European project related to skills/competencies in blockchain is the ongoing CHAISE project <https://chaise-blockchainskills.eu/>. |
| **Top relevant skills / competences when recruiting a Blockchain Developer for a dedicated project**  Five top skills that are essential for any Blockchain Developer.  Data Structure-  Smart Contracts-  Cryptography- Encryption – Decryption– Critical– Cipher:  Interoperability skills –  Some components of Blockchain Architecture –  Node – it is a user of blockchain architecture.  Block – it is a data structure.  Chain – a series of blocks in a precise order.  Miners – a particular node involves in the block verifying process. |
| Interviews  Portfolio of related work  Research interests and results |