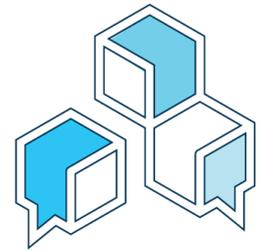


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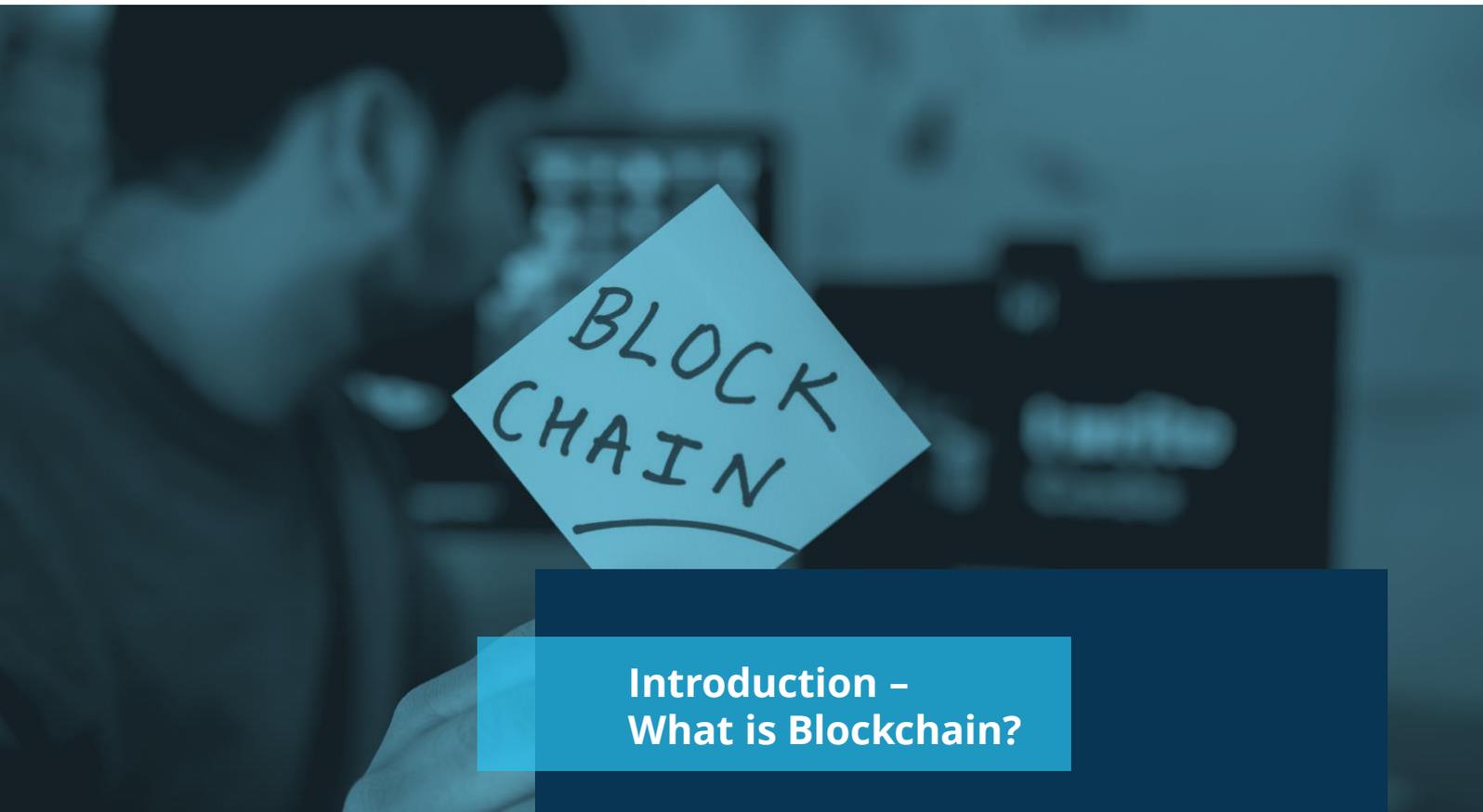
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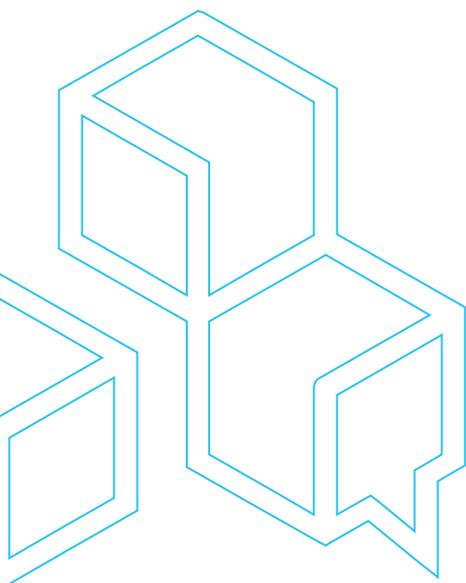
Executive Summary

A person is holding a blue sign with the words "BLOCK CHAIN" written on it in black marker. The background is a blurred image of a person looking at a smartphone.

BLOCK
CHAIN

Introduction – What is Blockchain?

- According to the European Commission, blockchain is a new technology that enables large groups of people and organisations, that may or may not know or trust each other, to collectively agree on and permanently record information without the need of a third-party authority. By creating trust in data in ways that were not possible before, blockchain has the potential to revolutionise how we share information and carry out transactions online. The technology will be instrumental in building a citizen-centric, sustainable, transparent, and inclusive European digital society.
- Blockchain technology has the potential to disrupt and benefit both society and businesses. Amongst others, the application of the technology enables the creation of new collaborative models in the digital economy, alternative model to dominant platforms, innovation, and new business opportunities; improve quality and efficiency of complex processes, as well as enables change in people's life and behaviour (through tokens incentives for instance).



EXECUTIVE SUMMARY: LITERATURE REVIEW



Blockchain for SMEs and High Growth Enterprises

- Ilbiz & Durst¹ provide a conceptual framework specific to SMEs, that mixes technical challenges with the key elements that blockchain brings as key for creating new services, namely: removing intermediaries, immutable and transparent records, and creation of crypto assets (which may become sources of funding for the companies devising them).
- Blockchain key areas of applications for SMEs are cooperation and transparency, financial exclusion. Chalmers et al.² also mention “ideology” as one of the main venture enablers in the blockchain space, analysing cases related to the music industry.
- Blockchain technologies can be adopted by start-ups and high growth enterprises both as part of the service or solution in their business model, but also as a platform for the funding of the business itself, since blockchains create economies and markets that entrepreneur can benefit from (in the case of public blockchains).
- This makes blockchain an area for entrepreneurship in which financing and business models may in some cases become closely entangled in contrast with other technologies enabling business models. In addition to funding approaches as Initial Coin Offerings (ICO) and Decentralised Autonomous Organisations (DAOs), Decentralised Finance (DeFi) promises to provide an additional route by freeing credit and lending from traditional institutions, albeit being currently immature and experimental for wide adoption.

Blockchain Competences and Skills for entrepreneurs and SME managers

- According to Düdder et al.³ blockchain requires a set of interdisciplinary skills. To operate successfully and across disciplines, additional competencies are required in addition to expertise in one's own field. Not only expertise in other fields, but also social skills and appreciative communication skills are decisive factors in the success of cooperation.

- Blockchain as an academic subject intersects with different sub-disciplines of theoretical and practical computer science, including decentralized computation and cryptography, along in some cases with knowledge in economics, finance and mechanism (incentive) design. The interdisciplinary scope of the research on blockchain is prompted by a range of industries for which blockchain use cases and proofs of concepts can be found today. A recent study on blockchain projects from Düdder et al.⁴ shows that the successful design, development, and implementation of blockchain-based business solutions requires deployment of interdisciplinary teams of experts with domain-specific knowledge.

Andragogy for educators to teach Blockchain competences

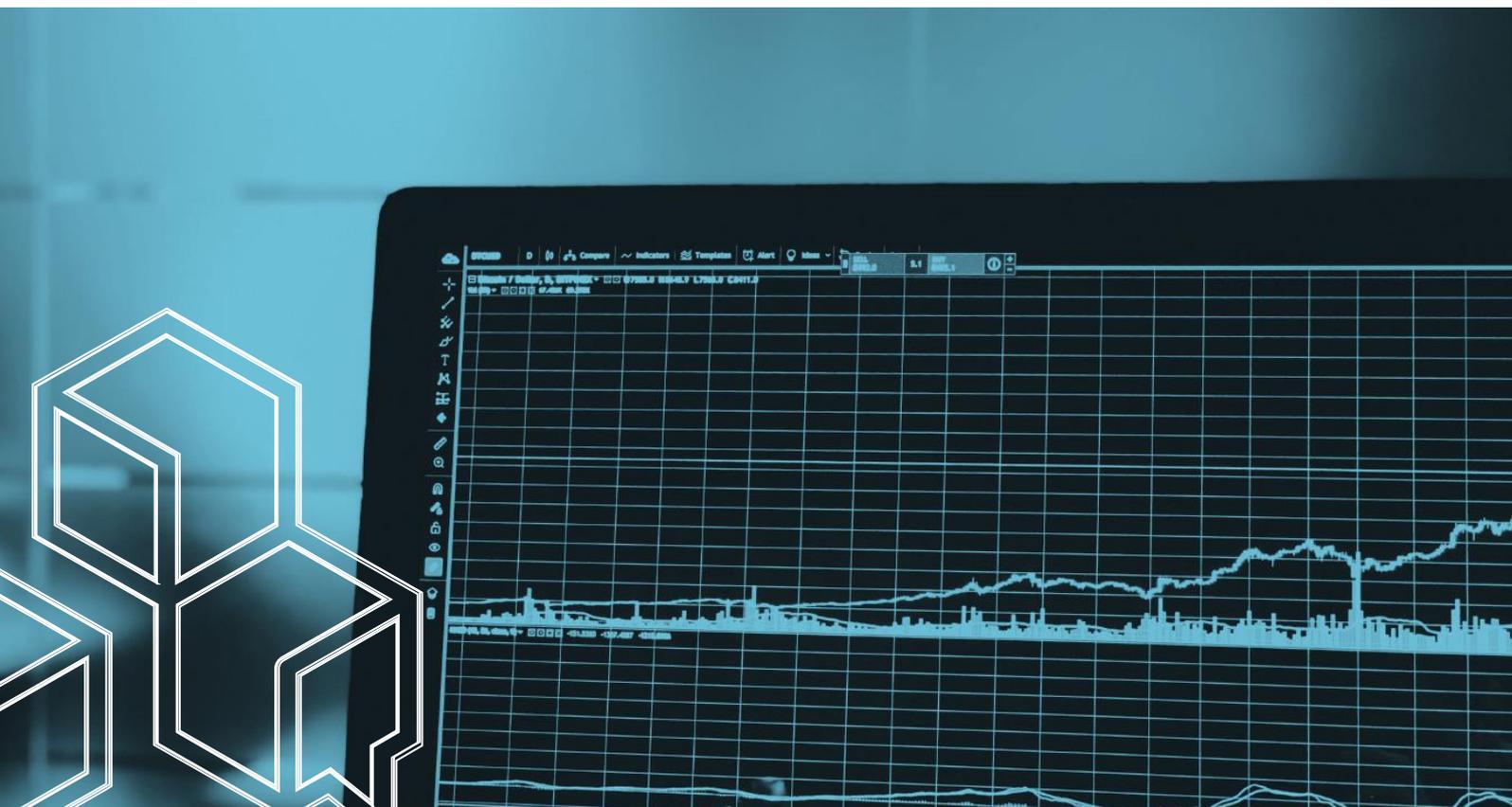
- One possibility for teaching entrepreneurship is to use in project- and case-based learning entrepreneurs as lecturers. In this case, learners will interactively discuss both the good and bad aspects of the project. Freeman et al.⁵ and Düdder et al.⁶ point out that project-based teaching and learning is a dynamic teaching approach based on the opinion that learners acquire more complete knowledge via active experiences. This method is particularly well suitable for interdisciplinary learning activities, which is a characteristic of blockchain.
- Based on the different backgrounds of the learners, education approaches in the field of blockchain need to be framed interdisciplinary from the core to be effective in empowering learners' employability. Blockchain is a highly interdisciplinary field, bringing together novel challenges and opportunities at the intersections of computer science, economics, engineering, finance, business, and law.

1. Ilbiz, E., & Durst, S. (2019). The Appropriation of Blockchain for Small and Medium-sized Enterprises. *Journal of Innovation Management*, 7(1), 26-45.
2. Chalmers, D., Matthews, R., & Hyslop, A. (2019). Blockchain as an external enabler of new venture ideas: Digital entrepreneurs and the disintermediation of the global music industry. *Journal of Business Research*.
3. Düdder, B., Fomin, V., Gürpınar, T., Henke, M., Ioannidis, P., Iqbal, M., et al. (2019). Exploring the Blockchain Skills Concept and Best Practice Use Cases. Project BlockNet IO2 White Paper. Edited by BlockNet Consortium. Available online at: https://www.knf.vu.lt/dokumentai/failai/projektai/blocknet/Project_BlockNet_Intellectual_Output_1_and_2.pdf (accessed June 17, 2021)
4. See 3
5. Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the national academy of sciences*, 111(23), 8410-8415.
6. Düdder, B., Wu, H., et al. (2020). Curriculum Guidance Document. The BlockNet Consortium. Project BlockNet Intellectual Output 3. White Paper. Available online at: https://www.knf.vu.lt/dokumentai/failai/projektai/blocknet/Project_BlockNet_Intellectual_Output_3.pdf (accessed May 06, 2021)

EXECUTIVE SUMMARY: LITERATURE REVIEW

Blockchain In Europe

- The European Commission has recently developed the EU blockchain strategy, which, on the one hand, is designed to enable innovation, accelerate the adoption of the technology, and create a balanced and consistent legal framework for blockchain and digital assets. On the one hand, the strategy facilitates and guides the implementation of blockchain technologies by EU member states, particularly by allocating funds for blockchain-related projects through initiatives such as Horizon Europe.
- The European blockchain strategy also aims to develop strong European political partnerships, promote legal certainty, support blockchain interoperability and standards, as well as develop blockchain skills through the [BlockCHAIN Skills for Europe](#) (CHAISE) initiative.
- At a national level, after the 2017 announcement of Alastria (Spain) and the [Dutch Blockchain Coalition](#), two of the first self-proclaimed multi-sector blockchain ecosystems in the world, multiple network initiatives have followed.
- While some countries have government-led or co-led blockchain ecosystems or clusters, such as Estonia, the Netherlands, Denmark, or Italy, others have seen industry-specific cluster such as finance forming, led by major organisations within the industry sector (e.g in Ireland and the UK), with little to no involvement from the respective governments.
- Blockchain skills development is still a relatively new field of education. The European commission recently commissioned the [CHAISE](#) project, to develop a strategic approach on blockchain skills development which will result in the design of the European blockchain skills strategy. Member states, such as the Netherlands, Denmark and Ireland are investing in upskilling citizens and enterprises leaders with the latest digital skills including AI and blockchain.





EXECUTIVE SUMMARY: RESEARCH FINDINGS

Drivers, Challenges and Key Success Factors to Blockchain's integration

- Main motivations for integrating blockchain or developing a blockchain enabled business include transparency, traceability and trust it can provide to companies throughout their supply chain, very often resulting into a competitive advantage enabling companies to outperform their competition or increase their customer base.
- Although attractive, companies integrating blockchain may face non negligible challenges starting with a general misconception of the technology and therefore distrust on its viability and benefits. Other mentioned challenges are cost of integration and difficulties to find and recruit blockchain experts. Additionally, the complex blockchain regulatory environment and mistrust and hesitance from potential competitors to share data, the technology itself still has shortfalls (e.g slow transaction speed, not designed to store large amounts of data).
- Nevertheless, according to companies who succeed in implementing blockchain, some keys success factors were critical to their growth such as defining early on clear use cases for using blockchain, having internally (within the team) blockchain knowledge and competences, starting small and testing/prototyping early on, as well as developing and being part of a network.

Competences for entrepreneurs and SME managers to integrate Blockchain

- As mentioned by Dudder et al.⁷, blockchain is a set of interdisciplinary skills. It might be hard for one individual to possess all the skills and it is therefore essential that the entrepreneur understands his assets and weaknesses well to complete himself with a supportive team. Nevertheless, a wide range of entrepreneurship and digital skills will have to be developed together with an excellent understanding of

blockchain terminology, use cases and infrastructure.

- EntreComp and DigiComp competence frameworks can both largely be used by educators to provide a base of competence development and assessment to entrepreneurs and SME managers willing to integrate blockchain. This will have to be completed by hands-on courses on blockchain fundamentals (such as distributed systems, crypto economics, consensus models and block inclusion in blockchain among others), using andragogy such as problem-based learning, use-cases scenarios but also design-thinking and lean start-up methodology to ensure rapid testing.

Competences for educators to teach Blockchain to entrepreneurs and SME managers

- To teach blockchain, entrepreneurship educators will need an excellent understanding of blockchain fundamentals and main applications. It is recommended that educators should have practical knowledge of the technology.
- Blockchain is not a subject that can easily be taught and educators will need to get as practical and close to real life scenarios for learners to understand and apply the knowledge. It is suggested that educators develop knowledge of diverse andragogy's such as case-based learning (CBL) or problem-based learning (PBL), where learners can work on real-life challenges, or interdisciplinarity problem-solving approach. Creating learning environment where learners can quickly prototype and test their solution in a close-to real life scenario is an important learning experience.
- Educators should also possess knowledge of the digital innovation process and design thinking principles. This will be useful for learners to identify the right pain points and problem to solve and think whether blockchain is the right technology for this specific problem.

7. See 3

Glossary

ITEM	TYPE	DESCRIPTION
Blockchain as a ledger	Basic terminology	A distributed ledger (also called a shared ledger or distributed ledger technology or DLT) is a consensus of replicated, shared, and synchronised digital data geographically spread across multiple sites, countries, or institutions. Unlike with a distributed database, there is no central administrator. ⁸
Nodes	Basic terminology	A node is a computer running specific software which allows that computer to process and communicate pieces of information to other nodes. In blockchains, each node stores a copy of the ledger and information is relayed from peer node to peer node until transmitted to all nodes in the network. ⁹
Hash	Basic terminology	A hash is the result of a function that transforms data into a unique, fixed-length digest that cannot be reversed to produce the input. It can be viewed as the digital version of a fingerprint, for any type of data. ¹⁰
Smart contracts	Basic terminology	Smart contracts are pieces of code stored on the blockchain that will self-execute once deployed, thus leveraging the trust and security of the blockchain network. They allow users to automate business logic and therefore enhance or completely redesign business processes and services. ¹¹
Wallets and personal management of funds	Basic terminology	A piece of software or hardware that allows users to manage their personal funds in a cryptocurrency: basically, to know their balance, and to carry out receiving and sending operations through the blockchain network of a cryptocurrency.
Consensus mechanisms or consensus algorithms	Basic terminology	Consensus algorithms ensure convergence towards a single, immutable version of the ledger. They allow actors on the network to agree on the content recorded on the blockchain, taking into consideration the fact that some actors can be faulty or malicious. This can be achieved by various means depending on the specific needs. The most famous consensus algorithms include proof-of-work, proof-of-stake, and proof-of-authority. ¹²
Tokens	Basic terminology	Tokens are a type of digital asset that can be tracked or transferred on a blockchain. Tokens are often used as a digital representation of assets like commodities, stocks, and even physical products. Tokens are also used to incentivise actors in maintaining and securing blockchain networks. (Blockchain and the future of digital assets, thematic report, by EU Blockchain)
Tokens fungible	- Basic terminology	Cryptocurrencies like bitcoin, and many network or utility tokens are fungible in nature, which means it can be traded for another bitcoin or tokens.

8. Distributed Ledger Technology: beyond block chain (PDF) (Report). Government Office for Science (UK). January 2016. Retrieved 29 August 2016.
 9. Blockchain and the future of digital assets, thematic report, by EU Blockchain https://www.eublockchainforum.eu/sites/default/files/report_digital_assets_v1.0.pdf
 10. See 9
 11. See 9
 12. See 9

Glossary

ITEM	TYPE	DESCRIPTION
Non-Fungible Tokens(NFT)	Basic terminology	A non-fungible token (NFT) is a special type of cryptographic token which represents something unique; NFT are thus not mutually interchangeable.
Consortium versus public, permission versus permissionless blockchains	Basic terminology	A permissioned blockchain (also known as private) can be thought of as closed ecosystems that can only be accessed by those who are allowed access. This is useful for companies, banks, and institutions that are comfortable to comply with the regulations and are very concerned about having complete control of their data. On the contrary, popular blockchains such as Bitcoin, Ethereum, Litecoin, Dash, and Monero are permissionless blockchains (also known as public). These allow anyone to transact and join as a validator. The data on these blockchains is publicly available, and complete copies of the ledgers are stored across the globe.
Pseudonymity and anonymity in blockchain	Basic terminology	Anonymity describes situations where the acting person's name is unknown. There is nothing about hiding the act itself. Privacy – on the other hand – is defined as the ability of an individual or group to seclude themselves, or information about themselves, and thereby express themselves selectively.
Decentralised oracles	Basic terminology	Decentralised oracles do not rely on a single source of truth; thereby, such oracles increase the authenticity of the information provided to smart contracts. Unlike centralised oracles, such oracles rely on multiple external sources and aim at achieving trust lessness.
Decentralisation and governance - technical	Basic terminology	Theoretically, decentralisation can make a government more accountable and responsive to the governed. Some advantages of decentralisation are the increase of political competition, improvement of public accountability, reduction of political instability, and the imposition of incentive-compatible limits on government power. However, decentralisation can threaten fiscal sustainability.
Decentralised Autonomous Organisation (DAO)	Funding entrepreneurship	An organisation whose operating rules have been encoded as a computer program in the form of smart contracts, and whose financial transaction record and operating rules are kept on a blockchain.
Initial Coin Offering (ICO)	Funding entrepreneurship	An initial coin offering (ICO) is the cryptocurrency industry's equivalent to an initial public offering (IPO). A company looking to raise money to create a new coin, app, or service launches an ICO to raise funds. ¹³
Incentive systems, mining	Cryptoeconomics	To promote the participation of external users in essential process of validation, cryptocurrencies include incentive systems such as mining. Mining is an essential process through which some participants called miners validate network transactions through operations that require intensive computational effort and for which they are rewarded by receiving tokens. The reward for the mining process is not guaranteed to all participants: it depends on who wins each round of the competition or mining game.

Glossary

ITEM	TYPE	DESCRIPTION
Transaction costs	Cryptoeconomics	The blockchain fee is a cryptocurrency transaction fee that is charged to users when performing crypto transactions. The fee is collected to process the transaction on the network. The lower the blockchain fee, the lower your transaction's priority in the blockchain network.
Staking	Cryptoeconomics	Staking involves holding funds in a cryptocurrency wallet to support the security and operations of a blockchain network. Simply put, staking is the act of locking cryptocurrencies to receive rewards.
Crypto-secession	Cryptoeconomics	Blockchain enables non-territorial "crypto-secession" not only reducing the costs associated with maintaining ledgers, but radically revising and de-concentrating data-conditioned networks to fundamentally challenge the economic positions of legacy firms and governments. ¹⁴
Decentralised finance (DeFi)	Cryptoeconomics - DeFi	Decentralised finance (or DeFi) is an experimental form of finance that does not rely on central financial intermediaries such as brokerages, exchanges, or banks to offer traditional financial instruments, and instead utilizes smart contracts on blockchains, the most common being Ethereum. DeFi platforms allow people to lend or borrow funds from others, speculate on price movements on a range of assets using derivatives, trade cryptocurrencies, insure against risks, and earn interest in savings-like accounts.
Fork	Cryptoeconomics	In the blockchain industry, a unique network created using the same protocol or consensus as a previously existing network. Forks can contain the original network's state or instantiate their own state. Forks happen naturally when a blockchain network is not at 100% consensus and resolve when the network reaches consensus. Forks can also be forced by refusing to adhere to the consensus of the network.
Stable coins	Cryptoeconomics	Stablecoins are digital units of value designed to minimise fluctuations in their price against a reference currency or basket of currencies. ¹⁵

17. Allen, D. W., Berg, C., & Novak, M. (2018). Blockchain: an entangled political economy approach. *Journal of Public Finance and Public Choice*, 33(2), 105-125.

18. Bullmann, D., Klemm, J. and Pinna, A. (2019), "In search for stability in crypto-assets: are stablecoins the solution?", Occasional Paper Series, No 230, ECB, August.

Introduction

According to the European Commission, blockchain is a new technology that enables large groups of people and organisations, that may or may not know or trust each other, to collectively agree on and permanently record information without the need of a third-party authority. By creating trust in data in ways that were not possible before, blockchain has the potential to revolutionise how we share information and carry out transactions online. Moreover, blockchain will allow more efficient interactions amongst citizens, enterprises, and public organisations, by reinforcing trust and enabling each party to retain control of their data. The technology will be instrumental in building a citizen-centric, sustainable, transparent, and inclusive European digital society.¹⁶

“Blockchain is a new technology that enables large groups of people and organisations, that may or may not know or trust each other, to collectively agree on and permanently record information without the need of a third-party authority”

16. European Commission, (2021), European Blockchain Strategy - Brochure, European Blockchain Strategy - Brochure | Shaping Europe's digital future. <https://digital-strategy.ec.europa.eu/en/library/european-blockchain-strategy-brochure>

How does blockchain work?

IBM defines blockchain as a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An asset can be tangible (a house, car, cash, land) or intangible (intellectual property, patents, copyrights, branding). Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for all involved¹⁷

Blockchain gets its name from the fact that data (such as who, what, when, where, how much, and even the condition – such as the temperature of a food shipment) is stored in groups known as blocks, and that each validated block is cryptographically sealed to the previous block, forming an ever-growing chain of data.¹⁸ To exemplify, each block is like a page of a ledger or a record book, therefore its other name of **Distributed Ledger Technology (DLT)**.

All network participants have access to the distributed ledger and its **immutable record of transactions**. With this shared ledger, transactions are recorded only once. No participant can change or interfere with a transaction after it's been recorded to the shared ledger. If a transaction record includes an error, a new transaction must be added to reverse the error, and both transactions are then visible.

Finally, it is important to know that to speed transactions, a set of rules – called a **smart contract** – is stored on the blockchain and executed automatically. A smart contract can define conditions for corporate bond transfers, include terms for travel insurance to be paid and much more.



Benefits of Blockchain

According to the European Commission¹⁹, the blockchain technology has the potential to disrupt and benefit both society and businesses. Amongst others, the application of the technology enables the creation of:

- New collaborative models in the digital economy (creating trust)
- Transformative capacities (disintermediation, incentives through use of tokens)
- Potential alternative model to dominant platforms (decentralisation, user empowerment)
- Higher quality and efficiency (traceability, immutability)
- New business opportunities for European companies
- European Commission, Gigler.S (2019, May 16), EU actions on Blockchain – Moving beyond the Hype

17. IBM, what is Blockchain, retrieved from website: <https://www.ibm.com/nl-en/topics/what-is-blockchain>
18. EU Blockchain, (n.d.), EU Blockchain Observatory & Forum, EUBlockchain. <https://www.eublockchainforum.eu/>
19. European Commission, Gigler.S (2019, May 16), EU actions on Blockchain – Moving beyond the Hype

Literature Review



2.1. The role of blockchain for start-ups and HE

Since their inception in 2009 with Bitcoin, blockchain technologies have attracted innovators and entrepreneurs due to the opportunities open for building new business ideas on top of the idea of decentralisation. Unlike other technologies, blockchain has also created a new market by itself, that of cryptocurrencies or crypto tokens, which makes the technology unique, since in some way, it brings a kind of built-in mechanism for financing innovations, which can be combined with the usual sources of funding.

In this report, we focus on the literature on the interplay of blockchain and innovations in start-ups and high-growth enterprises. A start-up is a company in its first stages of operations.²⁰ They are founded by one or more entrepreneurs who want to develop a product or service for which they believe there is demand, and usually they start with high costs and limited revenue, which is why they look for capital.²¹ The 2007 OECD-Eurostat Manual on Business Demography Statistics²² defines high-growth enterprises (HGE) as those “with average annualised growth greater than 20% per annum,

over a three-year period, and with ten or more employees at the beginning of the observation period”.²³ Growth is thus measured by the number of employees and by turnover.

As of today, there are no studies or reports available that compare start-ups and/or HGEs that have or have not integrated blockchain. However, it is important to note that many start-ups have based their initial growth in the creation of crypto assets, in a sense funding themselves through the release of them to the public as was the case of Initial Coin Offerings (ICOs), or simply participating in the growth of the newly created market in some way. Also, it is important to note that this is only applicable to companies in the realm of public and/or permissionless blockchains, while consortium or permissioned blockchains (sometimes called “enterprise blockchains”) follow different business and cost-justifying models, which are closer to business integration scenarios, and are not related, or indirectly related, to decentralised markets.

20. Grant, M. (2021, May 7). What You Should Know About Start-ups. Investopedia. <https://www.investopedia.com/terms/s/startup.asp#:~:text=The%20term%20startup%20refers%20to,they%20believe%20there%20is%20demand.>

21. See 5

22. Eurostat-OECD. (n.d.). Eurostat-OECD Manual on Business Demography Statistics. Eurostat-OECD Manual on Business Demography Statistics - Products Manuals and Guidelines - Eurostat. <https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-BA-07-010?inheritRedirect=true>.

23. See 7

Fundamental elements of blockchain

Ilbiz & Durst²⁴ provide a conceptual framework specific to SMEs, that mixes technical challenges (like scalability or network size, which are problems that would eventually be solved by technical means) with the key elements that blockchain brings as key for creating new services, namely: removing intermediaries, immutable and transparent records and creation of crypto assets (which may become

sources of funding for the companies devising them). Going further in similar directions, Kher et al²⁵ provide a survey of research in blockchain and related agenda. From the different perspectives of that survey, we are interested in their conclusions on the following elements:

- 1. Economics.** They focus on the game theoretic and incentive mechanisms, and transaction cost theory and social exchange theory.
- 2. Entrepreneurship.** They focus on the financing side of ICOs, also mention briefly DAOs.
- 3. Law and governance.** Focus on the interplay with existing regulation and the need of new ones

These are three fundamental topics, (1) is the essential ingredient to any blockchain business model that relies on high decentralisation (maybe excluding some consortium applications of blockchains as internal settlements bank networks), (2) points out to two key elements in financing new business specific to blockchain and (3) presents the major barrier of many business models. From a related standpoint, Allen²⁶ draws on entrepreneurial, institutional and transaction cost

theory to discuss the problems of uncertainty faced by blockchain entrepreneurs and discusses the implications to innovation policy. Novak²⁷ also discusses policy, but in this case analyses “crypto-friendly” jurisdictions as attempts to develop local blockchain-enabled economies by removing uncertainties, mainly regulatory and procedural. Regarding elements in which blockchain affects potentially business models, Nowinski and Kozma²⁸ summarised them in the following diagram.

Main application of blockchain technology in start-ups

Regarding elements in which blockchain affects potentially business models, Nowinski and Kozma²⁴ summarised them in the following diagram.

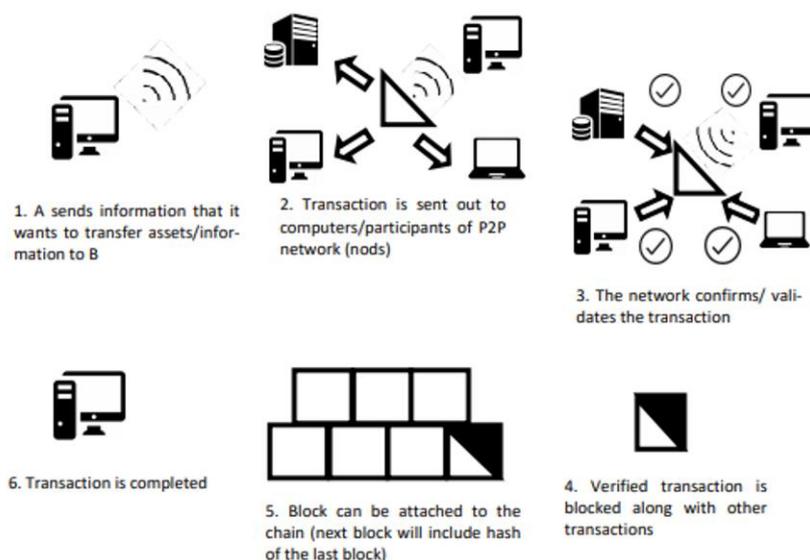


Figure 1: Simplified scheme of a blockchain transaction – Source: adapted model based on PWC (n.d.)

24. Ilbiz, E., & Durst, S. (2019). The Appropriation of Blockchain for Small and Medium-sized Enterprises. *Journal of Innovation Management*, 7(1), 26-45.
25. Kher, R., Terjesen, S., & Liu, C. (2020). Blockchain, Bitcoin, and ICOs: a review and research agenda. *Small Business Economics*, 1-22.
26. Allen, D. W. (2019). Governing the entrepreneurial discovery of blockchain applications. *Journal of Entrepreneurship and Public Policy*.
27. Novak, M. (2019). Crypto-friendliness: understanding blockchain public policy. *Journal of Entrepreneurship and Public Policy*.
28. Nowinski, W., & Kozma, M. (2017). How can blockchain technology disrupt the existing business models?. *Entrepreneurial Business and Economics Review*, 5(3), 173-188.

The potential impact in the above figure identifies elements that are specific to blockchain as the elimination of intermediaries, changes in the role of reputation and transaction security (both not requiring trust in centralised actors), eliminating forgery and supporting crowdfunding in novel ways (e.g. ICOs). Other elements in the diagram are less clearly specific to blockchain, e.g. micropayments per se are not specific to blockchain, but decentralised micropayments (as in lightning networks) are. The same can be said of personalised offerings and others. In what follows, we provide some relevant examples of business areas that are specific to blockchain technologies as a complement to more generic conceptual models.

Cryptoeconomic systems

Hojckova et al.²⁹ provide an interesting analysis of the case of P2P energy trading systems from the perspective of the factors of its eventual success. The study is interesting as a blueprint for all the sectors, since it provides a view of entrepreneurial activity as key in the initial phases of a new model. It also provides an interesting analysis framework of blocking and contributing factors for those innovations.

Blockchain for cooperation and transparency

A case that makes a difference to others is that of using blockchain as a way for enterprises to cooperate and provide transparency among them and to other actors and customers. The most relevant case is that of traceability of food production and delivery chains, that has a considerable number of use cases and even blockchains devised for the case as Ambrosus.

Financial exclusion

Larios-Hernández³⁰ reviews the entrepreneurial and innovation opportunities targeting individuals under financial exclusion, typically unbanked or people regularly involved in remittances. The main point is that the disintermediation brought by blockchain is an interesting approach to the practices of these populations. The main “sensitivities” that need to be considered are: cash preferences, informal lending practices, transfers and remittances, lack of legal identity and lack of attractiveness for conventional services.

Mining, staking, forking and platform-related entrepreneurial actions

In an empirical case study, Jabbar & Bjørn³¹ found that the blockchain infrastructure is shaped by entrepreneurial actions, which are purposeful and self-initiated, aiming at sustaining or increasing one’s own stake in the emerging information infrastructure. Engaging activities as contributing code on GitHub and hiring core developers to work on start-up are largely made possible by the governance enablers of the installed base at this early stage of infrastructural development. The emergence of alternative Blockchains is the result of circumventing activities by various groups and individuals.

Crypto-secession and new forms of organisation

An interesting line of thinking of individuals and groups in the blockchain space is that of breaking the current models, institutions and assumptions that are the “regular space” for business. Indeed, the inception of Bitcoin is connected to ideals and ethical values related to creating social cooperation for money outside of the existing political control, with the idea of decentralisation as the key force. While this does not apply to all business models and not all individuals have that ideological motivation, it is important to address it explicitly. How this affects to entrepreneurship is discussed by Allen et al.³² Chalmers et al.³³ also mention “ideology” as one of the main venture enablers in the blockchain space, analysing cases related to the music industry. Concretely, they identify notions of open-source information and anti-authoritarian decentralised governance structures.

Blockchain as route in funding entrepreneurship and innovation.

Chen³⁴ discusses how the blockchain space provides an alternative, more “democratic” in a sense, to funding entrepreneurial or innovation projects. He mentions **tokens** and **ICOs** as the main elements for that. Alluwhalia et al.³⁵ discuss that route for financing from the perspective of transactions cost theory. Transaction cost is also mentioned by Allen et al.³⁶. ICOs are discussed as a new way of crowdfunding by Martino et al³⁷.

29. Hojckova, K., Ahlborg, H., Morrison, G. M., & Sandén, B. (2020). Entrepreneurial use of context for technological system creation and expansion: The case of blockchain-based peer-to-peer electricity trading. *Research Policy*, 49(8), 104046.
30. Larios-Hernández, G. J. (2017). Blockchain entrepreneurship opportunity in the practices of the unbanked. *Business Horizons*, 60(6), 865-874.
31. Jabbar, K., & Bjørn, P. (2017). Growing the Blockchain information infrastructure. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 6487-6498).
32. Allen, D. W. (2017). Discovering and developing the blockchain cryptoeconomy. Available at SSRN 2815255.
33. Chalmers, D., Matthews, R., & Hystop, A. (2019). Blockchain as an external enabler of new venture ideas: Digital entrepreneurs and the disintermediation of the global music industry. *Journal of Business Research*.
34. Chen, Y. (2018). Blockchain tokens and the potential democratisation of entrepreneurship and innovation. *Business Horizons*, 61(4), 567-575.
35. Ahluwalia, S., Mahto, R. V., & Guerrero, M. (2020). Blockchain technology and startup financing: A transaction cost economics perspective. *Technological Forecasting and Social Change*, 151, 119854.
36. Allen, D. W., Berg, C., Markey-Towler, B., Novak, M., & Potts, J. (2020). Blockchain and the evolution of institutional technologies: Implications for innovation policy. *Research Policy*, 49(1), 103865.
37. Martino, P., Bellavitis, C., & DaSilva, C. M. (2019). Blockchain and initial coin offerings (ICOs): a new way of crowdfunding. Available at SSRN 3414238.

Financial innovations and the Decentralised Finance (DeFi) space.

Chen & Bellavitis³⁸ provide an introduction of **decentralised finance (DeFi)** as a potential disruptor of financial services, with a potential to broaden financial inclusion, facilitate open access, encourage **permissionless** innovation, and create new opportunities for entrepreneurs and innovators. They frame those innovations in transaction cost economics (TCE) and point disintermediation as the core element, combined with the borderless and transparent nature of blockchain platforms. That disintermediation combined with the idea of permissionless innovation (i.e. innovators can deploy their ideas without any constraint from third parties in open permissionless blockchains) may lead to combinatorial innovation, in which innovations are combined freely.

Decentralised finance services (or “protocols”) include liquidity pools, lending platforms, decentralised exchanges, debt markets and decentralised. Despite the current high level of activity and the proliferation of new proposals, the

field of DeFi is currently not free of risks, Schär³⁹ mentions smart contract execution risk, operational security and the dependencies on other protocols and external data. Further, there are authors that claim fundamental flaws to the concept of DeFi, for example, Harwick & Caton⁴⁰ consider the elimination of counterparty risk by technical means only as impossible while maintaining the pseudonymity inherent to decentralisation.

From a technical perspective, the initial DeFi innovations relied in the existence of stable coins and on-chain collateral. Stable coins are centralised (as for example, Tether) or decentralised tokens (as for example, DAI) that maintain their value close to a regular asset as the US dollar that is considered to be stable, i.e. less volatile. Collateralisation requires locking blockchain tokens associated to algorithms coded in smart contracts (in general, DeFi protocols are based on over-collateralisation), and that in most cases include some form of governance of the financial system by token holders.

CONCLUSIONS

Blockchain technologies can be adopted by start-ups and HGE both as part of the service or solution in their business model, but also as a platform for the funding of the business itself, since blockchains create economies and markets that entrepreneur can benefit from (in the case of public blockchains). Regarding the main business value elements, these include immutability and transparency, decentralisation (removal of intermediaries) and the core capability of creating markets by the combination of the core capabilities as shared ledger and the programmability provided by smart contracts.

This makes blockchain an area for entrepreneurship in which financing and business models may in some cases become closely entangled in contrast with other technologies enabling business models.

In addition to ICOs and DAOs, which are currently discussed as the core companion funding models, DeFi promises to provide an additional route by freeing credit and lending from traditional institutions, albeit being currently immature for wide adoption.

Among the risks, regulatory fit is the most important potential barrier, together with the fact that decentralised business models are break the common assumption that the entrepreneur is the sole or principal owner of the solution, which requires considering alternate models since appropriation and ownership of a technology, user base or lock-down are in general not viable routes, due to their conflict with the idea of decentralisation. -



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2.3. Blockchain skills and competences

What are competences?

According to Recommendation of the European Parliament and of the Council of 23rd April 2008 on the establishment of the European Qualifications Framework for Lifelong Learning (Framework for Defining Learning Outcomes):

- “knowledge” means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study;
- “skills” means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive or practical;
- “competence” means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

Entrepreneurs must always deploy a set of competencies to succeed in their entrepreneurial activities⁴¹. Competencies are seen as features that a person brings to a job situation, which can result in effective and/or higher performance in such job⁴². These characteristics consist of: motives and traits, social role and self-concept, knowledge, skills, attitudes, and capabilities and characteristics (personal qualities)^{43 44 45}.

In the case of entrepreneurs, they do not have jobs in the traditional sense; however, they do have jobs or tasks as they keep and run a new enterprise^{46 47}. Understanding what competencies need to be developed is important in trying to meet the training needs of people in every phase of the entrepreneurial process. Previous research from

Henry et al.⁴⁸ and Izquierdo³⁷ have recommended that entrepreneurship education must be focused on what occurs in each phase of development, these phases contain: awareness, pre startup, startup, growth, and maturity^{48 49 50}.

Blockchain, a model of interdisciplinary competences

According to Düdder et al.⁵¹, blockchain requires a set of interdisciplinary skills. To operate successfully and across disciplines, additional competencies are required in addition to expertise in one's own field. Not only expertise in other fields, but also social skills and appreciative communication skills are decisive factors for successful cooperation⁵². An interdisciplinary environment allows for rapid decision-making, cognitive diversity, and innovative content or creativity, as well as risks such as lack of openness to other disciplines, communication barriers, and conflicts^{53 54}. The focus here is on the integration and synthesis of different perspectives and methods for solving complex problems. The key elements are interdisciplinary communication and psychological readiness to apply knowledge in relevant related disciplines^{55 56}.

One interdisciplinary education programme on Blockchain is based on the developments of “BlockNet” project (“BlockChain Network Online Education for interdisciplinary European Competence Transfer”)⁵⁷, which has lately introduced an interdisciplinary blockchain modular online course for universities’ master programs and on-the-job trainings. Project BlockNet is funded by the European Commission in the context of the Erasmus+ program “KA2-Cooperation for Innovation and the Exchange of Good Practices. Strategic Partnerships for higher education”.

41. Izquierdo, E., & Deschoolmeester, D. (2010). What entrepreneurial competencies should be emphasized in entrepreneurship and innovation education at the undergraduate level. *Handbook of research in entrepreneurship education*, 3, 194-207.

42. Boyatzis, R. E. (1982). *The competent manager: A model for effective performance*. John Wiley & Sons.

43. Spencer, L. M., & Spencer, S. M. (1993). *Competence at work: models for superior performance*. New York [etc.]: John Wiley.

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45. Bagheri, A., & Pihie, Z. A. L. (2011). Entrepreneurial leadership: Towards a model for learning and development. *Human Resource Development International*, 14(4), 447-463.

46. Bird, B. (2002). Learning entrepreneurship competencies: The self-directed learning approach. *International Journal of Entrepreneurship Education*, 1, 203-227.

47. See 37

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51. Düdder, B., Fomin, V., Gürpınar, T., Henke, M., Iqbal, M., Janavičienė, V., Matulevičius, R., Straub, N., & Wu, H. (2021). Interdisciplinary Blockchain Education: Utilizing Blockchain Technology from Various Perspectives. *Frontiers in Blockchain*, 3:578022. DOI: 10.3389/fbloc.2020.578022

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53. Nancarrow, S. A., Booth, A., Ariss, S., Enderby, P., & Roots, A. (2013). Ten principles of good interdisciplinary team work. *Human Resources for Health*, 11:19. DOI: 10.1186/1478-4491-11-19

54. Brandstädter, S., & Sonntag, K. (2016). Interdisciplinary collaboration. In *Advances in ergonomic design of systems, products and processes* (pp. 395-409). Springer Vieweg, Berlin, Heidelberg.

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56. Düdder, B., Fomin, V., Gürpınar, T., Henke, M., Iqbal, M., Janavičienė, V., Matulevičius, R., Straub, N., & Wu, H. (2021). Interdisciplinary Blockchain Education: Utilizing Blockchain Technology from Various Perspectives. *Frontiers in Blockchain*, 3:578022. DOI: 10.3389/fbloc.2020.578022 e-Estonia. Available online at: <https://e-estonia.com> (accessed May 14, 2021)

57. see 48

In Figure 2 below, twelve domain-specific competence clusters are presented and structured along the four main fields of competences (technical, social, personal, methodological) according to Reetz^{58 59} and Baethge et al.⁶⁰. Combining these four competences Düdder et al.⁶¹ create a superordinate competence – the “occupational acting competence”. This competence is understood as “the willingness and ability of the individual to think through professional, social and private situations properly and to behave in an individual and socially responsible manner”⁶².

In the context of the BlockNet project, the occupational acting competence can be seen as the overarching competence goal and is titled as “occupational acting competence for Blockchain related interdisciplinary projects”. The used Occupational Acting Competence Model (KMK) model is based on the presented four competences. KMK, however, collects competences in a more granular and differentiated way. This leads to the fact that learning competences, which are particularly important for the BlockNet learning course, can be considered separately⁶³.

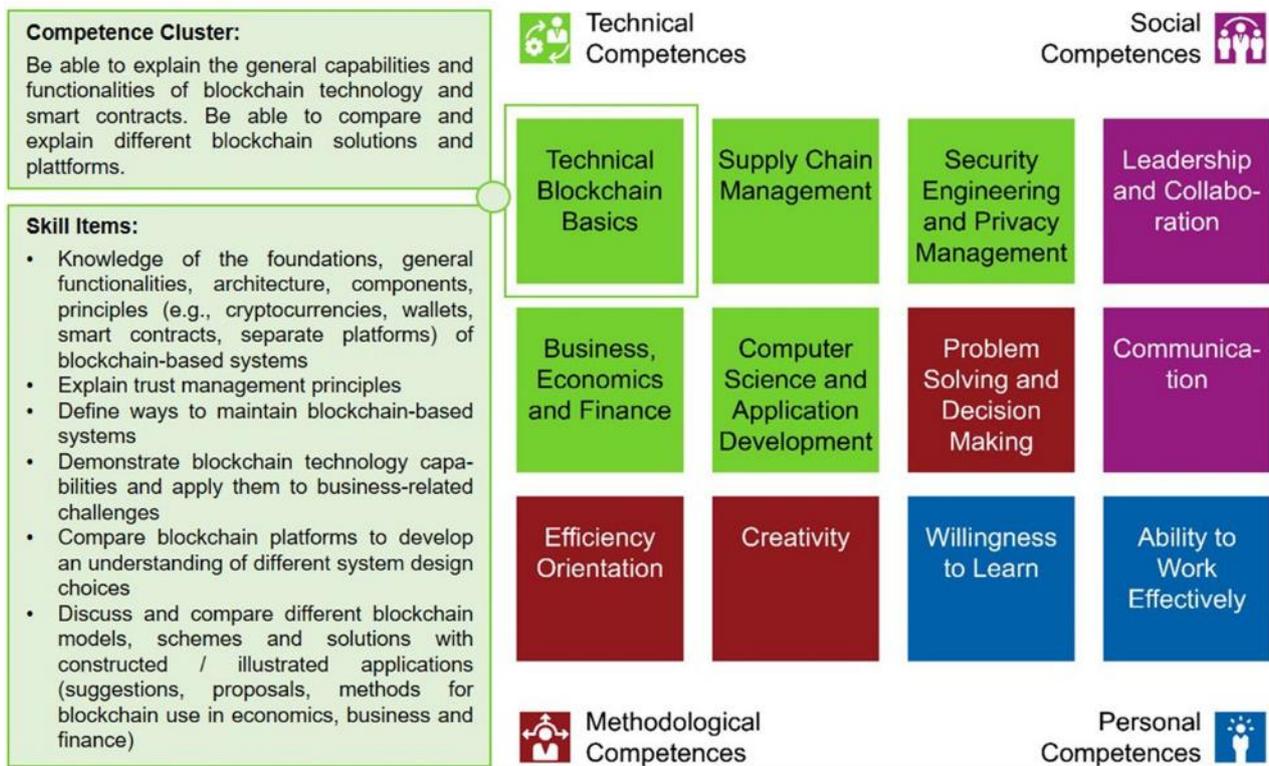


Figure 2. BlockNet competence model. Used with Permission. Graphic by Düdder et al. (2019⁶⁴).

Management researchers and practitioners need to improve their theoretical and practical knowledge of transaction costs, management mechanisms, and risk mitigation to better understand possible ways to implement a blockchain system and implement the business needs of a particular company⁶⁵.

Düdder et al. point out that there may be a need to adapt financial methods for estimating transaction costs and return on investment, considering the different technological and organisational logic of blockchain technology compared to traditional IT systems.

Blockchain as an academic subject intersects with different sub-disciplines of theoretical and practical computer science. The interdisciplinary scope of the research on blockchain is prompted by a range of industries for which blockchain uses cases and proofs of concepts can be found today. The study of Düdder et al.⁶⁶ shows that the successful design, development, and implementation of blockchain-based business solutions requires deployment of interdisciplinary teams of experts with domain-specific knowledge.

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 62. See 57
 63. See 57
 64. See 57
 65. Lumineau, F., Wang, W., & Schilke, O. (2020). Blockchain governance - A new way of organizing collaborations. Organization Science, Forthcoming. Available online at: <https://ssrn.com/abstract=3562941> (accessed May 28, 2021).
 66. See 57

2.3. Andragogy to teach Blockchain competences

One possibility for teaching entrepreneurship is to use project- and case-based learning and using entrepreneurs as lecturers. In this case, learners will interactively discuss both the good and bad aspects of the project. Freeman et al.⁶⁷ and Düdder and al.⁶⁸ point out that project-based teaching and learning is a dynamic teaching approach based on the opinion that learners acquire more complete knowledge via active experiences. This method is particularly well suited for interdisciplinary learning activities, which is a characteristic of blockchain.

Based on the different backgrounds of the learners, educational approaches in the field of blockchain need to be framed as interdisciplinary from the core

to be effective in empowering learners' employability. Blockchain is a highly interdisciplinary field, bringing together novel challenges and opportunities at the intersections of computer science, economics, engineering, finance, business, and law. This makes it necessary for educators to apply interdisciplinary courses giving learners important skills and knowledge of blockchain technology and its application and impact in the fields of Supply Chain and Logistics, Business, Economics, Finance, and Computer Science. This will help learners acquire the knowledge and skills needed to exploit opportunities and to be prepared for changes in employment trends ([Project BlockNet](#)).

Researchers in education are continuously exploring new forms of teaching, learning and assessment that can support learners' skills. Digital and online learning seems to be an amendment in innovating and individualising pedagogy for learners, and in providing solutions for an educational journey. By the exploitation of digital and online learning, trainers and learners can also promote soft and digital skills and competence via participating learning methodologies built on connectives and constructivist learning theory. Digital and online learning can provide learners and trainers with engaging opportunities to strike and exploit multimedia information, and to apply academic and vocational skills to solving actual work problems/situations that could be linked, simulated, or expressed as virtual reality in schools⁶⁹.

It is important to develop interdisciplinary courses that provide comprehensive blockchain competencies and knowledge, help to understand the scope of blockchain application, and its impact on different business environments^{70 71}.

In the course "Important basics of interdisciplinarity" at TU Dortmund practical topics will also be discussed and directly tested in practical phases. In this way, students will be given a definition of the concept of interdisciplinarity, and a distinction will be made, for example, between interdisciplinarity and multi-disciplinarity. In the workshop "Intercultural Communication" at TU Dortmund, students can further develop their intercultural competences, one of the soft skills that is very much in demand in the profession⁷².

Engineers often spend a large part of their working time on written documentation and communication. These skills become an important key competence in application of blockchain in business. In addition, presentation skills are also crucial if you want to sell yourself and your products well and convey technical knowledge in a skilful way. For instance, the workshop "Target Group Adaptive Writing and Presentations for Engineers – Basics" at TU Dortmund uses many exercises and individual consultation to convey in a compact and comprehensible way how professional success can be increased and communication can be made more effective with well thought-out writing⁷³.

67. Freeman, S. et al. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America*, 111(23), 8410–8415. DOI: 10.1073/pnas.1319030111

68. See 48

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72. See 48

73. See 48

Blockchain in the European Union



3.1. What is happening at the supranational level?

“Europe’s ambition is to set the gold standard for blockchain technologies. We have implemented a strong regulatory and policy framework that supports sustainable blockchain innovation as well as the start-up and scale-up ecosystems. Administrations across Europe play a trailblazing role in implementing this exciting and essential new technology.”

Roberto Viola,
Director General, DG CONNECT

Blockchain is one of the key emerging technologies for Europe, on a par with AI, IoT, Quantum Computing and 5G. Known as the technology of trust, it enables large groups of people and organisations that may not know or trust each other to agree on and permanently record information without the need for a third-party authority.

Blockchain is important for the European Union (EU) as it can help revolutionise how data is shared, transform Europe's industries and cross-border public services, build a citizen-centric digital society, and more broadly contribute to the European economy. While the technology develops fast and continuously, EU officials have casted doubts over the standards that are being set by players in the rest of the world, who do not always share the same European values when it comes to privacy or sustainability. To address the issue, the EU aims to become a leader in blockchain and to ensure that the development of the technology goes hand in hand with EU values.

The bloc has recently developed the **EU Blockchain Strategy**, which, on the one hand, is designed to enable innovation, accelerate the adoption of the technology, and create a balanced and consistent legal framework for blockchain and digital assets. More specifically, the EU Blockchain Strategy aims to:

DEVELOP STRONG POLITICAL PARTNERSHIPS

In 2018, the Commission signed a declaration with 21 EU member states institutionalising the European Blockchain Partnership (EBP). The EBP is a joint initiative to develop a common EU strategy on blockchain and to build the first European Blockchain Services Infrastructure (EBSI), creating and sharing a blockchain structure available to the public. The EBP and EBSI serve as a technological and regulatory sandbox, leading to better, more informed regulation on the technological and use case front⁷⁷.

Promote legal certainty

In its strategy, the Commission envisioned a shared blockchain legal and regulatory framework. To this hand, it has launched a proposal for an EU regulatory approach to crypto-assets⁷⁸. Additionally, *Blockchain for Europe*, an organisation that represents numerous international blockchain companies at the EU-level, supports European policymakers, academics and companies to develop a European regulatory framework to support and promote blockchain-based innovation

Provide funding for blockchain innovation

The EU provides funding for blockchain research and development through grants and investments. Since 2013, the block has funded several projects that are aimed at promoting the implementation of blockchain. The funding was originally issued through the Framework Programme for Research, and subsequently through the Horizon 2020 programme. It is estimated that between 2016-2020, the Commission issued over EUR 200 million in prizes and grants through Horizon 2020 only⁷⁴.

Additionally, the European Commission and its member states have set up an **AI/Blockchain Investment** fund to support highly innovative start-ups. It is estimated that around EUR 500-700 million will be made available by the end of 2021⁷⁵. Thereafter, the EU and its Member States will enlarge the fund under the InvestEU programme and the Recovery and Resilience Facility. The aim of the funds is "to finance the development of highly innovative artificial intelligence and blockchain companies as part of a wider move to create a dynamic EU-wide innovation ecosystem⁷⁶."

Support blockchain interoperability and standards

In terms of blockchain standards, the European Commission has taken an active role, especially in relevant topics such as interoperability, governance, identity, security, and smart contracts. Some of the main organisations that work on European blockchain standards include: StandICT, the European Committee for Standardisation, national standards bodies and global organisations such as the International Organisation for Standardisation (ISO) (e.g. ISO TC307).

74. European Commission. (2021). European Blockchain Strategy - Brochure. European Blockchain Strategy - Brochure | Shaping Europe's digital future. <https://digital-strategy.ec.europa.eu/en/library/european-blockchain-strategy-brochure>.
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77. European Commission. (2021). Blockchain funding. Shaping Europe's digital future. <https://digital-strategy.ec.europa.eu/en/policies/blockchain-funding>.
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The Commission interacts with the private sector, academia and the blockchain community primarily through two bodies:

- The International **Association for Trusted Blockchain Applications (INATBA)**, a multilateral public-private partnership which brings together governmental representatives, international organisations, industry (including small enterprise and micro enterprise) and academia.
- The European Blockchain Observatory and Forum, created by European Commission and funded by the European Parliament, to accelerate blockchain innovation and the development of the blockchain ecosystem within the EU and so help cement Europe's position as a global leader in this transformative new technology

DEVELOP BLOCKCHAIN SKILLS

The European Commission has invested in initiatives focused on skills development to ensure that the needed high-level skills are developed and available. Here are some of the major initiatives:

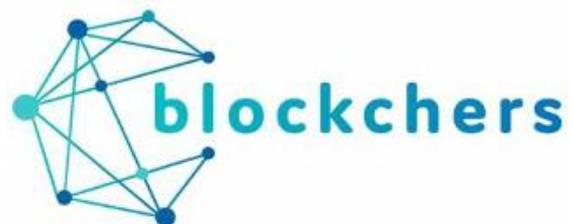
BLOCKCHAIN SKILLS FOR EUROPE

The BlockCHAIN Skills for Europe (CHAISE) initiative was recently funded by the Commission. It aims to develop a strategic approach on blockchain skills development and will result in the design of the European Blockchain Skills Strategy. A 5-semester Vocational education and training programme will be developed in 10+ EU languages. The learning materials will be combined into an open online course, the first-ever "blockchain specialist" occupational profile to be developed. This will be in line with existing competences and qualification frameworks. The CHAISE project will also kick off the European Blockchain Skills Cooperation Network and National Blockchain Skills Partnerships. These will ensure the implementation of the Blockchain Skills Strategy both at the EU and national level upon the project's completion.



BLOCKCHERS

Blockchers is a Horizon 2020 project that will facilitate the revolution of blockchain and other distributed ledger technologies (DLTs) across European SMEs. It is an acceleration process for SMEs and start-ups to build real world use cases of blockchain technologies, thereby financing real world use cases of this technology in traditional sectors. (De Meijer, 2019) One of the main goals of Blockchers will be fostering the matchmaking among traditional SMEs and potential DLT specialists, as technology providers, and "sensitize about the benefits and opportunities around DLTs to implement real use case scenarios in a variety of verticals". Alastria Blockchain Ecosystem has been chosen by the European Commission as the technological partner for the Blockchers Project. They will provide the blockchain infrastructure to the start-ups participating in this EU Project, developing blockchain solutions to SMEs. (De Meijer, 2019)



79. See 30

BLOCKSTART

A leading European innovation consultancy Bax & Company has set up a pan-European blockchain/DLT acceleration programme Blockstart. Its main objective is to facilitate mutually beneficial partnerships between blockchain/DLT solution providers and end-user SMEs. In its 3rd and final Open Call (until May 26, 2021), BlockStart is looking for early and growth-stage blockchain/DLT startups from all over the EU and H2020 Associated Countries. These 3 stage-immersive acceleration programmes (Ideation Kick-off > Prototype > Pilot) will manage a fund of at least €265,000 aimed at financing blockchain/DLT technologies in the fields of fintech, ICT and retail, with selected startups receiving up to €20,000 equity-free funding per pilot. At the end of the programme, selected startups will have the chance to pitch to a large audience of investors, stakeholders, startups and others at BlockStart's Demo Day, planned for February 2022. (De Meijer, 2019; Insights, 2021)



EUROPEAN DIGITAL ACADEMY

The European Digital Academy was funded by the Commission with the support of the European Parliament and launched in 2020. It has the objective to support the reskilling and upskilling of individuals and SMEs in key emerging technologies such as blockchain. To achieve this, the academy will develop a new platform which maps online learning opportunities from different providers. Furthermore, online training modules will be developed based on the needs identified by the project.



DIGITALEUROPE

DIGITALEUROPE is a trade association that represents industries undergoing digital transformation in Europe. Through their work with European institutions and EU member states, DIGITALEUROPE aims to shape the blockchain policy and business environment. Important to notice that they include in their key performance indicators of a stronger digital Europe the nurturing of SMEs and scale-ups, as well as AI and the Data Economy, through investment in technologies.



3.2. BLOCKCHAIN POLICIES, STRATEGIES, AND CONTEXT IN THE PARTNERS COUNTRIES

While the European Commission is setting up the foundation for the wide implementation of blockchain throughout Europe, EU member states have been taking initiatives in testing the technology, investigating its benefits and the best ways to integrate it at a national level. After the 2017 announcement of Alastria (Spain) and the Dutch Blockchain Coalition, two of the first self-proclaimed multi-sector blockchain ecosystems in the world, multiple initiatives have followed. Very often, it concerns reports, as it has been particularly the case for the UK.

policymakers – and/or specific target audiences – but also a mean to bring awareness on innovative blockchain projects and initiatives happening at national, supranational or industry levels.

In the following section, we delve into the national contexts and blockchain ecosystems of our partner countries, namely the **Netherlands, Denmark, Estonia, Ireland, the UK, and Spain**. The non-systematic desk research exercise aims to evaluate the stage of development and acceptance of blockchain across partners countries. While some countries have government-led or co-led blockchain ecosystems or clusters, such as Estonia, the Netherlands, Denmark, others have seen industry-specific cluster such as finance forming, led by major organisations within the industry sector (e.g. in Ireland and the UK), with little involvement from the respective governments.



Estonia is internationally recognised for its digital society. The EU member state, which counts less than 2 million inhabitants, has managed to develop one of the most technologically advanced systems of government serving as a role model to many. 99% of its public services are electronic. Not surprisingly, Estonia has also been the first country in the world to integrate blockchain technology at the governmental level.

Furthermore, the government has included the further research & development of blockchain in its strategic priorities for 2022, as well as it has cooperated with international organisations, such as NATO, to ensure the integrity of data.

Cybersecurity strategy. Republic of Estonia 2019-2022

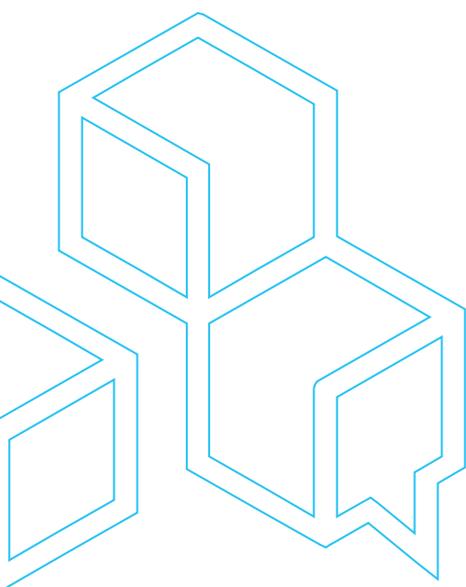
The Cybersecurity Strategy⁸⁰ was introduced in 2019 and it has the goal to develop definite principles and political anchor points on key issues regarding future technologies. Furthermore, it wants to ensure that the risks and threats that arise from the development of new technologies are properly addressed. To achieve the goal, the government has set research competences and research priority fields for Estonia, such as cryptography, blockchain technology, AI and secure identity management, to ensure that the development of critical capabilities and competence are represented at the level of fundamental and applied research. Republic of Estonia. Cyber Security Strategy. Ministry of Economic Affairs.

Developers of security and safety with international organisations

After Estonia's experience with cyber-attacks in 2007, which defaulted key economic and political infrastructures, the government scalable blockchain technology was developed to ensure the integrity of data stored in government repositories and to protect its data against insider threats. Estonia became host to the NATO Cooperative Cyber Defence Centre of Excellence and the European IT agency.⁸¹

KSI Blockchain⁸²

Estonia has been the first country in the world to deploy blockchain technology, through KSI blockchain, in production systems with the Succession Registry kept by the Ministry of Justice. KSI is a blockchain technology used globally to make sure that networks, systems, and data are free of compromise, all while retaining 100% data privacy. With KSI Blockchain deployed in Estonian government networks, history cannot be rewritten by anybody, and the authenticity of the electronic data can be mathematically proven. It means that no-one – not hackers, not system administrators, and not even government itself – can manipulate the data and get away with that.



80. Republic of Estonia. Cyber Security Strategy. Ministry of Economic Affairs.
81. e-Estonia. (2019, April 3). Security and safety - e-Estonia. e. <https://e-estonia.com/solutions/security-and-safety/>.
82. See 8.



The Netherlands is internationally seen as one of the forerunners in the field of blockchain and has carried out a relatively large amount of blockchain research. In general, the Dutch international focus, trading spirit and current leadership position in the field of blockchain, have proven to be good enablers for international connections to blockchain hubs internationally. Various collaborations have been set up within these hubs: outgoing and incoming blockchain missions, hackathons, research projects and joint projects.

Organisations such as the Dutch Blockchain Coalition facilitate numerous collaborations both nationally and internationally. Nationally, Dutch government favours a vision for a 'blockchain-based government' with an action plan in line with their Digitalisation Strategy adopted in June 2018 (and updated in 2019). This strategy mentions blockchain projects and initiatives that have been taking place in collaboration with government (and other) public and private partners over the past few years.

Dutch Digitisation Strategy

The Dutch Digitisation Strategy⁸³ was launched in 2018 and emphasises that digitisation offers opportunities for prosperity, but also comes with the challenges. It encourages collaboration to overcome these challenges. It was the first government-wide formulation of ambitions and objectives in the field of digitisation.

Three main goals were highlighted in this strategy:

1. For the Netherlands to become a digital leader in Europe, as well as a pioneer and testing ground for responsible digital innovation, everyone must be able to participate both in the industry and society, which requires basic skills, digital inclusion, sustainable employability, and lifelong development. It will also require retraining and training for future skills and jobs.
2. Providing a good basis of trust, including privacy, digital security, and careful application of new technology, with clear agreements about sharing data (Rijksoverheid, n.d.).
3. In the Dutch Digitalisation Strategy (Rijksoverheid, n.d.) five blockchain projects are presented that are related to services provided by the national government.

The blockchain projects are started for citizens, companies, institutions, and governments around:

- Self-Sovereign Identity (SSI): smooth, reliable digital interaction
- Pensions: full insight into current costs at a lower cost pension construction and easy switching
- Logistics: transparent, reliable, fair chains
- Education: development of a European provision for clarity about diplomas obtained
- Compliance by design: expenditure always according to the requirements

The projects on identities and degrees are also part of an EU approach to implement blockchain solutions. Several initiatives related to blockchain have been underlined by the Dutch Digitisation Strategy as important for digitisation, such as the Human Capital Agenda, and the Dutch Blockchain Coalition. Such initiatives look to bring digital companies and professionals together and will help advance the Digitisation Strategy for the Netherlands.

The Dutch Blockchain Coalition

Already in March 2017, representatives from the public, private and knowledge sector took the initiative to establish the Dutch Blockchain Coalition (DBC)⁸⁴. Government entities recognised the urgent need for such an initiative and facilitated the process of establishing a national coalition.

With building blocks such as digital identities, security and legal frameworks, the DBC lays the foundation for the large-scale roll-out of blockchain technology with parties from the logistics, energy, financial services and ICT sectors, and the government.

It also works off an action agenda, that investigates the possibilities for blockchain technology, assesses whether this technology sufficiently satisfies legislation, and builds research and training programmes in this field. This action agenda focuses on the following three lines of action;

1. Developing blockchain building blocks: Digital Identities;
2. Realising the conditions for utilising blockchain,
3. developing and realising the Human Capital Agenda (mentioned above). Internationally the DBC makes agreements about standardisation, norms, and governance with parties like ISO and the European Commission. It also works on other cross-border initiatives.

83. Ministerie van Algemene Zaken. (2019, July 19). Nederlandse Digitaliseringsstrategie 2.0. Rapport | Rijksoverheid.nl. <https://www.rijksoverheid.nl/documenten/rapporten/2019/07/05/nederlandse-digitaliseringsstrategie-2.0>.
84. Dutch Blockchain Coalition. (2017). Actieagenda. BC3. <https://dutchblockchaincoalition.org/uploads/pdf/Blockchain-actieagenda-v2.pdf> & Dutch Blockchain Coalition (2018). Blockchain for Good. BC3. <https://dutchblockchaincoalition.org/uploads/pdf/Visiedocument-Blockchain-For-Good-NL.pdf>

Denmark has been very progressive in its push towards mainstream adoption of the blockchain and AI in governmental and Industry functions, though specific experiences from Danish companies are still limited. The government of Denmark is looking into the use of AI and the blockchain in digital identity (citizen-first approach), healthcare, business support and its welfare system. The EU member state is one of those countries which have ensured that most of its service provision to citizens is done digitally. Indeed, 90% of Denmark's governmental services are already being done digitally⁸⁵. The country is also being forced into the blockchain evolution by the country's population demographics. Denmark's ageing population means that fewer younger people are available to get into the public service. Therefore, this is a classical case where augmentation of the human workforce using the blockchain and AI is desirable. For Denmark, this has become a necessity, even though it can be quite controversial.

The publication of the **Digital Strategy for the years 2016-2020**⁸⁶, titled "A Stronger and More Secure Digital Denmark", identifies three goals that will serve as the template on which the Danish government would kick-start AI and blockchain-based initiatives. These goals are to provide an enabling environment for growth of the sector, fostering the development of high-quality digital solutions that are user-friendly, and to make security and confidence in the AI-based systems a priority.

Furthermore, the establishment of **DCKAI (the Danish Centre for Artificial Intelligence)** is one of the strategies that was identified as central to the full-scale adoption of AI in Danish government businesses. The strategy was defined in the document "Towards a Digital Growth Strategy – MADE," published by the Danish government in October 2017. The launch in January 2018 of the "Strategy for Denmark's Digital Growth," which makes AI the central focus of further digital and tech advances. Finally, the publication of the "Study on the Economic Impact of Blockchain on the Danish Industry and Labour" report in 2019 by the European Blockchain Center at the IT University of Copenhagen, Fraunhofer Institute for Industrial Engineering, Confederation of Danish Industry, Statistics Denmark, and the Danish Industry Foundation.

The Danish government is looking into developing a blockchain ecosystems, through the creation of clusters, as a competitive strategy in the context of a global economy. While it is too early to say which will be the driving forces for a blockchain industry cluster in Denmark, there are several start-ups and established companies in the Greater Copenhagen region that may indicate the emergence of a blockchain industry cluster. The overview of the Danish blockchain cluster illustrated that most identified blockchain-related entities can be classified in three main sectors: fintech, professional services industry and IT, and the maritime shipping and transportation industry.



85. (Basu, 2017).

86. The Ministry of Finance. (n.d.). Digital Strategy 2016-2020. Agency for Digitisation. <https://en.digst.dk/policy-and-strategy/digital-strategy/>.



With its record of a global technology hub, it perhaps not surprising that Ireland is now positioning itself as a blockchain development centre of excellence with some companies leveraging blockchain technology. For example, Ireland already hosts many companies involved in blockchain, including Accenture, Arc-Net, Coinbase, ConsenSys, Deloitte Labs, Fidelity Labs, Circle and Infosys. Blockchain is particularly being adopted in the finance, insurance and fintech industries and it is also being used by public bodies, in supply chain,

logistic management and as part of technology infrastructure. There are several government initiatives to support businesses in Ireland. However, specifically regarding blockchain, these initiatives are not fully coordinated between government entities and are not yet embedded in a holistic national digital strategy. Despite the lack of regulation and governmental support, Ireland is becoming something of a hub for blockchain development in the giant corporations but the application uptake in SME's is low.

However, in the intervening 2 years, the government has sought to enact policies and strategies to ensure that any digital transformation is supported at national level by actions encompassing multiple dimensions, from the development of digital competences in the workforce to ensuring a sound environment for the creation and implementation of innovative solutions. Some of these are:

- Proposed National Digital Strategy: identifying key areas for development and support: AI, VR, 3D Printing and Blockchain.
- Supporting enterprise-led network initiatives to encourage the adoption of productivity-enhancing techniques such as ERP and industrial robots.
- Providing opportunities to upskill or reskill, including on the job training, short courses, industry certification and formal education and training programmes, for example, through the New National Apprenticeship Scheme
- Support digitalisation of business processes in SMEs, for example through targeted loans or vouchers and creation of a small number of regional competence centres
- Encouraging wider take-up of Skillnet Ireland programmes to develop management capabilities in Irish SMEs and consider a further push to target firms that are not at the technological frontier.

The Irish National Government recognises that Blockchain could deliver cost savings and efficiencies in many sectors and that the technology presents an opportunity to assist in the delivery of the IFS2020⁸⁷ objectives by fostering growth in the technology sector, while supporting indigenous companies and continue to secure foreign investment.

Regarding blockchain, in a 2018 report, the combination of a lack of high-quality and affordable infrastructure, a lack of trust in digital technologies and activities, a shortage of the requisite skills, an inadequate regulatory environment, and security

concerns were identified as the major barriers to uptake. These findings have been considered in the preparation of the Industry 4.0 Strategy, the strategy that will most likely have the greatest impact on digital innovation in Ireland and which is focused on the digital transformation of the manufacturing sector and its supply chain⁸⁸.

87. International Financial Services Strategy. Gov.ie – December 2020 retrieved from website: <https://www.gov.ie/en/publication/ireland-for-finance-strategy/>.

88. Government of Ireland. (2019). Ireland's Industry 4.0 Strategy 2020-2025. Ministry for Business Enterprise and Innovation. <https://enterprise.gov.ie/en/Publications/Publication-files/Irelands-Industry-4-Strategy-2020-2025.pdf>

89. Gobierno de España. (2021). Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027. Secretaría General Técnica del Ministerio de Ciencia e Innovación. <https://www.ciencia.gob.es/stifis/MICINN/Ministerio/FICHEROS/EECTI-2021-2027.pdf>



While the country does not have an official blockchain strategy, blockchain has become in practice a legitimate area of interest in the landscape of research and innovation. This is complemented by a significant activity of associations and groups, and the existence of some blockchain specific hubs and incubators point out to a relevant entrepreneurial activity.

The EECTI (Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027)⁸⁹ is the strategic plan of Science, Technology and Innovation that drives policy in these areas and serves as a framework for different calls and initiatives. Blockchain is a subline in the line “Next Generation Internet” that is included in the group of “Digital World, Industry, Space and Defence”. As such, it is explicitly included in the agenda for R&D and innovation. This is reflected in the fact that in calls for funding technology-based spinoffs and start-ups as the program NEOTEC managed by CDTI, there have been already several start-ups funded with projects using blockchain technologies.

The local government of Catalonia approved in 2019 a “Blockchain Strategy”⁹⁰ for the public administration of the Autonomous Community. It includes six areas: public administration, promotion, innovation, entrepreneurship ecosystem, talent, and regulation. Regarding entrepreneurship, the strategy includes programs for starting up and new spaces. Other local governments have also been proactive in blockchain. For example, the regional government of Andalucía has organised in 2017 blockchain workshops in the framework of their regional strategy to fostering ICT.

Outside of the activities of the public administration, the non-profit association [Alastria](#) started mid-2017, is the largest Spanish initiative with the vision of “democratizing access to blockchain in Spain” and deploying blockchains for use in permissioned settings⁹¹. Membership in Alastria is open to any type of organisation, including companies, Universities and public administration bodies. Alastria currently provides partners with two blockchain networks with a public permissioned setting. Network T is a deployment of the Quorum Ethereum-based fork. Network B is a deployment of Hyperledger Besu. The focus of those networks is in being regulation-compliant and scalable, so they do

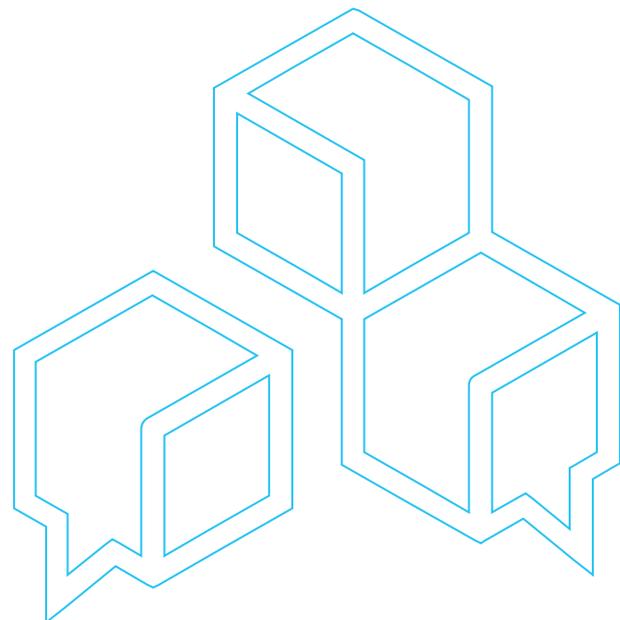
not have built-in crypto-economic features (no tokens). Alastria is currently working on a solution for Self-Sovereign Identity (SSI) Alastria_ID for users, similar to Hyperledger Indy.

[AECHAIN](#) (Asociación de empresas de blockchain) is a Spanish association of blockchain companies and organisations, integrated in CEOE (the Spanish confederation of companies). They are active in the promotion and dissemination of news and good practices in diverse applications of blockchain technology.

[Blockchain España](#) is an association with the mission of “fostering the blockchain ecosystem in Spain” and organizing courses and events regularly. At the time of this writing, the catalogue of courses includes the following, aimed at diverse audiences:

- introductory course to blockchain (Bitcoin and Ethereum)
- Ethereum development.
- Blockchain and capital markets.
- Legal expert in blockchain, smart contracts and ICOs
- Introduction to Hyperledger.
- Blockchain for managers.

Blockchain España is in turn a member of an association of communities in the scope of ibero-american countries called “[Alianza Blockchain Iberoamerica](#)” that has the broad mission of strengthening the adoption of blockchain technology in Ibero-american countries



89. Gobierno de España. (2021). Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027. Secretaría General Técnica del Ministerio de Ciencia e Innovación. <https://www.ciencia.gob.es/stfls/MICINN/Ministerio/FICHEROS/EECTI-2021-2027.pdf>



Established in 2017, the [British Blockchain Association \(BBA\)](#) is a not-for-profit organisation that promotes evidence-based adoption of Blockchain and Distributed Ledger Technologies (DLT) across the public and private sectors. Their [advisory board](#) is drawn from the worlds of Blockchain, Academia, Information Technology, Computer Science, regulators and policymakers in the field of distributed ledger technologies. BBA is a close-knit network of experts and organisations connecting policymakers, academics, blockchain engineers, venture capitalists and visionaries. It hosts the [Centre for Evidence-Based Blockchain \(CEBB\)](#) which is a Think Tank of thought leaders in Blockchain, conducting high-quality research, providing executive education programs and multidisciplinary training workshops.

The All-Party Parliamentary Groups (APPG) are an informal cross-party group that have no official status within parliament. They are run by and for Members of the Commons and Lords and may include individuals and organisations from outside parliament in their administration and activities.

The [APPG on Blockchain](#) was set up in January 2018 to ensure that industry and society benefit from the full potential of blockchain and other distributed ledger technologies (DLT). It encourages participation from Business, Academics and representatives of the civil society. In 2021, the APPG on Blockchain will bring evidence and use-cases to the UK Parliament on implementation topics such as Interoperability and Scalability, International Trade, Convergence between Blockchain, Artificial Intelligence and Internet of Things, Blockchain for Government, Central Bank Digital Currencies. In 2022, the focus of the APPG on Blockchain will be on DeFi – Desentralise Finance, Blockchain As A Service (BAAS), Sustainability, Cybersecurity and Blockchain Use-cases⁹².

The Big Innovation Centre is a global hub of innovative companies and organisations, thought leaders and 'what works' open innovators. They come together in taskforces to build innovative capabilities across innovation and investment ecosystems where they see gaps or opportunities. They are the founding Secretariat of the APPG on Blockchain.



92. APPG Blockchain, 2021/2022 programme, Ensuring Industry And Society Benefit From The Full Potential Of Blockchain

3.3. Blockchain support and competences initiatives for SMEs and high growth enterprises

Support initiatives towards start-ups and SMEs to innovate around blockchain technologies but also to promote the benefits and facilitate the adoption of the technology by SMEs have been spreading in the past years. A lot of activities such as Hackathons, accelerators and bootcamps, Blockchain weeks and events occurred with the objective to create new ventures and pilot test projects in specific sectors, developing regional blockchain start-up ecosystem or clusters. This led to the formation of blockchain network, in the form of public-private partnerships or simply private networks, gathering to share knowledge and expertise as well as to create a united voice to shape and influence the usage of blockchain technology. Through those networks, SMEs very often find advice, mentoring, trainings, and financial support to consider this new technology. This section provides insights into each respective partner country support initiatives.

Blockchain skills development is still a new if not non-existent field of education. As mentioned above, the EU recently commissioned the CHAISE project, to develop a strategic approach on blockchain skills development and will result in the design of the European Blockchain Skills Strategy. At national level, we see a lot of disparities. Some national government, together with industry networks such as the Netherlands, Denmark and Ireland are investing in upskilling citizens and enterprises leaders with the latest digital skills including AI and blockchain. In other countries, private blockchain networks, or non-profits are setting up their own blockchain trainings, courses, workshops for SME and start-ups. The Netherlands and Denmark are particular in the sense that stakeholders are organised in a triple helix model, ensuring knowledge is shared among all stakeholders but also ensuring that curriculums developed are relevant and addressing future digital needs.

NETHERLANDS

Blockchain support initiatives for SMEs and high growth companies

The [Dutch Blockchain Coalition](#) (DBC) offers start-ups, scale-ups and SMEs a place within the coalition; where they can participate in existing working groups by providing in-kind expertise and cooperation; and where they can access and be part of Dutch blockchain start-ups ecosystem such as: [Techruption](#), [YesDelft!](#), [StartupDelta](#), [Blockchain Netherlands](#) and [Start-up Bootcamp Amsterdam](#). The coalition can actively support affiliated initiatives where possible. In parallel and in coordination with the DBC, various public and private initiatives and organisations are facilitating blockchain innovation and supporting blockchain entrepreneurship such as the [Netherlands Enterprise Agency](#), [Brightlands Smart Services Campus](#) or the [Dutch Blockchain Hackathon](#), a multi-sector grassroots movement of more than 1500 international members from the largest open blockchain innovation program in the world.

Blockchain competences Initiatives

The third mission of the public-private partnership of Dutch Blockchain Coalition is to help accelerate the blockchain momentum within organisations, partly by creating and organizing courses and other informative sessions aimed at specific sectors, supported, by the Human Capital Agenda.

The Human Capital Agenda

The Human Capital Agenda makes up part of the Dutch Digitalisation Strategy and is the action plan to meet the growing demand for ICT professionals. It was reviewed in 2019 and has so far developed the “Blockchain in a Day” training module which was offered to partners and stakeholders of the Dutch Blockchain Coalition. It also created a matchmaking tool developed to link interested parties with regards to blockchain research topics. Its focus is now on cooperation between education and business⁹³. NLdigital, a collective of companies that aim to enable the digital transformation, will also contribute to this renewed agenda with regards to new technologies in higher education curricula such as blockchain and AI⁹⁴. Furthermore, the Human Capital Agenda is preparing the publication of a report that will describe the (key) competencies and profiles of the blockchain professional of the future.

93. Platform voor de InformatieSamenleving, (2021, May 3). Human Capital Agenda ICT – ECP. Platform voor de InformatieSamenleving. ECP. <https://ecp.nl/project/human-capital-agenda-ict/>.
94. Dutch Blockchain Coalition (2018). Blockchain for Good. BC3. <https://dutchblockchaincoalition.org/uploads/pdf/Visiedocument-Blockchain-For-Good-NL.pdf>

Dutch Blockchain Coalition

The Dutch Blockchain Coalition (DBC) has developed a Massive Open Online Course on blockchain technology (accessible to everyone), and a day training module developed and offered to all coalition partners and stakeholders. In addition, the DBC also developed the Teach the Teacher program where blockchain experts from the coalition provide hands-on sessions with 'tutors' to teachers from universities and higher vocational education institutions to ensure that the correct, up-to-date knowledge is present in the educational world.

In small-scale meetings with breakout sessions, teachers are thus updated on the topics relevant to them (business, legal & tech) based on the most recent developments. In addition, those experts help write educational programs⁹⁵. Furthermore, a matching tool has also been developed so that students, companies, colleges, and universities link each other on Blockchain research topics. By bringing universities and colleges together, the DBC ensure mutual learning and coordination of the Blockchain curriculum. Instead of teaching material and develop methods individually in silos, they bring together an ecosystem of education and research institutions.

DENMARK

Blockchain support initiatives for SMEs and high growth companies

Copenhagen Fintech Week

[Copenhagen Fintech Week](#) aims to shape the future of finance by creating unique connections between start-ups, corporates, investors, and academia. The goal of this annual initiative is to foster the development of compelling fintech solutions, with a focus on sustainability, its impact on businesses and society and the UN's sustainable development goals (SDGs).

Digital Hub Denmark

[Digital Hub Denmark](#) is a non-profit organisation that connects international tech talent, start-ups, companies, investors and delegations with opportunities in Denmark. It provides a range of activities to support business access to specialist expertise and opportunities for cooperation on the development of new business models. In addition, the Danish Government will strengthen research in digital technologies, including Big Data, artificial intelligence and the Internet of Things, attract international conferences and knowledge of new technology, and market Denmark as a digital pioneer in order to attract investment.

SME:Digital

With a collective scheme under the heading [SME:Digital](#), the Danish Government assists in the digital enhancement of small and medium-sized enterprises and support Danish e-commerce by offering:

- Private consultancy and assistance in development of digital transformation business cases.
- Better potential for e-commerce and e-exports via an e-commerce centre.
- Improving the skills of business leaders.
- Digital design consultancy.

Blockchain competences Initiatives

Although the Technology Pact, part of the *Strategy for Denmark's Digital Growth*, lays the foundation for the skills for a technological and digital future, no skills and competence development framework exist in Denmark for Blockchain. However, an empirical analysis based on a comprehensive survey among +3000 Danish companies was performed in early 2019 with the aim of gaining insights into the current state of blockchain technologies in Denmark. The same year, the Danish Industry Foundation invested 1million euro to create the Blockchain Academy Network⁹⁶ with the expertise of Concordium, a Swiss blockchain company, and other Danish educational partners such as the Alexandra Institute, the Aarhus University, the European Blockchain Center of the IT University in Copenhagen, and the Copenhagen Institute for Future Studies. Over a period of 2 years, the network aims to qualify Danish senior executives and IT and Digital managers for a future with Blockchain by providing a series of free (mostly online) educational programs.

The network will be developing training materials and user cases for teaching Danish professionals and technical managers in safe use of blockchain technology, including multi-party computation and high-assurance cryptography. It also aims to establish close collaboration with industry to ensure the relevance and the specificity of the educational activities, future scenarios as relevant and use cases. At Higher Education level, many institutions are developing their own curriculum. For instance, the European Blockchain Center, within the IT University of Copenhagen (ITU), provides Blockchain research and education. It also provides a 2-Days Course of Blockchain Economics for Danish SMEs⁹⁷. ITU has been frequently ranked to be among the leading universities in the world in Blockchain education, with experience in PhD Blockchain summer schools since 2016.

95. Blockchain for Good, De visie en missie van de Dutch Blockchain Coalition, DBC, 2018

96. Blockchain Academy Network: <https://blockchainacademy.dk/elementor-676/>

97. European Blockchain Center, retrieved from website: <https://www.ebcc.eu/courses-and-services/>

Blockchain support initiatives for SMEs and high growth companies

In Ireland, the first point of entry for many SME's is the **Local Enterprise Office** which do offer several financial supports, which could be used for projects with a blockchain element, such as Trading Online Voucher Scheme, Priming Grant, Business Expansion Grants, Agile Innovation Grants, Microfinance Ireland and Brexit Loan Scheme.

Enterprise Ireland

[Enterprise Ireland](#), a government agency responsible for supporting Irish-owned businesses to grow and export, has launched a 750.000 EUR Competitive Start Fund for Fintech and Infrastructure Tech start-up companies working in blockchain. Additionally, they offer a wide range of support for innovation to SMEs and start-ups in the manufacturing and internationally traded services sectors. Innovation Vouchers and an Exploring Innovation grant encourage firms to get started in planning innovation and working with external knowledge providers. An RD&I (research, development, and innovation) Fund offers more substantial innovation grants, with a bonus for collaboration between two companies. Commercialisation of research is encouraged by Innovation Partnership projects, which support SMEs to work with Irish research institutes, and an Agile Innovation Fund, which helps commercialise innovations from research institutes. Leadership development and advice is also provided for innovation through the Innovation 4 Growth programme and the High Potential Start Up programme, so to discuss standards of rapidly emerging blockchain technology.

Blockchain Ireland

[Blockchain Ireland](#) was founded in 2015 with the support of national agencies IDA Ireland, Enterprise Ireland, and the Department of Finance to do two things (i) Establish Ireland as a global blockchain and crypto hub and (ii) to create blockchain and crypto-based jobs. The forum also includes global blockchain technology companies, global organisations across all industries and sectors, academia, start-ups as well as participants of the wider Irish blockchain community. They also have a blockchain Education Working Group, looking into blockchain skills and education.

“**Blockathon Ireland Hackaton**” was hosted in January 2019, focusing on the presentation of potential blockchain applications in public services provided by the Government of Ireland and the “**Blockchain Ireland Week**” was organised in May 2019, bringing together entrepreneurs, developers, governmental representatives, and business leaders for a series of talk.

Blockchain competences Initiatives

There were no educational programmes provided by any universities in Ireland before the year 2019. Although there is significant programme support for SME workforce skills development, very little of it is specifically focused on blockchain technologies. The National Training Fund (NTF) invested EUR 142 million in 2019 for apprenticeships, including access for SMEs. It also invested EUR 28 million in supporting Skillnet Ireland programmes. These include the Training Networks Programme, the Future Skills Programme (which provides seed funding for enterprise groups to develop innovative enterprise-led trainings with HEIs and private training providers) and a Management Development programme for SMEs.

The Technology Ireland Skillnet is the only Skillnet which offers several blockchain related training programmes, specifically aimed at SME's such as Certificate in Emerging Digital Technologies, Ethereum Development Course and Blockchain Overview, Applications and Standards.

Grassroot organisations like CoderDojo have greatly enabled training around the country and there are some specific training programmes targeted at the sector as outlined. At a Higher Institution level, 12 Irish educational institutions (7%) are somehow supporting and researching the blockchain sector in the form of ongoing research, study programmes or partnerships with the other companies. State supported academic programmes include Master's in Blockchain Distributed Ledger Technologies programme (DCU)⁹⁸, Postgraduate Certificate in Blockchain Security (AIT), Diploma in Blockchain Technology (Dublin Business School) as well as numerous SpringBoard upskilling certificate programmes.

98. DCU. (n.d.). Launch of Country's First Master's in Blockchain (Distributed Ledger Technologies) through Skillnet Ireland and DCU: News at DCU. Dublin City University. <https://www.dcu.ie/news/news/2019/05/launch-of-countrys-first-masters-in-blockchain-distributed-ledger-technologies>.



Blockchain support initiatives for SMEs and high growth companies

Start-up bootcamp Fin Tech

Based in London, for each programme they select ten start-ups providing expert-led masterclasses in all areas of business development. They offer an intensive 3+3-month program, one of the key focus areas is Blockchain.

Barclays Accelerator (TechStars)

Run by one of the world's largest and most successful banks, the Barclays Accelerator is firmly focused on exciting and disruptive early stage fintech companies which include those using Blockchain technology. The program is run by Techstars with them also providing the funding. Aside from funding you will gain access to critical people and decision makers at Barclays, gain

mentorship from leading Fintech entrepreneurs and industry experts, gain access to a collaborative workspace with cutting-edge facilities, gain investor access through pitch days and become a TechStars alumnus (which comes with some impressive benefits and network access).

The FinTech Innovation Lab

Fin Tech Innovation Lab is a highly competitive 12-week program that helps early-to growth-stage start-up companies refine and test their value proposition with the support of the world's leading financial service firms. Selected companies receive:

- Mentoring from leading firms and VCs, as well as the Lab's Entrepreneurs Network and Industry Advisors.
- Insights from senior figures and user groups in the financial sector – covering product feedback and potential deployment of proofs-of-concept.
- Weekly workshops and panel discussions on wide ranging topics from procurement and technology architecture to bank regulation and industry trends.
- Workspace, if your company chooses

The program culminates in a Demo Day where companies showcase their technology to financial service executives, investors, and journalists. If selected, at least two members of the company must reside in the city of the FinTech Innovation Lab program they have chosen for the duration of the program.

Entrepreneurial Spark & Hatchery

One of the world's biggest free accelerator for start-up and scaling businesses, ESpark accepts applicants from the idea stage to those who have been running for up to 4 years (£1,000,000 turnover). They also offer a free service for a 2-tier accelerator process. The main programme begins with a 3-day boot camp. Entrepreneurial Spark run four programs covering the critical stages of an early-stage business; these programs are Sprint, Enable, Grow and Scale. Depending on the programme you join, you will receive office space (some London based) at one of their hubs, an intensive education programme, network access and much more. The Entrepreneurial Spark brand covers Scotland, while the Hatchery brand covers other cities across the UK. Funding/duration: Entrepreneurial Spark does not offer investments or ask for equity. The standard programme duration is 6 – 18 months.

Blockchain competences Initiatives

The UK government are currently working on a National Data strategy framework for the approach and investment in data to strengthen the economy and create big opportunities for the future. In the framework it mentions the aim to launch an online portal to support businesses' access to data skills training, helping signpost SMEs to good-quality online training material matched to their technical data science capabilities and ambitions⁹⁹.

At a higher education level, the UCL CBT was founded in 2016 to research the effects of Distributed Ledger Technologies and Blockchain into our socio-economic systems and to promote the safe and organic development and adoption of Blockchain-based platforms. They run Executive Education Programmes which are designed for business leaders, innovators, regulators, and public policy makers who need to quickly gain a fundamental understanding of Blockchain including both the opportunities and risks. They also run a free online course, Introduction to Blockchain and Distributed Ledger Technology (DLT) which aims to enhance understanding of DLT and Blockchain technology and explore how it can be used to solve business problems.

99. See 36.



Blockchain support initiatives for SMEs and high growth companies

Cryptoplaza

[Cryptoplaza](#) is a business and start-up hub in the centre of Madrid, dedicated to blockchain or crypto businesses, featuring a coworking space and organizing regular events. Blockchainhub Spain is a blockchain-specific incubation and acceleration hub.

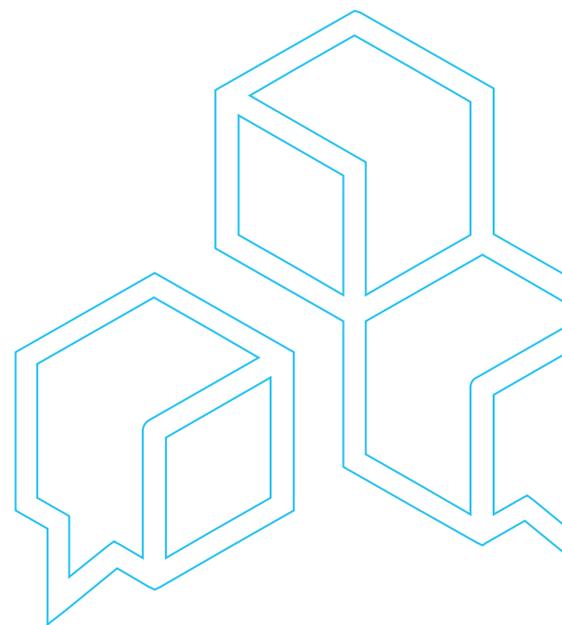
Incyde

[Incyde](#) is a non-profit foundation created in 1999 by the Chambers of Commerce in the country. Its focus is fostering employment, and helping SMEs and entrepreneurs via training, events and other actions. Notably, they have a catalogue of training offerings adapted to the needs of the labour market, and it includes "Blockchain, applications and impact on business". The relevance of that program is that it features explicitly entrepreneurs in different collectives and areas, including youth but also the general public, in different cohorts the course addresses adults or youngsters depending on the region addressed. They approach the training using Lean Start-up methodology and combine training with mentoring in the same activities.

There are also initiatives specific to blockchain sponsored by large companies. A relevant example is the call in 2020 for blockchain companies in the Open Future program at Telefonica. Open Future is an open and global innovation program that brings together entrepreneurs, start-ups, investors as well as public and private organisations from around the world and is committed to the development of new technologies as a transforming core. In the financial sector, it is remarkable that the Switzerland's stock exchange (SIX) will setup offices of its F10 start-up incubator in Madrid and Barcelona, which addresses blockchain technologies in the fintech domain.

Blockchain competences Initiatives

In Spain, the educational offering in Higher Education is limited, but this is complemented by training offerings in diverse aspects related to blockchain. The first one-year [Ms.C. degree](#) in blockchain was offered by the University of Alcalá starting 2017, with a mix of technical and economics & business contents. Other programs following this approach later include the MsC in Global Blockchain Technologies offered by the University of Barcelona. Other Universities offered similar programs as Universidad Autónoma de Madrid but are now extinct. While official studies are just a few, there are many shorter courses offered by companies and associations in the specifics of either technology or economics or legal aspects. Notably, INCYDE offers vocational educational programs oriented to entrepreneurs in blockchain.



BEGIN RESEARCH FINDINGS

4.1 METHODOLOGY

“

The expert interviews aim to validate and complement the blockchain skills and competences needs identified during the literature review process with practical evidence from blockchain educators and blockchain experts and/or entrepreneurs.

”

Data has a better idea

Experts Interview

8 interviews with Blockchain experts from Ireland, England, Spain and Estonia have been conducted. By experts we understand individuals with a deep knowledge of Blockchain technology's applications as well as teaching experience and an understanding of blockchain skills for entrepreneurs.

Those interviews had for objectives

1. to complement and expand the insights from the literature and national context reviews,
2. acquire deeper exploratory-style insights, experience, and opinion from a blockchain educators and blockchain experts (user) perspective
3. provide insights into defining the skills and competences required for high growth SME managers and start-ups entrepreneurs to identify, evaluate, and integrate blockchain technology into their business and
4. inform the partnership about the minimum level of blockchain's technology's understanding by entrepreneurship educators, skills and competences required for entrepreneurship educators to teach blockchain as well as recommended andragogy.

The expert interviews questions are building upon the review of the EntreComp and Digcomp competence framework as well as on some questions of the literature review on skills needs and best suited andragogy. The expert interviews aim to validate and complement the blockchain skills and competences needs identified during the literature review process with practical evidence from blockchain educators and blockchain experts and/or entrepreneurs.

Case studies

14 case studies have been conducted across the globe with high growth, digital, internet-based companies of different sectors having integrated Blockchain technology and able to showcase their results and impacts.

Those case studies had for objectives to collect successful examples illustrating how blockchain is transforming high growth SMEs and start-ups business models, productivity, competitiveness, and growth, but also to understand most important (soft and hard) skills and competences to integrate blockchain which would generate further insights for the analysis stage.

The case studies questions are touching on the entrepreneurship journey of the founders, motivations, challenges, key success factors as well as critical competences and lessons learned.

Review of EntreComp and DigiComp Framework

In addition to the case studies and experts' interviews, we reviewed the European Entrepreneurship Competence Framework (EntreComp), as well as European Digital Competence Framework (DigiComp) and other relevant frameworks to determine the specific entrepreneurial and technical competences needed for the successful identification, evaluation and integration of blockchain technologies. The competences identified from the interview conducted have been aligned to the terminology used by the EntreComp and DigiComp framework to facilitate the reading and re-use.

<p>European Entrepreneurship Competence Framework (EntreComp)</p>	<p>EntreComp is the European reference framework for competences in entrepreneurship. The framework establishes a shared understanding of the knowledge, skills and attitudes that describe what it means to be entrepreneurial. EntreComp recognizes the opportunity of acting entrepreneurially. Accordingly, entrepreneurship is defined as the competence to act upon opportunities and ideas to create value for others (Bacigalupo et al., 2018). EntreComp classifies 3 main entrepreneurship competence areas:</p> <ol style="list-style-type: none"> 1) Ideas & Opportunities, 2) Resources, and 3) Into Action. <p>'Ideas & Opportunities' refers to creativity, vision, and sustainable thinking. 'Resources' include motivation, mobilizing resources, financial and economic literacy. Lastly, 'Into Action' relates to planning and managing, working with others, and coping with uncertainty. Together, the three categories define entrepreneurship competences and describe it as an ability to turn ideas and opportunities into action that generate value.</p>
<p>European Digital Competence Framework (DigiComp)</p>	<p>DigiComp offers a tool to improve citizen's digital competence. DigiComp classifies 5 main digital competence areas:</p> <ol style="list-style-type: none"> 1) Information & Data Literacy, 2) Communication & Collaboration, 3) Digital Content Creation, 4) Safety, and 5) Problem Solving.

Limitations

This study has some limitations. The first limitation is the small sample size of experts interview (8) and those limited to few countries namely, Ireland, UK, Spain and Estonia, as well as the small sample size of case studies (14). The second limitation was the choice for a qualitative analysis while the use of quantitative research methods, such as a survey, could have brought more depth and validation to the information. Finally, blockchain is a relatively new field of study, which meant limited access to literature documents and diverse expertise.

4.2 Drivers, challenges, and key success factors to blockchain integration

Support initiatives towards start-ups and SMEs to innovate around blockchain technologies but also to promote the benefits and facilitate the adoption of the technology by SMEs have been spreading in the past years. A lot of activities such as Hackathons, accelerators and bootcamps, Blockchain weeks and events occurred with the objective to create new ventures and pilot test projects in specific sectors, developing regional blockchain start-up ecosystem or clusters. This led to the formation of blockchain network, in the form of public-private partnerships or simply private networks, gathering to share knowledge and expertise as well as to create a united voice to shape and influence the usage of blockchain technology. Through those.

The main motivation for Integrating blockchain or developing a blockchain enabled business are the transparency, traceability and trust it can provide to companies throughout their supply chain, very often resulting into a competitive advantage enabling companies to outperform their competition or increase their customer base.

Although attractive, companies integrating blockchain may face non negligible challenges starting with a general misconception of the technology and therefore distrust on its viability and benefits from potential stakeholders. The integration of the technology can also get costly, particularly when the company does not have internal expertise. Finding and recruiting blockchain experts can also become a challenge. Additionally, companies can find challenging the complex blockchain regulatory environment, mistrust, and hesitance from potential competitors to share data, and some of the

technology shortfalls (e.g slow transaction speed, not designed to store large amounts of data)

Nevertheless, according to companies who succeed in implementing blockchain, some keys success factors were critical to their growth such as defining early on clear use cases for using blockchain, having internally (within the team) blockchain knowledge and competences, starting small and testing/prototyping early on, as well as developing and being part of a network.





KEY DRIVERS

Numerous drivers for integrating Blockchain technologies have been identified, most of which relate to the benefits that the technology can bring.

Transparency and trust

The fact that Blockchain allows transparency across supply chains is an important driver for companies to implement the technology. Transparency enables greater security, trust, and traceability of products in the supply chain and increase the security of transactions. Related to the increase in efficiency of processes, as well as cost saving, companies can experience new competitive advantages. An increase in supply chain efficiency and competition in the supply chain drive businesses to implement Blockchain technologies to improve their product and service offerings. Thus, increasing their competitive advantage.

Competitive Advantage

Blockchain technologies requires creativity and innovative mindsets for businesses to be able to reimagine their processes and business models. Blockchain enables new market opportunities, drives innovation, and help create a sustainable future through the transparency and trust that it brings.

Reduction of costs of distrust

Increased transparency reduces the costs of distrust within the market. If two or more stakeholders do not trust each other, they will be less likely to conduct business together, and missing business opportunities. However, when using a technology like Blockchain, two stakeholders that do not necessarily know each other are more prone to conduct business as the technology will provide trust and transparency for its users.

Data ownership and immutability

Users can see how their data are managed throughout the entire blockchain, maintaining full ownership of what they input. Furthermore, since the technology does not allow the storage of centralised data, but it is rather distributed on chain blocks kept on different servers, users are able to insert data in their own blocks, yet without being able to modify the data that is inserted by third parties.



KEY CHALLENGES

From the case studies and expert interview conducted, some key challenges and barriers have been identified as possibly limiting the ease of integration of blockchain technologies.

Distrust and misconceptions

There are certain misconceptions around Blockchain which makes it challenging to get stakeholders on board when pitching a blockchain-enabled concept. These misunderstandings mean that some SMEs may see Blockchain as an immature technology (compared to traditional IT systems) and not worth to consider and invest resources in, rather than an opportunity to improve their business model.

Cost of integration

Blockchain-enabled businesses can be costly to implement which prevents some companies from doing so, particularly when the internal teams do not have the resources, expertise and technical skills required.

Blockchain skills shortage

Overall, there appears to be a skills shortage which prevents businesses from integrating Blockchain technologies. Lack of proficient consultants for Blockchain that may help businesses to determine how or whether to implement Blockchain is a barrier, as well the general lack of expertise in the subject. The need for training in Blockchain skills may hinder businesses from considering such technological solutions.

Privacy and security concerns

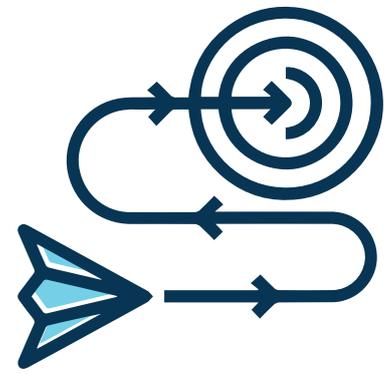
Businesses are naturally concerned about sharing their data and trade secrets with potential competitors, particularly with regards to public Blockchains. Transparency is not desirable in many industries such as the financial, law, or medical sectors. Therefore, trust and openness to collaborate from SMEs remains a major barrier.

Shortfalls of Blockchain

Blockchain is a relatively new technology compared to traditional IT systems and is not designed to store large amounts of data. Blockchain also has a relatively slow transaction speed and still holds some technology restrictions.

Regulatory barriers

Some barriers are regulatory in nature and restrict the free use of technologies and having to comply with regulations hinders businesses from using the full capabilities of Blockchain technologies. On the other hand, the decentralised nature of Blockchain creates uncertainty and this is often a barrier toward adoption. Furthermore, the legality of certain aspects of Blockchain are uncertain in many jurisdictions.



KEY SUCCESS FACTORS

Key success factors appeared as being critical to a successful blockchain-enabled businesses, as below explained:

Clear defined use cases

First and foremost, it is critical to understand what the problem is the company is trying to solve and why blockchain is the right technology to enable the solution. To increase the implementation success, it is important to identify a structured blockchain use case for the business. What is the role, purpose of using blockchain, how will the company benefit from it? Use cases that are closely located to the core business require alignment to the business line, without significantly impeding development speed. In addition, a streamlined use case identification process must be implemented, to systematically develop and re-evaluate the fit between the market and the Blockchain technology.

Knowledge and training of staff

To facilitate and ensure a sustainable adoption of the technology, those involved in the integration of Blockchain should have the technical skills and knowledge required, from the inception of a project to its deployment. Skills should be cross-disciplinary, and it is beneficial if staff have experience in technological fields. Having a prior basic knowledge of Blockchain and its limitations and uses is also valuable.

Internal processes and infrastructures

To successfully integrate Blockchain technologies, businesses should have streamlined and dedicated processes that ensure the efficiency of operations and build up Blockchain-related competences in the organisation. The company should also display good change management skills, and agile project management to effectively implement Blockchain.

Start small

To succeed, it has been recommended by entrepreneurs to “start small” by establishing a basic infrastructure in the beginning to get familiar with the topic. A structured use case should be identified, and the technologies should be applied where they are required. With this, when starting off it is suggested that the sharing of information with partners should be easily achievable, to ensure that there are no issues. After successfully implementing Blockchain on a smaller, more specific scale, only then is advisable to scale-up operations.

Management support

To ensure a good adoption of the technology, SME managers should secure support from business management and come to an agreement on the role that Blockchain will play in the business. Having management that encourages a culture of innovation and supports the use of new technologies is a key success factor.

Network

Being part of a network that can support and share knowledge on the implementation of Blockchain technologies. This allows members of the network to learn from one another. This network can also be used to help overcome the scepticism around Blockchain.

Funding and support

The funding and support may be provided privately or publicly i.e., by regional funds. Such funding may allow SMEs to identify and evaluate the Blockchain technology that is needed. On the other hand, open-source tools can also be valuable.

4.3 Competences for entrepreneurs and SME managers

The following section introduces the most important entrepreneurial and technical competences identified from the case studies with entrepreneurs and expert's interviews. While both EntreComp and DigiComp competences framework have been used to structure the competences identified, it is insufficient to cover all the competences required when looking to develop Blockchain-enabled businesses. Under Technical competences, technical skills for blockchain have been identified.

Entrepreneurship competences for entrepreneurs and SME Managers

The table below provide an overview of the key entrepreneurship competencies entrepreneurs and SME managers should develop when developing a business and looking to integrate blockchain. Competences have been aligned to the EntreComp framework terminology.

EntreComp Area of Competence: Ideas and opportunities	
Spotting Opportunities	<p>Based on the results of the study, being a problem-solver with critical thinking ability is essential when developing blockchain-enabled business. Being able to identify, understand and define a problem to be solved and thinking of potential digital solutions such as Blockchain is something learners will need to develop.</p> <p>As Wilhelm Myrer the CEO of Empower mentioned: <i>"the more you understand blockchain technology and what it can enable, the easier it is to innovate and apply it to new business ideas."</i></p>
Creativity	<p>This competence is essential to blockchain. To succeed, learners need the ability to connect information and knowledge, but also the ability to think freely, without limitation, and be able to imagine, conceptualise disruptive solutions or business models using digital technology. They however also need to have enough understanding of the available digital technologies to explore and experiment with those and achieve valuable concepts.</p> <p>John Roberts, CEO of Blockaviation says: <i>"Always engage your critical thinking. Question everything, be creative in your approach and don't be afraid to try something - it might not work but you won't know until you try."</i></p>
Vision	<p>It important that learners can develop a vision to guide strategic decision-making and turn ideas into action. This means that they can hold a comprehensive vision of the future, knowledge of the technological advances and trends while also having sufficient planning and prioritisation capacity to develop a sustainable long-term strategy in accordance with these.</p> <p>Phil Brown, VP of Circularise says: <i>"There are a lot of hypes and promises about blockchain. Yet, entrepreneurs must have the capacity to seize opportunity and to transform promises into reality."</i></p>

EntreComp Area of Competence: **Resources**

<p>Self-awareness & self-efficacy</p>	<p>A competence mentioned by most entrepreneurs interviewed is the ability to identify and assess one's strengths and weaknesses and compensate for their weaknesses by teaming up with others while further developing their strengths. <i>"Know where your weaknesses are and find a partner that completes you, most of the time, who is the opposite profile. It is more important to know what you are horrible at than what you are good at"</i> says Ashish Gadnis, CEO of BanQu. This is furthermore important in this ever-evolving technological context where few entrepreneurs can at once identify digital business opportunities, develop a digital solution, and manage business operations.</p>
<p>Mobilising others</p>	<p>The ability to effectively communicate and work with others is something that was pointed as critical for successful development of the Blockchain potential. In the realm of communications, the experts mentioned skills such as writing, presenting, and speaking, all with a proactive and open approach towards collaboration. In addition, and coming from the entrepreneurs directly, storytelling has been identified as a critical skill, which means the ability to engage with stakeholders by telling a simple, easy to understand story of the company's unique selling proposition. This is even more important due to the lack of understanding about blockchain and the opportunities it presents within business which requires from entrepreneurs to spend a lot of time explaining how it works and its benefits, on top of pitching their business idea. As Wilhelm Myrer the CEO of Empower mentioned, <i>"Develop excellent communication skills. As the technology is new, there is still a lot of ignorance and entrepreneurs need to invest time and resources at marketing/selling their ideas, explaining how the technology can solve certain issues."</i> Another important skill is being able to internally communicate the proposed solution to a problem so that there is an understanding amongst all involved.</p>
<p>Motivation & Perseverance</p>	<p>It was pointed out that to succeed, entrepreneurs must be determined to turn their idea into action, which is why skills such as self-motivation, self-confidence, discipline, accountability, resilience, and determination, facing discomfort and self-criticism were mentioned as relevant skills to have.</p> <p>Focusing on the problem to be solved by using blockchain and being mission-driven will help entrepreneurs to be focused and to not give up when facing adversity. For instance, when he goes to bed, Ashish Gadnis, CEO of BanQu asks himself: <i>"Did what I did today help someone to get out of poverty. If the answer is Yes I go to bed, if No I stay up"</i>.</p>
<p>Financial & economic literacy</p>	<p>Learners must develop business acumen and be able to plan for the financial sustainability of their venture. It is important that the entrepreneurs understand the industry in which they operate as well as the value chain to understand where to develop a competitive advantage and differentiate from their peers. In line with this, Blockaviation CEO John Roberts said during an interview: <i>"Garner a competitive advantage against your peers by engaging in value chain analysis. This process is invaluable to create a superior service that is highly valued by the customer, and which will ultimately increase your profit margin."</i></p>

EntreComp Area of Competence: **Into Action**

<p>Taking the initiative</p>	<p>Another important group of skills that was mentioned by the experts is related to taking action, to drive the initiatives energetically and successfully. This is critical when starting any businesses and having to continuously reach out to people and organisations for financial and technical support, but particularly in an ever evolving complex, and disruptive environment where to get information, it is imperative to take the initiative to research and self-learn as well as to reach out to others.</p>
<p>Working with others</p>	<p>In line with the <i>Taking the Initiatives</i> competence, entrepreneurs will have to learn to build a team, consortia and networks based on the needs of their blockchain activity.</p> <p>Most blockchain entrepreneurs interviewed created their own blockchain network as they sought peer-learning and experience sharing but also to create a united voice and contact point to communicate and exchange with the national government on regulations and infrastructure. Blockaviation CEO John Roberts said: <i>“Build a consortium of industry, technology and business experts, a team is greater than the sum of its parts”</i>. In addition, Cuneyt Eti, CEO of CapexMove, mentioned that collaborating with all stakeholders in the development of a solution can led to everyone understanding the issues from different perspectives. In the end, this can result in a solution that is relevant and practical for all parties.</p>
<p>Coping with uncertainty, ambiguity & risk</p>	<p>Entrepreneurs need to develop the ability to weigh-up risks and make decisions despite uncertainty and ambiguity. When facing adversity, technical difficulties, numerous stakeholders and priorities, it is critical that entrepreneurs remain flexible and open-minded to disruption and manage to adapt to change.</p>
<p>Planning & Management:</p>	<p>Competences related to planning & management (such as agile management) are essential. Learners will have to develop the ability to create an action plan, which identifies the priorities and milestones for the achievement of their goals but also refine the priorities to adjust to changing circumstances, which very often happens when working with digital technologies such as Blockchain.</p> <p>More specifically, competences and skills mentioned were change management, strategy planning, financial modelling, product management, negotiation, quality performance, information management, analytical skills and resource management, among others.</p> <p>Cuneyt Eti, co-founder & CEO of Capexmove: <i>“Use this as an opportunity to upskill your team”</i></p>

Technical competences for entrepreneurs and SME managers

DigiComp competences

The table below provide an overview of the key digital competencies entrepreneurs and SME managers should develop when developing a digital solution using blockchain. Competences have been aligned to the DigiComp framework terminology.



EntreComp Area of Competence: **Digital Content Creation**

Programming

it is important to develop the knowledge to plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task. Another set of skills pointed out as critical by the experts was related to computer science and infrastructure, data structure, such as SQL, coding, agile software development, network software and hardware, machine learning, cybersecurity, debugging, etc. AS mentioned by the co-founders of Relica, Daniel & Jeremy Street: *"Prior experience in software development will aid business owners significantly when integrating blockchain technology. It's also important to have a rich understanding on the limitations of various blockchains and to ensure your chosen blockchain has a stable, fixed and scalable protocol to run your business."*

DigiComp Area of Competence: **Problem Solving***

*All competences of the DigiComp area Problem Solving are important to develop when working with Blockchain, with the two following ones in particular:

Identifying needs and technological responses

Learners need to be able to assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility).

Peter Lind Damkjaer, co-founder and CTO of Diplomasafe, says: *"Blockchain is an excellent tool, but end users do not care about the technology: they care about having a simple-to-use and attractive user interface"*

Creatively using digital technologies

This is one of the most important technical competences to develop according to the entrepreneurs; to be able to use digital tools and technologies to create knowledge and to innovate processes and products. Having enough understanding and knowledge of digital technologies and solutions (which one to use to solve what issues, in what context) to innovate. This includes a particular good understanding of the various blockchain use cases and possibilities.

Peter Bainbridge-Clayton, CEO and Founder says: *"Find a problem that your business needs to solve and then figure out how the unique capabilities of blockchain can be used to solve that problem"*

EntreComp Area of Competence: **Safety**

Protecting Devices

It is imperative for learners to be able to protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.

Protecting data and privacy

Learners need to understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used. Finally, as pointed out by the experts, it important to develop of blockchain-risk-management considerations, regulatory and compliance requirements, financial implications, liability concerns, etc.

Blockchain Technical Skills

Blockchain knowledge and competences are multi and inter-disciplinary. As a technology it can be integrated or combined with other digital technologies and services. It is imperative for anyone willing to explore and experiment with this technology to learn and develop a great understanding of the blockchain technology and its possibilities or ensure to have someone within the team with this expertise. Key technical competences generated from the interviews with blockchain experts are:

BLOCKCHAIN TECHNICAL SKILLS	DESCRIPTION
Open Source Stewardship model	How companies that develop open source get benefit from that, or how open source projects get the funding to develop. This is critical as all permissionless blockchain projects are open source
Decentralised business models	How it is possible that the company developing a new decentralised application can still get benefits even without barriers of entry to competitors. The role of retaining tokens and foundations promoting blockchain initiatives.
Funding from blockchain	Know the way startups can be financed by on-chain mechanisms as DAOs or crowdfunding, and other sources of funding specific to the blockchain scene.
Financial inclusion	Understand the ways blockchain might address problems of financial exclusion or bankless individuals.
Fundamentals: distributed systems	Understand the problems of communication in computer networks, network failures and malicious communication.
Fundamentals: cryptography	Understand asymmetric cryptography, cryptographic hashes, digital signatures and digital certificates.
Fundamentals: blockchain types	Understand models of consensus depending on types of computer networks, and understand classical consensus algorithms and how these drive leader selection. Reason that these mechanisms are the key to the fact that blockchains are tamper proof and immutable. Introduce at least failure-only models as Raft, permissioned network models with byzantine fault tolerance as PFBT, and then lottery models as PoW and variants of PoS with their incentive systems.
Fundamentals: governance models in blockchain	Be able to discuss the differences of open, permissionless blockchains and private, permissioned ones and other hybrid schemes.
Fundamentals: smart contract essentials	Understand how changes in blockchains, especially permissionless ones, are made, including the idea of forking and the idea of on-chain governance.

BLOCKCHAIN TECHNICAL SKILLS	DESCRIPTION
Fundamentals: smart contract essentials	Understand the concept of smart contract and how it can be used to implement
Complements: the concept of oracles	Understand how external data can be included inside blockchains with some degree of credibility.
Fundamentals: key management, addresses and pseudonymity	Understand key management, wallets and its types, and how addresses of transactions make blockchain pseudonymous. Know about privacy-oriented blockchains as Monero or ZCash.
Cryptoeconomics: token economies	Understand and be able to assess tokens as designed via smart contracts. Describe the differences of fungible and non-fungible tokens. Understand the regulatory aspects of token offerings.
Complements: decentralised file systems.	Understand the complementary role of decentralised file systems as IPFS to blockchain solutions.
Cryptoeconomics fundamentals	Understand the incentives and business models of mining, staking and validating as a means of growing and securing blockchains, and how this affects the sustainability of blockchains.
Cryptoeconomics: DAOs	Understand societal structure in decentralised space and the role of DAOs. Understand the fit of these entities with current regulation.
Cryptoeconomics: DeFi	Understand the most important decentralised finance (DeFi) applications and their possibilities for innovation.
Applications: traceability and transparency	Know and discuss how different blockchain solutions, decentralised or not, apply to the case of traceability of products and services, or to make transparent existing processes.

4.4 COMPETENCES FOR EDUCATORS

Based on the interviews conducted with blockchain experts, it appears essential that educators not only possess the knowledge, skills and attitudes of entrepreneurship and innovation but also of the Blockchain technologies and possible use cases. In the following section we list a summary of key entrepreneurship and technical competences for educators should develop based on experts' insights from interviews.

Entrepreneurship competences

Digital Innovation Process, Lean Startup and Agile Methodology

Educators themselves should have the ability to innovate to transfer this skill to their students. They should have knowledge of the innovation process steps to follow, how to use the business canvas method to iteratively develop entrepreneurial journeys, as well as the agile methodology to quickly test and prototype digital solutions.

Collaboration and working with others

Educators should bridge the gap between knowledge and practice; therefore, and as mentioned by experts, educators should be integrated into the Blockchain community. Being part of networks, working groups and alliances that are focused on Blockchain ensure that educators have relevant knowledge in the field. In addition, networks have the potential to keep educators up to date with developments in Blockchain and may also create connections for students to exploit through work-based learning.

Personal data handling and regulation

Educators should have good knowledge of regulations and data handling. This is critical as when devising blockchain applications that include any form of personal data, the immutability of blockchain can become an issue with regulation, especially GDPR.

Technical competences

Knowledge of the Blockchain and its application

Based on interview with experts, Blockchain educators need to develop the same blockchain fundamentals as entrepreneurs and SME managers. Expert Interview 2 mentioned that educators should have "a detailed understanding of the blockchain technology, in order to perceive problems and use cases from different perspectives in distributed environments".

Below are the fundamentals technical skills they should ensure to acquire:

TECHNICAL SKILLS NAME	DESCRIPTION	EDUCATOR PROFILE
Fundamentals: distributed systems	Understand the problems of communication in computer networks, network failures and malicious communication.	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain Trainer of entrepreneurs in blockchain
Fundamentals: cryptography	Understand asymmetric cryptography, cryptographic hashes, digital signatures and digital certificates.	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain

TECHNICAL SKILLS NAME	DESCRIPTION	EDUCATOR PROFILE
Fundamentals: consensus models and block inclusion in blockchain	Educators will need to understand models of consensus depending on types of computer networks and understand classical consensus algorithms and how this drive leader selection. Reason that these mechanisms are the key to the fact that blockchains are tamper proof and immutable. Introduce at least failure-only models as Raft, permissioned network models with byzantine fault tolerance as PFBT, and then lottery models as PoW and variants of PoS with their incentive systems.	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain Trainer of entrepreneurs in blockchain
Fundamentals: blockchain types	Educators should be able to discuss the differences of open, permissionless blockchains and private, permissioned ones and other hybrid schemes.	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain Teacher of legal aspects of blockchain
Fundamentals: governance models in blockchain	Understand how changes in blockchains, especially permissionless ones, are made, including the idea of forking and the idea of on-chain governance.	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain
Fundamentals: smart contract essentials	Understand the concept of smart contract and how it can be used to implement	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain
Fundamentals: the concept of oracles	Understand how external data can be included inside blockchains with some degree of credibility.	<ul style="list-style-type: none"> Coordinator of postgraduate studies in blockchain

Teaching blockchain to entrepreneurs will require from educators a knowledge of the technology's fundamentals and the potential applications of Blockchain. Educators should understand how Blockchain may be applied to simplify complex systems and should also have knowledge of the foundations, general functionalities, architecture, components, principles (e.g., cryptocurrencies, wallets, smart contracts, separate platforms) of Blockchain-based systems. Expert Interview 2 emphasised that educators should have necessary knowledge of cross-disciplinary skills (regulatory, AI, IoT...) for solving problems in a distributed environment.

Practical experience

Beyond having knowledge alone, it was suggested by interviewees that educators should develop practical experience in innovation in blockchain. Educators should be able to demonstrate blockchain technology capabilities and apply them to business-related challenges; compare blockchain platforms to develop an understanding of different system design choices; and discuss and compare different blockchain models, schemes, and solutions with constructed/illustrated applications. Furthermore, experience working in or with SMEs, or even having run their own business would be beneficial.

4.5. SUGGESTED ANDRAGOGIES AND LEARNING ENVIRONMENTS

The following section presents **a list of recommended andragogy for entrepreneurship educators to teach blockchain competences** compiled from the literature review and from our interviews with blockchain educators and experts. Andragogy refers to methods and principles used in adult education.

Design Thinking

Most interviews mentioned the important to start with identifying the problem to solve, and then assessing whether blockchain is the right technology to solve this challenge. Therefore, we believe that a problem-centric innovative approach to teaching blockchain should be considered by starting the courses asking the learners key questions such as: What is the problem to solve? What is the context? How do I solve this problem in this specific context using digital technology such as Blockchain? This is an entrepreneurial approach which incorporates critical thinking and design thinking.

Problem-based Learning (PBL)

With problem-based learning, students develop skills in analytical thinking and reflective judgment by reading and discussing complex, realistic scenarios.

Case-Based Learning (CBL)

To teach and introduce the Blockchain-related competences, a case-based approach could be taken where it inspires and engages learners in discussion of specific scenarios that resemble or typically are real-life scenarios. This will provide students with a relevant opportunity to see the diverse usage possible of blockchain but also how the technology can be used to solve different problems. Entrepreneurs understand the frustration and cost of unnecessary friction which is high on the list of advantages for using Blockchain. By taking a familiar use case to small entrepreneurs and SME managers and showcasing how blockchain can eliminate unnecessary costs, middlemen and delays, entrepreneurs will certainly want to learn.

Interdisciplinarity problem-solving approach

Integrating emerging technologies with far-reaching effects like Blockchain leads to complex challenges for all types of organisations and can only be mastered by collaboration, integrating different disciplines, and establishing interdisciplinary teams (Laufs and Sandner, 2020¹⁰⁰).

The increasing market demand for interdisciplinary competences necessitates educational institutions to support learners' abilities to collaborate across disciplines, hence facilitating an interdisciplinary learning approach. According to experts' interview, the development of interdisciplinary courses that offer students from different disciplines with comprehensive blockchain-related competences and knowledge helps understand the scope of BCT application and impact on different business environment. It was also mentioned that it could be beneficial to integrate multiple roles and functionalities depending on the maturity of the project into the course. This is especially important in blockchain integration projects, where the relationships between internal and cross-company actors often lead to challenges where actors have difficulties in reaching a mutual understanding of objectives, capabilities, and requirements of the blockchain integration and lack a common technical language and regular basis (Laufs and Sandner, 2020⁸⁷).

Testing and prototyping

A great learning environment is a where learners have the possibility to quickly create a concept or Minimum Viable Product (MVP) which can be tested and prototyped has been mentioned by many entrepreneurs to quickly assess the viability of the product, its gaps and the customer desire for the solution. This is important to see early on if the product is viable and desirable by the users. In addition, testing environment such as Blockchain test framework (e.g Ethereum tester, Truffle) or a Blockchain Sandbox, which are live-like testing environment used to ensure regulatory compliance and security checks for financial operations, have been recommended to test early the solution developed.

Online courses

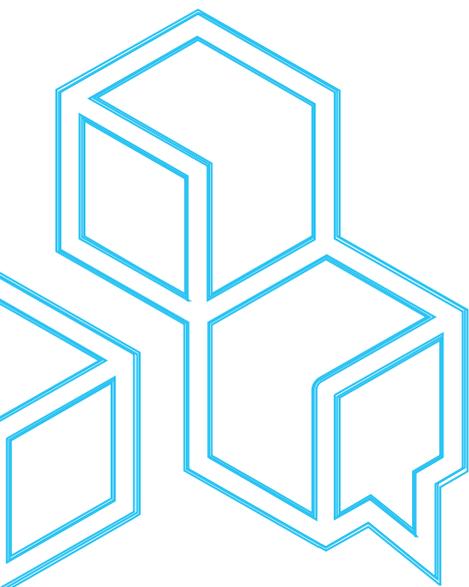
Online courses may be a good option for teaching Blockchain-related skills, particularly active digital learning methods. Different concepts of how courses can be delivered online exist: e.g., Massive Open Online Courses (MOOCs), Small Network Online Courses (SNOCs).

100. Laufs, D., & Sandner, P. (2020). Implementing blockchain projects in banks. Banking & Financial Services Policy Report, 39.

CONCLUSION & RECOMMENDATIONS



The objective of the guide is to raise awareness and commitment to introducing training in blockchain for business within entrepreneurship VET. Based on literature review, expert interviews, case studies with successful blockchain entrepreneurs and a review of the EntreComp and DigiComp framework, we developed a model synthesizing the most important entrepreneurial, technical, and blockchain-specific knowledge and competences required to integrate as well as to teach blockchain.



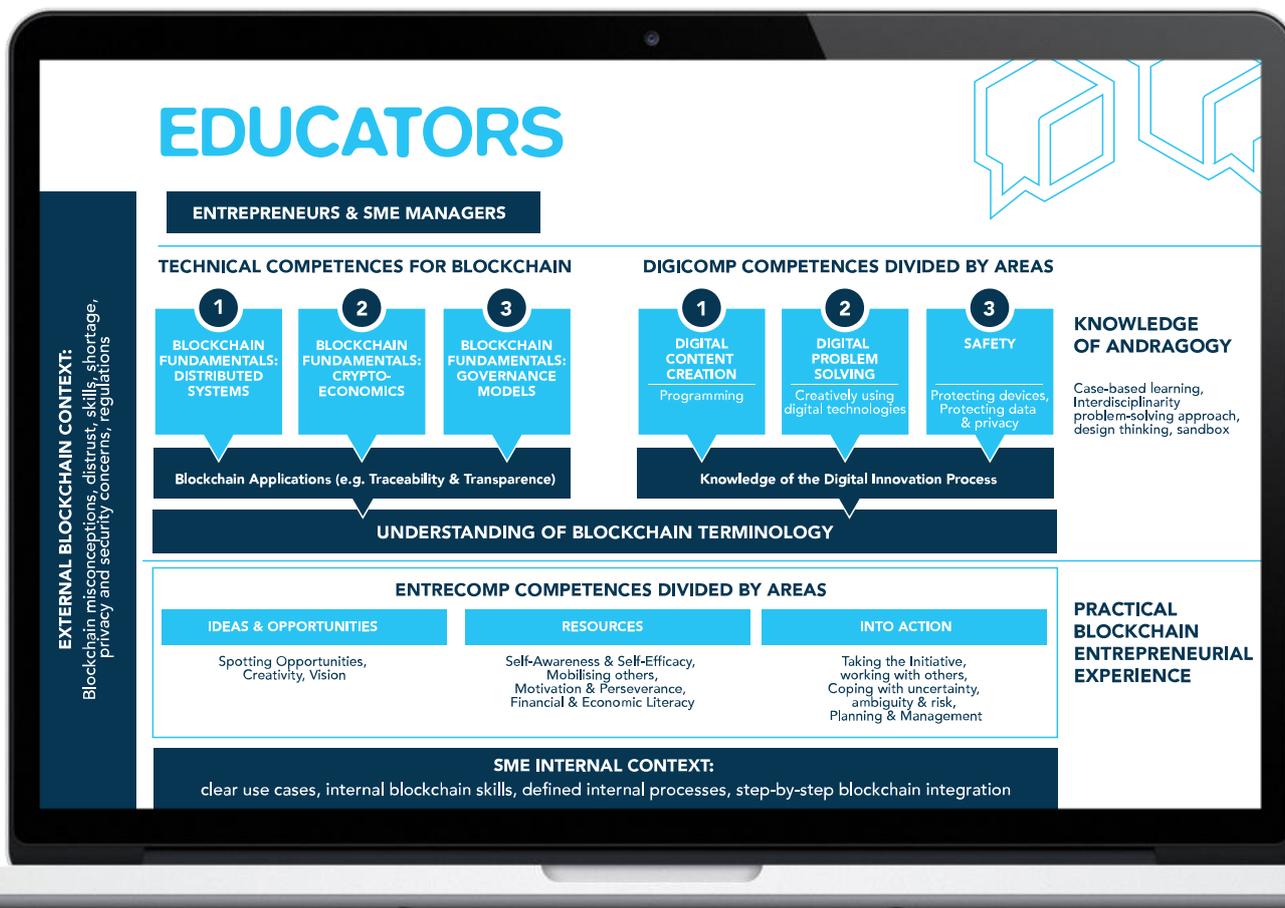


Figure 3. BEGIN Blockchain competences summary (see appendix 1)

While entrepreneurs will have to develop specific competences, it is important to mention that successfully running a blockchain-enabled enterprise will also depend on diverse factors, such as the internal and external environment and context of the company, as well as the level of understanding of blockchain from the business leaders (based on the learning from the drivers, challenges and key success factors collected during the interviews).

The external environment and context in which the enterprise operates can facilitate or limit the success of the blockchain integration. For instance, trust among stakeholders will be essential to fasten the process while privacy and security concerns from stakeholders or customers can slow it down. Similarly, the internal environment of the company will be essential in its success. The corporate culture, capabilities, and resources available, or management support can impact the success of the solution. The table below explains each element of the Figure 3 in details:

Drivers, Challenges and Key Success Factors to integrate Blockchain	
SME Internal Context	The company's internal context can be a driver or a barrier to the successful integration of blockchain. According to companies who succeeded in implementing blockchain, some key success factors were critical to their growth such as defining early on clear use cases for using blockchain, having internal (within the team) blockchain knowledge and competences, having access to resources or funding, starting small and testing/prototyping early on, as well as developing and being part of a network.
External Context	The company's external context will also significantly influence the decision to integrate Blockchain. Depending on it, companies may face non-negligible challenges starting with a general misconception from stakeholders of the technology and therefore distrust on its viability and benefits. Other mentioned challenges are the still high cost of integration and difficulties to find and recruit blockchain experts. Additionally, the complex blockchain regulatory environment and mistrust and hesitance from potential competitors to share data can hinder the implementation of blockchain-enabled solutions within companies.

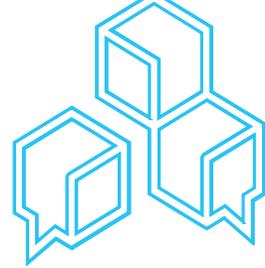
Knowledge and Competences for entrepreneurs and SME managers (and Entrepreneurship Educators)

<u>Knowledge of Blockchain Terminology</u>	General understanding of Blockchain concepts and terminology (as listed in the glossary) is a prerequisite as well as key capabilities. Knowledge of fundamental blockchain terminology such as ledger, nodes, smart contracts, fungible versus non-fungible tokens, pseudonymity, and anonymity in blockchain, but also financial, crypto economics terms such as Initial Coin Offering, Incentive systems, stable coins, staking, etc.
<u>EntreComp Framework</u>	The European EntreComp competences framework can be used as framework of reference to develop and assess the level of entrepreneurship competences required to develop a blockchain-enabled enterprise. EntreComp competences such as spotting opportunities, creativity, vision, mobilising others, motivation & perseverance, taking the initiative, working with others, coping with uncertainty, ambiguity & risk as well as planning & management are essential competences to acquire.
<u>DigiComp Competences For entrepreneurs And for educators</u>	The European DigiComp competences framework can be used as framework of reference to develop and assess the level of digital competences required to use blockchain. DigiComp competences such as programming, identifying needs and technological responses, creatively using digital technologies, protecting devices and protecting data and privacy are critical to develop at an advanced level.
<u>Technical competences for Blockchain</u>	To be able to innovate and use the technology, it is essential for learners and educators to have an excellent grasp of some fundamental blockchain concepts and terms of the technology such as distributed systems, governance models, consensus models and block inclusion in blockchain, cryptography and cryptoeconomics.

Knowledge and Competences for Entrepreneurship Educators

<u>Specific Andragogies to teaching Blockchain</u>	To ensure blockchain competences can be taught and assimilated successfully by the learners, educators need to have experience of diverse andragogies such as case-based learning (CBL) or problem-based learning, where learners can work on real-life challenges, or interdisciplinarity problem-solving approach. Creating learning a environment where learners can quickly prototype and test their solution in a close-to-real life scenario is important learning experience.
<u>Digital Innovation process/ Lean Startup and Agile Methodology</u>	To teach blockchain to entrepreneurs and SME managers, educators will need pre-existent knowledge of the digital innovation process and design thinking principles. This knowledge is necessary to ensure learners have identified the right pain points and problem to solve and think through how these problems can be remedied by digital technology and/or whether blockchain is the right technology for this specific problem.
<u>Practical Experience of Entrepreneurship and Blockchain</u>	It has been recommended by experts for educators to possess entrepreneurial experience as well as digital skills as well as well as practical knowledge of blockchain. A detailed understanding of the Blockchain technology will help educators to perceive problems and use cases from different perspectives in distributed environments while a practical knowledge will help them to demonstrate blockchain technology capabilities and apply them to business-related challenges.
<u>Specific Andragogies to teaching Blockchain</u>	To ensure blockchain competences can be taught and assimilated successfully by the learners, educators need to have experience of diverse andragogies such as case-based learning (CBL) or problem-based learning, where learners can work on real-life challenges, or interdisciplinarity problem-solving approach. Creating learning a environment where learners can quickly prototype and test their solution in a close-to-real life scenario is important learning experience.

APPENDIX 1



Educators

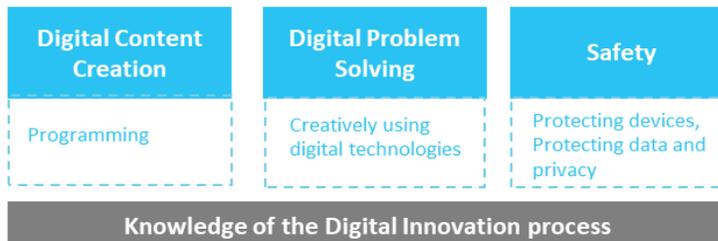
Entrepreneurs and SME Managers

External Blockchain context: Blockchain misconceptions, distrust, skills shortage, privacy and security concerns, regulations

Technical competences for Blockchain



DigiComp competences divided by areas



Understanding of blockchain terminology

Knowledge of Andragogy:
case-based learning, Interdisciplinarity problem-solving approach, design thinking, sandbox

EntreComp competences divided by areas



Practical Blockchain and Entrepreneurial Experience

SME Internal context: clear use cases, internal blockchain skills, defined internal processes, step-by-step blockchain integration

We will create a **new blockchain training model** that enables entrepreneurship educators to teach blockchain technology to their **SME and entrepreneurship learners.**



Follow our journey here



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momentum
[educate + innovate]



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