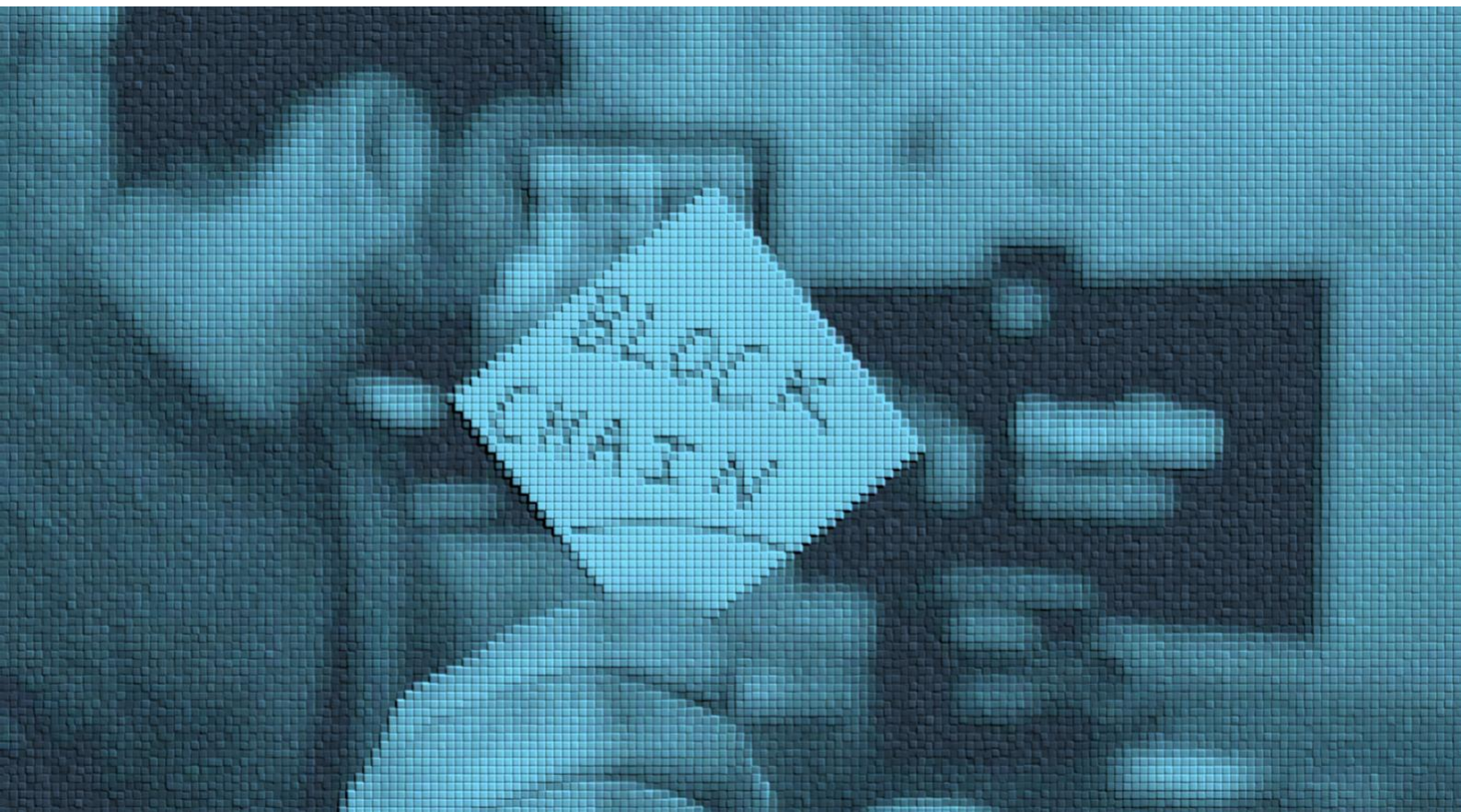




PEEB

PROMOTING EDUCATION FOR
ENTREPRENEURS ON BLOCKCHAIN



Guide to

blockchain Competences

vet-peeб.net

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



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

Table of Contents

Executive Summary	4
Introduction – What is blockchain?.....	4
Literature Review	5
blockchain in Partner Countries and Associated Contexts	6
Research findings.....	7
Glossary	8
1. Introduction	12
1.1. About blockchain	12
1.2. How does blockchain work?.....	13
1.3. Benefits of blockchain	13
2. Literature Review	15
2.1. The role of blockchain for start-ups and HE	15
2.2. Blockchain skills and competences	22
2.3. Andragogy to teach blockchain competences	25
3. blockchain in Partner Countries	27
3.1. What is happening at the supranational level?	27
3.2. Blockchain policies, strategies, and context in the partners countries	33
3.3. Blockchain support and competences initiatives for SMEs and high growth enterprises ..	37
3.4. Practical snapshot for entrepreneurs and educators: what matters in each country	42
4. PEEB research findings	45
4.1. Methodology.....	45
4.2. Drivers, challenges, and key success factors to blockchain integration.....	49

4.3. Cost considerations for blockchain adoption in SMEs.....	54
4.4. Competences for entrepreneurs and SME managers.....	56
4.5. Competences for educators.....	64
4.6. Suggested andragogical approaches and learning environments.....	68
5. Conclusion and recommendations.....	70

Executive Summary



Introduction - What is blockchain?

According to the European Commission, blockchain is a 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 can support the development of citizen-centric, transparent, and inclusive digital economies, particularly by enabling trust-based digital services for businesses and communities in emerging and transition economies.

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).

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. While blockchain-based financing models such as tokenisation and decentralised financial services are emerging, their adoption by SMEs remains limited and context-dependent. For most SMEs, especially in Palestine and Tunisia, blockchain’s current value lies more in improving operational transparency, traceability, and trust, rather than serving as a direct financing mechanism.

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 decentralised 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 require 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

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

good and bad aspects of the project. Freeman et al.⁵ and Düdler 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.

Blockchain in Partner Countries and Associated Contexts

Blockchain adoption and skills development are progressing at different speeds across regions. In Palestine and Tunisia, awareness of blockchain is increasing, particularly in areas such as entrepreneurship, fintech, supply chains, and digital services. However, structured training opportunities for SME managers and entrepreneurship educators remain limited, creating a gap between interest in the technology and the ability to apply it in practice.

In this context, international cooperation and knowledge transfer are essential. Experience from more mature ecosystems within the partnership supports local capacity building by helping adapt blockchain concepts, use cases, and skills development approaches to local economic realities. This includes an emphasis on practical business applications, regulatory awareness, and gradual adoption pathways that are realistic for SMEs and start-ups.

At the European level, the EU blockchain strategy aims to support innovation, accelerate adoption, and provide a coherent legal framework for blockchain and digital assets. The strategy also promotes political cooperation, interoperability, standardisation, and skills development, notably through initiatives such as **CHAISE** (block**CHA**in **S**kills for **E**urope). Across Europe, blockchain ecosystems have developed through a mix of public-sector involvement and industry-led initiatives, reflecting different governance models. Overall, blockchain skills development remains an emerging educational field, with increasing but still uneven investment in upskilling entrepreneurs, SME leaders, and educators in advanced digital skills, including blockchain.



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 key 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 Düdder 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.
- Established entrepreneurship and digital competence frameworks can be used by educators as a reference point for competence development and assessment. These should be adapted to local contexts and complemented by practical, hands-on learning on blockchain fundamentals, business use cases, and decision-making processes relevant to SMEs.

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.

⁷ See 3

- 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 support learners in identifying relevant business challenges and assessing whether blockchain is an appropriate and value-adding solution for their specific context.

Glossary

Core blockchain Concepts & Architecture	
blockchain as a ledger	A distributed ledger (also called a shared ledger or distributed ledger technology, DLT) is a consensus of replicated, shared, and synchronized digital data geographically spread across multiple sites, countries, or institutions. Unlike a traditional database, updates are agreed via network rules (consensus) rather than a single central administrator.
Nodes	A node is a computer running software that processes and communicates blockchain data to other nodes. Nodes can have different roles (e.g., validating, relaying, or reading data), and not all nodes necessarily store a full copy of the ledger.
Hash	A hash is the output of a function that transforms data into a fixed-length digest. Hashes are designed to be hard to reverse and are used to verify data integrity; even small input changes produce a very different digest.
Consensus mechanisms (consensus algorithms)	Consensus mechanisms allow network participants to agree on the ledger state, even if some actors are faulty or malicious. The choice of mechanism affects speed, cost, governance, and operational requirements.
Consortium vs public; permissioned vs	Permissioned blockchains restrict who can participate and/or validate transactions. Permissionless (public) blockchains allow anyone to join and transact; data is generally publicly readable.

permissionless blockchains	
Decentralised oracles	Oracles provide external information to smart contracts. Decentralised oracle approaches reduce reliance on a single source by using multiple data providers and validation methods.
Layer-2 scaling (high-level)	Techniques that process transactions outside a main blockchain (layer-1) while still anchoring security to it, typically improving speed and lowering costs.
Interoperability and bridges (high-level)	Methods that enable assets or data to move between different blockchain networks or systems, supporting multi-partner ecosystems.
blockchain-as-a-service (baas) / managed infrastructure	Cloud or platform services that provide ready-to-use blockchain infrastructure and tools, reducing the need for in-house technical setup.
blockchain governance	The decision-making and rules that determine how a blockchain system evolves (e.g., upgrades, permissions, dispute handling).
Fork	A network divergence created when participants do not follow the same rules or consensus, which can lead to temporary or lasting splits.

Smart Contracts, Applications & Privacy

Smart contracts	Pieces of code stored on a blockchain that are executed when triggered by transactions, automating business rules and processes.
Wallets and access management	Software or hardware tools that help users manage access to blockchain-based assets and applications, including signing transactions.
Pseudonymity, anonymity, and privacy in blockchain	blockchain systems may be pseudonymous; privacy can be enhanced through encryption, permissioned access, or privacy-preserving techniques.

Blockchain explorers and on-chain verification	Tools that allow users to view and verify public blockchain data such as transactions, wallet addresses, and smart contract activity.
Privacy-preserving techniques (high-level)	Approaches that protect sensitive business information while enabling verification (e.g., proving something is true without revealing underlying data).

Tokens, Crypto-assets & Cryptoeconomics

Tokens	blockchain-based digital assets that can represent value or rights and support new business models such as tokenisation.
Tokens - Fungible	Digital tokens where each unit is interchangeable with another unit of the same token.
Non-Fungible Tokens (NFT)	Cryptographic tokens representing unique assets that are not mutually interchangeable.
Tokenisation (as a business mechanism)	The process of representing real-world assets, rights, or claims as blockchain-based tokens.
Incentive systems, mining	Mechanisms that promote participation in validation through rewards, often using computational work.
Transaction costs	Network fees charged to process transactions, which vary depending on network rules and congestion.
Staking	Locking tokens to support the security and operation of certain blockchain networks in exchange for potential rewards.
Stablecoins	Digital units of value designed to reduce price volatility against a reference asset.
Decentralised Finance (DeFi)	An experimental form of finance using smart contracts instead of traditional intermediaries.

Funding, Governance & Regulatory Aspects

<i>Decentralised Autonomous Organisation (DAO)</i>	An organisation whose operating rules are encoded as smart contracts and whose financial transactions are recorded on a blockchain.
<i>Initial Coin Offering (ICO)</i>	A token-based fundraising mechanism used to raise funds for a project or venture.
<i>Security Token Offering (STO)</i>	A fundraising approach where tokens represent regulated investment-type claims.
<i>Legal status of tokens and DAOs</i>	The legal classification and compliance obligations of tokens and DAOs, depending on jurisdiction and structure.

1. Introduction

1.1. About blockchain

According to the European Commission, blockchain is a 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 can enable more efficient interactions among enterprises, public organisations, and citizens by reinforcing trust and allowing each party to retain control over their data. In this way, blockchain can support the development of more transparent, inclusive, and sustainable digital ecosystems, particularly in emerging and transition economies.



1.2. 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 involved.⁸

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 data⁹. To summarise, 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.



1.3. Benefits of blockchain

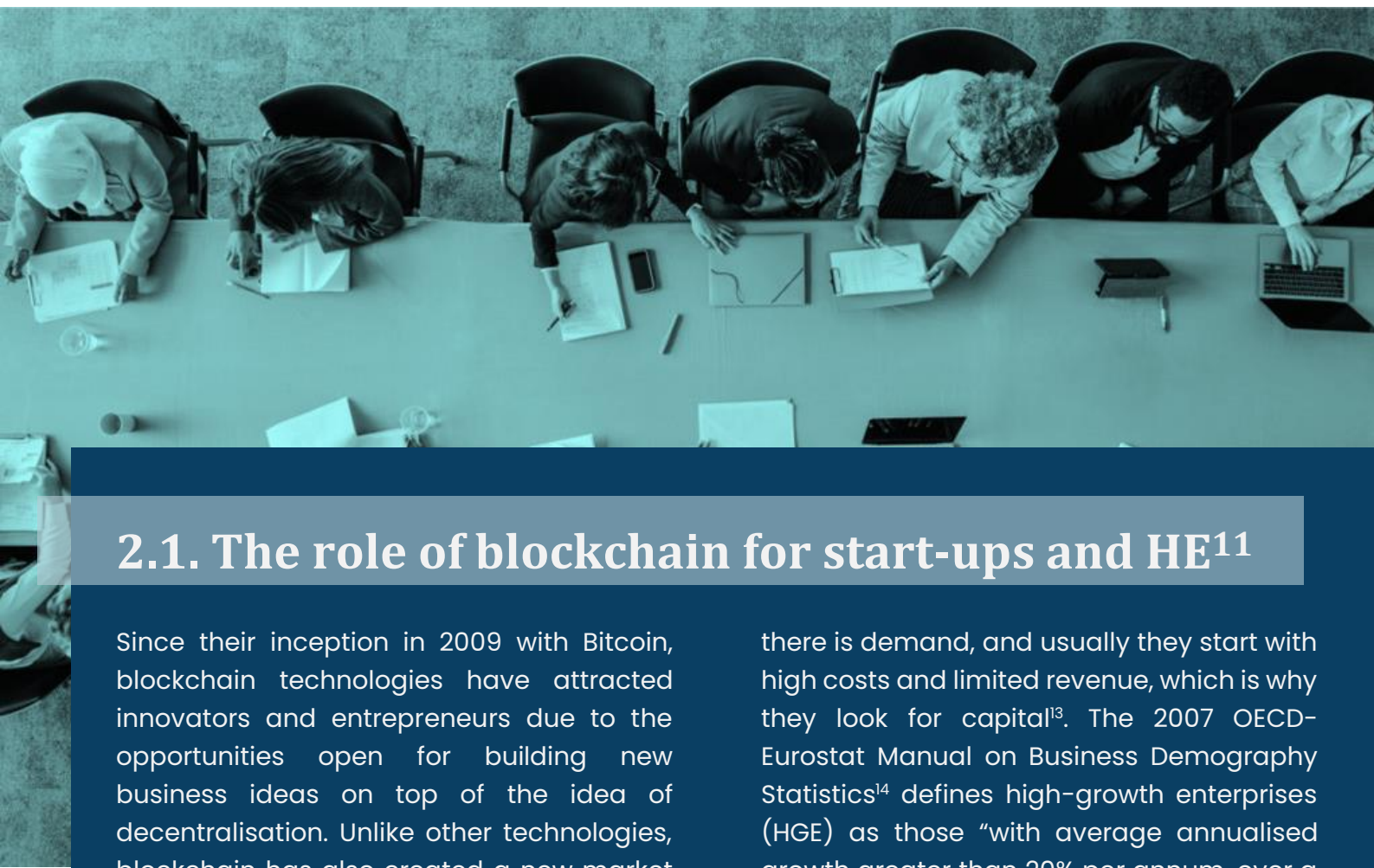
According to the European Commission¹⁰, the blockchain technology has the potential to disrupt and benefit both society and businesses. Amongst others, the application of the technology enables the creation of:

- New collaborative models in the digital economy (creating trust).

¹⁰ European Commission, Gigler.S (2019, May 16), EU actions on blockchain – Moving beyond the Hype

- 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 SMEs and start-ups operating in diverse economic contexts.

2. Literature Review



2.1. The role of blockchain for start-ups and HE¹¹

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 operations¹². 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 capital¹³. The 2007 OECD-Eurostat Manual on Business Demography Statistics¹⁴ 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 period¹⁵”. 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

¹¹ High-growth Enterprises

¹² 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>.

¹³ See 5

¹⁴ 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-RA-07-010?inheritRedirect=true>.

¹⁵ See 7

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.

Fundamental elements of blockchain

Ilbiz & Durst¹⁶ 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 the creation of crypto-assets, which in some cases may support new value exchange or incentive mechanisms, depending on regulatory and market conditions.. Going further in similar directions, Kher et al¹⁷ provide a survey

1. **Economics.** They focus on the game theoretic and incentive mechanisms, and transaction cost theory and social exchange theory.
2. **Entrepreneurship.** They discuss how blockchain influences entrepreneurial experimentation, including alternative coordination and governance models, while recognising that token-based financing mechanisms are not universally applicable to SMEs.
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, Allen¹⁸ 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. Novak¹⁹ 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 Kozma²⁰ 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.

¹⁶ Ilbiz, E., & Durst, S. (2019). The Appropriation of blockchain for Small and Medium-sized Enterprises. *Journal of Innovation Management*, 7(1), 26–45.

¹⁷ Kher, R., Terjesen, S., & Liu, C. (2020). blockchain, Bitcoin, and ICOs: a review and research agenda. *Small Business Economics*, 1–22.

¹⁸ Allen, D. W. (2019). Governing the entrepreneurial discovery of blockchain applications. *Journal of Entrepreneurship and Public Policy*.

¹⁹ Novak, M. (2019). Crypto-friendliness: understanding blockchain public policy. *Journal of Entrepreneurship and Public Policy*.

²⁰ Nowiński, W., & Kozma, M. (2017). How can blockchain technology disrupt the existing business models? *Entrepreneurial Business and Economics Review*, 5(3), 173–188.

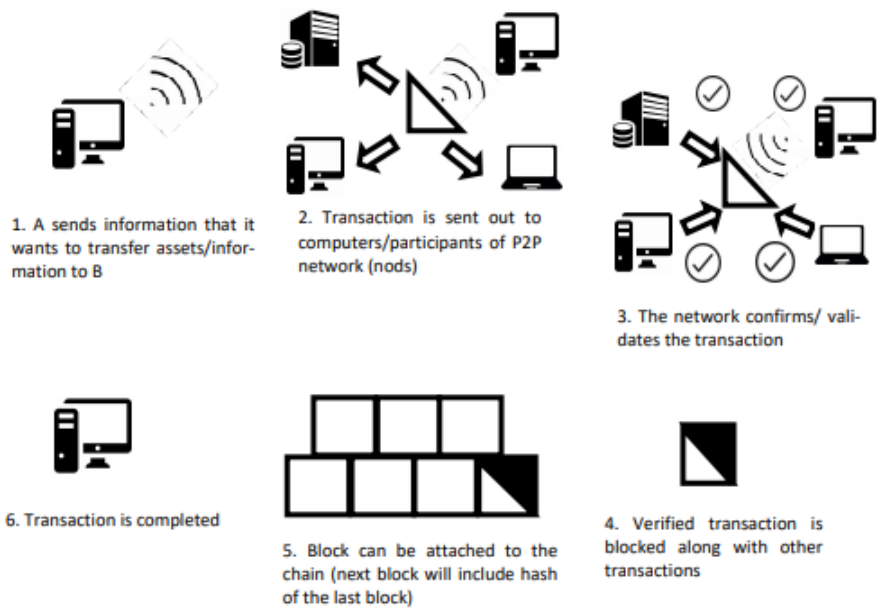


Figure 1: Simplified scheme of a blockchain transaction – Source: adapted model based on PWC (n.d.)

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 enabling new forms of value exchange and collaboration, with limited experimentation in alternative fundraising mechanisms. 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.²¹ 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. A prominent example is the use of blockchain for traceability in food production and delivery chains, where multiple platforms and initiatives demonstrate how transparency and shared data can support trust among supply chain actors.

Financial exclusion

Larios-Hernández²² 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 & Bjørn²³ 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

²¹ 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.

²² Larios-Hernández, G. J. (2017). *Blockchain entrepreneurship opportunity in the practices of the unbanked*. *Business Horizons*, 60(6), 865-874.

²³ 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).

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.²⁴

Chalmers et al.²⁵ 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.

Chen²⁶ 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.²⁷ discuss that route for financing from the perspective of transactions cost theory. Transaction cost is also mentioned by Allen et al.²⁸. ICOs are discussed as a new way of crowdfunding by Martino et al.²⁹.

Financial innovations and the Decentralised Finance (DeFi) space.

Chen & Bellavitis³⁰ 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, Schär³¹ 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 & Caton³² 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

24 Allen, D. W. (2017). *Discovering and developing the blockchain cryptoeconomy*. Available at SSRN 2815255.

25 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*.

26 Chen, Y. (2018). *Blockchain tokens and the potential democratisation of entrepreneurship and innovation*. *Business Horizons*, 61(4), 567–575.

27 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.

28 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.

29 Martino, P., Bellavitis, C., & DaSilva, C. M. (2019). *Blockchain and initial coin offerings (ICOs): a new way of crowdfunding*. Available at SSRN 3414238.

30 Chen, Y., & Bellavitis, C. (2020). *Blockchain disruption and decentralised finance: The rise of decentralised business models*. *Journal of Business Venturing Insights*, 13, e00151.

31 Schär, F. (2020). *Decentralised finance: On blockchain- and smart contract-based financial markets*. Available at SSRN 3571335.

32 Harwick, C., & Caton, J. (2020). *What's holding back blockchain finance? On the possibility of decentralised autonomous finance*. *The Quarterly Review of Economics and Finance*.

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

Overall, blockchain can matter for start-ups and HGEs in two interlinked ways: as part of the product/service value proposition and, in some public-network cases, as part of the financing pathway (because blockchain ecosystems can generate markets that ventures can participate in). Across the literature, the most cited “business value mechanisms” are immutability and transparency, disintermediation, and the creation of new market/incentive structures enabled by shared ledgers and smart contract programmability. This makes blockchain distinctive as an entrepreneurship domain where business models and financing mechanisms can become more entangled than in many other digital technologies, while newer funding pathways (including DeFi) remain active but immature and risk-exposed for broad adoption.

2.2. 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 activities³³. Competencies are seen as features that a person brings to a job situation, which can result in effective and/or higher performance in such job³⁴. These

characteristics consist of motives and traits,

social role and self-concept, knowledge, skills, attitudes, and capabilities and characteristics (personal qualities)^{35 36 37}.

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^{38 39}.

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^{40 41 42}.

Blockchain, a model of interdisciplinary competences

According to Düdder et al.⁴³, 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 cooperation⁴⁴. An interdisciplinary environment allows for rapid

decision-making, cognitive diversity, and innovative content or creativity, as well as risks

33 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.

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

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

36 Man, T. W., Lau, T., & Chan, K. F. (2002). The competitiveness of small and medium enterprises: A conceptualization with focus on entrepreneurial competencies. *Journal of business venturing*, 17(2), 123–142.

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

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

39 See 37

40 Henry, C., Hill, F., & Leitch, C. (2005a). Entrepreneurship education and training: Can entrepreneurship be taught? Part I. *Education and Training*, 47(2), 98–111. DOI: 10.1108/00400910510586524

41 Henry, C., Hill, F., & Leitch, C. (2005b). Entrepreneurship education and training: Can entrepreneurship be taught? Part II. *Education and Training*, 47(3), 158–169. DOI: 10.1108/00400910510592211

42 See 37

43 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

44 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)

such as lack of openness to other disciplines, communication barriers, and conflicts^{45 46}. 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^{47 48}.

One interdisciplinary education programme on blockchain is based on the developments of

BlockNet project (“Blockchain Network Online Education for interdisciplinary European Competence Transfer”), 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”**.

45 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

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

47 Kachalov, N., Kornienko, A., Kvesko, R., Kvesko, S., & Chaplinskaya, Y. (2015). Interdisciplinary competences and their status role in the system of higher professional education. *Procedia Social and Behavioural Sciences*, 206, 429-433. DOI: 10.1016/j.sbspro.2015.10.078

48 Döder, 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/ftboc.2020.578022 e-Estonia. Available online at: <https://e-estonia.com> (accessed May 14, 2021)

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^{49 50} and Baethge et al.⁵¹. Combining these four competences Dürder et al.⁵² 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”⁵³.

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 separately⁵⁴.

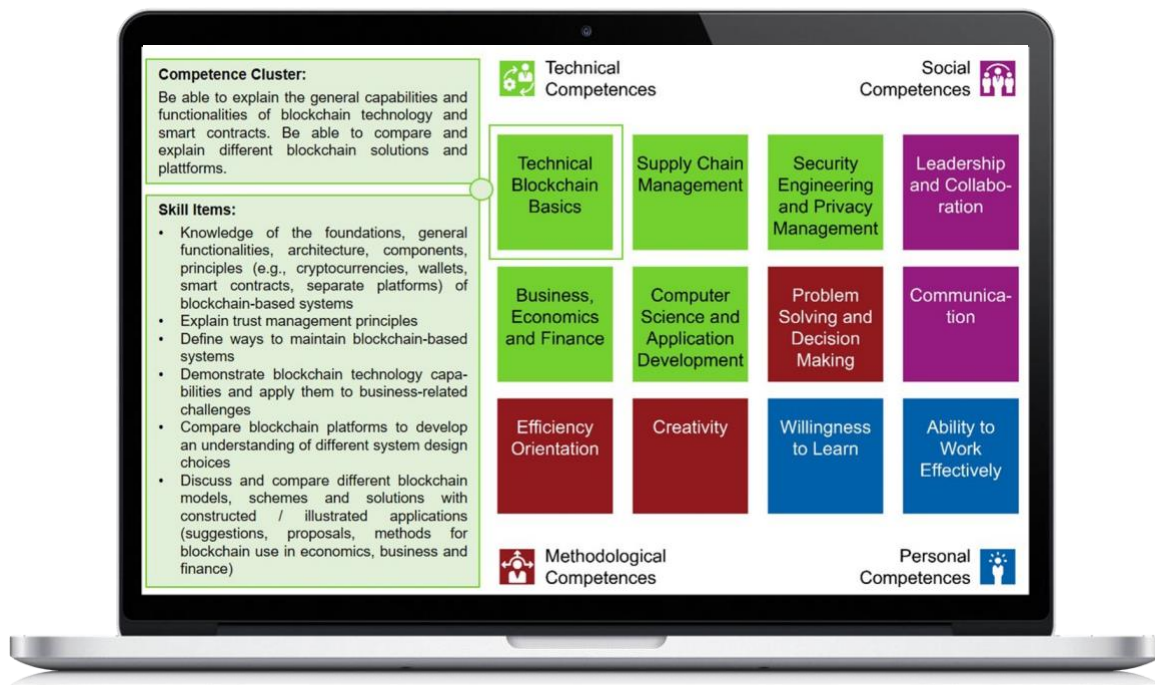


Figure 2. BlockNet competence model. Used with Permission. Graphic by Dürder et al. (2019⁵⁵).

Management researchers and practitioners need to improve their theoretical and practical knowledge of transaction costs, management mechanisms, and risk mitigation to better understand

49 Reetz, L. (1989a). Zum Konzept der Schlüsselqualifikationen in der Berufsbildung. Teil 1. BWP Berufsbildung Wissenschaft Praxis, 18, 3–10

50 Reetz, L. (1989b). Zum Konzept der Schlüsselqualifikationen in der Berufsbildung. Teil 2. BWP Berufsbildung Wissenschaft Praxis, 24–30.

51 Baethge, M., Achtenhagen, F., Arends, L., Babic, E., Baethge-Kinsky, V., & Weber, S. (2006). *Berufsbildungs-Pisa. Machbarkeitsstudie*. München: Franz Steiner.

52 Dürder, 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)

53 See 57

54 See 57

55 See 57

possible ways to implement a blockchain system and implement the business needs of a particular company⁵⁶.

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.⁵⁷ shows that the successful design, development, and implementation of blockchain-based business solutions require deployment of interdisciplinary teams of experts with domain-specific knowledge.

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.⁵⁸ and Düdder and al.⁵⁹ 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

⁵⁶ Lumineau, F., Wang, W., & Schilke, O. (2020). *blockchain governance - A new way of organizing collaborations*. *Organisation Science*, Forthcoming. Available online at: <https://ssrn.com/abstract=3562941> (accessed May 28, 2021).

⁵⁷ See 57

⁵⁸ 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

⁵⁹ See 48

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 schools ⁶⁰.

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^{61 62}. In applied interdisciplinary courses delivered through universities, entrepreneurship centers, or incubators, practical topics can be discussed and directly tested through case studies and guided exercises linked to real business contexts. 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. Through targeted workshops and group activities, participants can further develop communication and collaboration skills that are essential for working with partners, clients, and support institutions in diverse entrepreneurial environments.

Entrepreneurs and SME managers often spend a large part of their working time on written documentation, reporting, and communication with clients, partners, and regulators. 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, short practical workshops on business writing and presentations can use exercises and feedback to help participants communicate value propositions, explain digital solutions clearly, and engage stakeholders more effectively.

⁶⁰ Brojpito, A. (2018). *Digital skills and competence, and digital and online learning*. European Training Foundation, Turin. Available online at: https://www.etf.europa.eu/sites/default/files/2018-10/DSC%20and%20DOL_0.pdf (accessed May 12, 2021)

⁶¹ Kachalov, N., Kormienko, A., Kvesko, R., Kvesko, S., & Chaplinskaya, Y. (2015). *Interdisciplinary competences and their status role in the system of higher professional education*. *Procedia Social and Behavioural Sciences*, 206, 429–433. DOI: 10.1016/j.sbspro.2015.10.078

⁶² Temelkova, M. (2018). *Skills for digital leadership – prerequisite for developing high-tech economy*. *International Journal of Advanced Research in Management and Social Sciences*, 7(12), 50–74.

3. blockchain in Partner Countries



3.1. What is happening at the supranational level?

At the supranational level, international institutions and regional blocs have increasingly focused on blockchain as a strategic digital technology, particularly in relation to regulation, trust frameworks, and support for innovation ecosystems. Policy discussions emphasize the need to balance innovation with concerns related to data protection, sustainability, and responsible use.

Blockchain is widely recognized as an emerging digital technology alongside artificial intelligence, the Internet of Things, and advanced connectivity infrastructures. Often described as a “technology of trust,” it enables multiple actors that may not fully trust each other to share and record information in a tamper-resistant way without relying exclusively on central intermediaries.

Experiences from Europe illustrate how public policy can support blockchain adoption by combining innovation incentives with safeguards related to privacy, sustainability, and governance. These approaches offer useful reference points for other regions seeking to encourage blockchain experimentation while maintaining public trust and regulatory clarity.

At the policy level, the European Union has developed a coordinated blockchain strategy intended to support innovation while providing legal clarity for businesses and public administrations. Rather than serving as a template, this experience provides illustrative examples of how regulatory coherence, funding mechanisms, and stakeholder coordination can jointly support blockchain adoption in SME and start-up ecosystems.

Provide funding for blockchain innovation

The EU provides funding for blockchain research, experimentation, and early deployment through a sequence of research and innovation programmes, combining grants with investment-oriented instruments. Since 2013, EU support for blockchain-related initiatives has been channelled through successive framework programmes, notably Horizon 2020, which the European Commission reports supported blockchain projects with over €200 million in prizes and grants during 2016–2020.⁶³

This support continues under Horizon Europe (2021–2027), the EU's main research and innovation programme, with a budget of around €95.5 billion (current prices). Blockchain- and DLT-relevant activities are funded through competitive calls that typically support applied R&D, pilots, testing in real-world settings, and ecosystem-building actions linked to the EU's broader digital transition priorities.⁶⁴ Reflecting this continuity, European Commission reporting indicates that between 2016 and 2024, Horizon 2020 and Horizon Europe together provided approximately €700 million in grants to projects in which blockchain or distributed ledger technologies play a role, across multiple application areas.⁶⁵

Beyond direct grants, Europe also uses blended finance and innovation funding mechanisms to support start-ups and SMEs working on blockchain and related digital technologies. A key example under Horizon Europe is the European Innovation Council (EIC) Accelerator, which supports high-potential start-ups and SMEs seeking to scale

⁶³ European Commission, *European blockchain Strategy – Brochure* (2019).

⁶⁴ European Commission, *Commission welcomes political agreement on Horizon Europe* (Press release, 9 Dec 2020).

⁶⁵ European Commission, *blockchain and web3 strategy* (policy page; includes funding figures for 2016–2024).

market-creating innovations.⁶⁶ These combined funding models illustrate how public investment can reduce early-stage risk and encourage structured experimentation—an approach that is relevant for incubators,

accelerators, university entrepreneurship units, and SME support ecosystems in Palestine and Tunisia when designing pathways from idea, to pilot, to adoption.⁶⁷

Develop strong political partnerships

One important lesson from the European experience is the role of multi-country and multi-stakeholder partnerships in reducing fragmentation. Collaborative initiatives between governments, regulators, and technology providers have been used to test blockchain solutions in controlled environments, allowing policymakers and businesses to learn from pilot implementations before scaling them. Such sandbox-style approaches can help emerging ecosystems manage uncertainty and reduce adoption risks.⁶⁸

Promote legal certainty

Legal and regulatory clarity has emerged as a critical factor for blockchain adoption. International experience shows that uncertainty around crypto-assets, data protection, and liability can discourage SMEs from experimenting with blockchain solutions. Clear guidance, proportionate regulation, and dialogue between regulators and businesses are therefore essential to support responsible adoption, particularly in emerging markets.⁶⁹

Support blockchain interoperability and standards

Standardization efforts at international level highlight the importance of interoperability, security, digital identity, and governance in blockchain systems. Global standard-setting bodies, such as the International Organisation for Standardization (ISO), provide reference frameworks that can help SMEs and policymakers avoid vendor lock-in and support cross-border compatibility.

community

Public-private dialogue mechanisms have played an important role in connecting policymakers, industry, SMEs, and academia. International examples show that observatories, forums, and industry associations can help disseminate knowledge, share best practices, and align expectations between regulators and market actors—functions that are equally relevant in smaller and emerging blockchain ecosystems.

Interact with the

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:

⁶⁶ European Innovation Council (European Commission), EIC Accelerator (programme description).

⁶⁷ European Commission (2023), blockchain Strategy and EU Funding Overview; OECD (2022), Financing SMEs and Entrepreneurs.

⁶⁸ European Commission. (2021). blockchain funding. Shaping Europe's digital future. <https://digital-strategy.ec.europa.eu/en/policies/blockchain-funding>.

⁶⁹ World Bank (2022), Regulating blockchain and Digital Assets.

BLOCKCHAIN SKILLS FOR EUROPE

The Blockchain Skills for Europe (CHAISE) initiative is an Erasmus+ Sector Skills Alliance launched to develop a strategic approach to blockchain skills in Europe and deliver training solutions addressing identified skills shortages.⁷⁰ The project delivered the European blockchain Skills Strategy in April 2022 and has published supporting strategy materials.⁷¹ It also developed training solutions, including an innovative 5-semester VET programme designed for delivery in multiple EU languages, and produced occupational/skills profiling work (including a “blockchain specialist” occupational profile) aligned with competence and qualification frameworks. In addition, CHAISE promotes cooperation mechanisms (e.g., networks and national partnerships) intended to support uptake and implementation of the strategy across countries and stakeholders.⁷²



BLOCKCHERS

BLOCKCHERS was a Horizon 2020 project (Grant Agreement 828840) that ran from 1 February 2019 to 31 January 2021.⁷³ It supported practical blockchain/DLT uptake across SMEs through an acceleration model combining open calls, pilot implementation and ecosystem support, helping blockchain solution providers work with traditional SMEs on real-world use cases. CORDIS project information records a total project cost of €1,500,000 and confirms the project timeline and closure.⁷⁴



BLOCKSTART

Bax & Company set up BlockStart as a pan-European blockchain/DLT partnership and acceleration programme to facilitate mutually beneficial collaborations between blockchain/DLT solution providers and end-user SMEs.⁷⁵ The



⁷⁰ CHAISE (Project website) – “About / mission and training solutions” overview.

⁷¹ CHAISE – European blockchain Skills Strategy (deliverable PDF, incl. April 2022 delivery).

⁷² Cedefop – CHAISE project fiche (Strategy release and sectoral cooperation framing).

⁷³ European Commission CORDIS – BLOCKCHERS project reporting page (timeline and closure).

⁷⁴ European Commission CORDIS – BLOCKCHERS project page (total cost and project facts).

⁷⁵ BlockStart – Programme brochure (funding amounts and programme structure).

programme offered a structured 3-stage pathway (Ideation Kick-off – Prototype – Pilot) and equity-free support, including funding of up to €20,000 for selected DLT/blockchain solution providers and up to €4,500 for end-user SMEs (as presented in programme materials). The third open call referenced in earlier texts closed on 26 May 2021 and the programme later showcased results through a third Demo Day held in February 2022 (as reflected in the project’s published press materials).⁷⁶

EUROPEAN DIGITAL ACADEMY

The European Digital Academy was launched in 2020 with the objective of supporting reskilling and upskilling—particularly for individuals and SMEs—across key emerging technologies including blockchain.⁷⁷ Its outputs are associated with the “Digital SkillUp” initiative, which provides an online training space and learning content on emerging technologies (including blockchain) and is presented as accessible to both citizens and SMEs.⁷⁸



DIGITALEUROPE

DIGITALEUROPE is a European trade association representing digitally transforming industries.⁷⁹ Through engagement with EU institutions and Member States, it works to shape the broader business, policy and regulatory environment affecting digital technologies. It also publishes “key indicators” for Europe’s digital ambition, including targets and resources linked to SMEs/scale-ups (e.g., scale-up ecosystem performance and unicorn-related targets as part of its indicator set).⁸⁰



⁷⁶ BlockStart – Open Call 3 press release (call deadline and Demo Day planning) and project press page (Demo Day reference).

⁷⁷ Digital SME – European Digital Academy announcement (launch and objectives, 2020).

⁷⁸ Digital Skills & Jobs Platform – Digital SkillUp description (EU-funded training for citizens and SMEs).

⁷⁹ DIGITALEUROPE – Mission & Values (who they represent and purpose).

⁸⁰ DIGITALEUROPE – Key indicators for a stronger digital Europe (scale-up/unicorn-related targets and SME/scale-up resources).

3.2. Blockchain policies, strategies, and context in the partners countries

Blockchain adoption in Palestine and Tunisia remains at an early and uneven stage, particularly when compared with more mature European ecosystems. Unlike several EU Member States, neither Palestine nor Tunisia has adopted a comprehensive national blockchain strategy. Instead, blockchain-related initiatives are emerging through a combination of targeted policy instruments, regulatory experimentation, donor-supported programs, and entrepreneurial activity, especially in fintech, digital services, and supply-chain-related sectors.

Evidence from the market needs analysis conducted within the project shows that blockchain adoption among SMEs is still limited and largely exploratory, with most firms reporting low levels of integration and a lack of internal capacity to assess or implement blockchain solutions. Key barriers include limited financial resources, regulatory uncertainty, concerns related to data security and trust, and a shortage of applied business-oriented blockchain skills

Within this context, the role of higher education institutions, incubators, entrepreneurship units, and applied training programs becomes critical. Rather than focusing on large-scale infrastructure deployment, current efforts in both countries are oriented toward awareness-raising, skills development, pilot experimentation, and the identification of realistic use cases relevant to SME needs.

Tunisia

Tunisia has taken several steps to create a more enabling environment for digital entrepreneurship, within which blockchain technologies are increasingly discussed, particularly in relation to fintech, digital identity, and financial inclusion. The adoption of the Startup Act (2018) marked a turning point in supporting innovation-driven enterprises, providing legal recognition, fiscal incentives, and administrative facilitation for startups, including those operating in emerging digital domains.

From a regulatory perspective, blockchain experimentation in Tunisia has been most visible in the financial sector. The Central Bank of Tunisia has promoted innovation through initiatives such as regulatory sandboxes aimed at fintech solutions, including blockchain-based applications for payments, compliance, and digital services. However, these initiatives remain limited in scale and are primarily accessible to a small number of firms with sufficient technical and financial capacity.

Findings from the project's market needs analysis indicate that Tunisian SMEs generally perceive blockchain as a potential driver of new business models and transparency, but lack the skills required to evaluate feasibility, costs, and risks. Most firms prioritize competencies related to innovation management, financial assessment, and risk management over advanced technical development skills, confirming the need for applied, decision-oriented training rather than developer-focused programs.

Spain

While the country does not have a standalone national blockchain strategy, blockchain has become an established component of Spain's broader digital transformation, research, and innovation agendas. 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.

Palestine

The Palestinian entrepreneurial ecosystem operates under significant structural constraints related to market access, mobility, and regulatory fragmentation. Despite these challenges, the ICT and digital entrepreneurship sectors have demonstrated resilience, with growing interest in technologies that can reduce reliance on intermediaries, enhance trust, and facilitate cross-border transactions.

Blockchain discussions in Palestine have largely focused on awareness-raising activities, short training initiatives, and exploratory pilots, often supported by universities, technology hubs, and international development actors. While no formal national blockchain strategy exists, fintech-related innovation has attracted attention due to its potential relevance for payments, remittances, and digital services in a constrained economic environment.

Survey evidence collected within the project highlights that Palestinian SMEs face similar challenges to their Tunisian counterparts: low levels of blockchain integration, limited internal processes for acquiring blockchain-related skills, and strong concerns regarding regulatory clarity and data security. At the same time, respondents emphasize the importance of ethical considerations such as confidentiality, accountability, and transparency, aligning blockchain interest with broader governance and trust issues rather than purely technical innovation.

The EECTI (*Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027*)⁸¹ 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 within the ‘Next Generation Internet’ priority, included in the broader ‘Digital World, Industry, Space and Defence’ framework, and continues to be supported through competitive research and innovation funding instruments. As such, it is explicitly included in the agenda for R&D and innovation. This is reflected in the continued presence of blockchain-based projects among funded technology-based spinoffs and start-ups, including through instruments such as the NEOTEC programme managed by CDTI.

The local government of Catalonia approved in 2019 a ‘blockchain Strategy’⁸² for the public administration of the Autonomous Community, which has since guided pilot projects and institutional experimentation in selected administrative domains. 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 settings⁸³. 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. Alastria provides partners with two permissioned blockchain networks designed to support enterprise and public-sector use cases in a regulation-compliant manner. 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 has also explored solutions related to Self-Sovereign Identity (SSI), reflecting broader interest in digital identity frameworks within regulated and consortium-based environments.

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

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.

81 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/stfs/MICINN/Ministerio/FICHEROS/EECTI-2021-2027.pdf>

82

83 Ibáñez Jiménez, J. W., & Puig, Á. (2017). *La primera blockchain española y su impacto en la eficiencia de las empresas*. *Economistas*, 3(155), pp. 45-52.

- 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.

Despite the growing availability of blockchain-related courses and professional training initiatives, most educational offers in Spain remain technically oriented or targeted at specialist profiles. Training specifically designed for SME managers, entrepreneurs, and non-technical decision-makers is still limited, particularly with regard to evaluating business relevance, organisational impact, and return on investment.

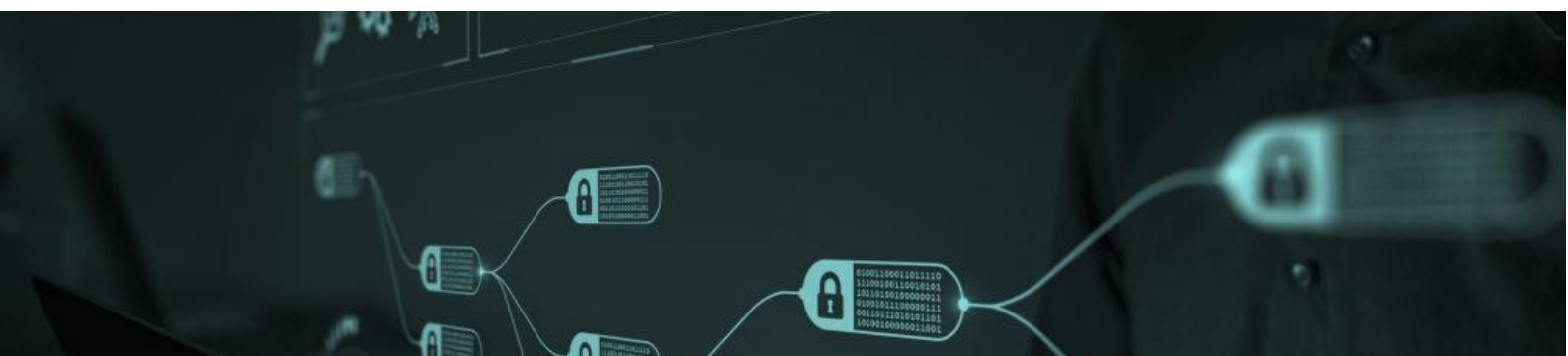
Italy

Italy presents a steadily evolving blockchain landscape, shaped by a combination of institutional recognition, entrepreneurial experimentation, and sector-specific applications. The country was among the first in Europe to formally recognize the legal validity of blockchain-based records and smart contracts, which contributed to increased attention from both public institutions and private actors.

Blockchain-related initiatives in Italy are typically embedded within broader frameworks addressing digital transformation, innovation, and industrial modernization. Rather than pursuing large-scale national blockchain infrastructures, the Italian approach has favoured pilot projects and applied use cases, particularly in sectors such as manufacturing, agri-food supply chains, certification, logistics, and professional services. In these contexts, blockchain is primarily valued for its ability to support traceability, transparency, and trusted data exchange across multiple organisations.

The Italian entrepreneurial ecosystem includes a growing number of startups and technology providers offering blockchain-based solutions, often delivered through platform or Software-as-a-Service models. These solutions are generally targeted at addressing specific operational problems rather than promoting blockchain as a disruptive technology in itself. As a result, adoption among small and medium-sized enterprises has been selective and pragmatic, with firms showing interest where blockchain can be integrated into existing processes with limited organisational disruption.

Education and training activities related to blockchain in Italy are mainly delivered by universities, business schools, and professional training organisations. These offerings frequently combine blockchain with themes such as innovation management, legal and regulatory frameworks, and digital business models. Compared to more technically oriented programs, there is a noticeable emphasis on governance, compliance, and organisational implications, reflecting the needs of SMEs operating in regulated or quality-sensitive environments.



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

Support initiatives that help start-ups and SMEs innovate with blockchain—and, just as importantly, understand when not to use it—have expanded in recent years. Typical activities include hackathons, bootcamps, accelerator tracks, industry meetups, and targeted short courses that translate blockchain concepts into business decisions (use-case selection, cost/benefit, partners, legal and data considerations). For SMEs, these ecosystems matter because they provide access to mentoring, peer learning, pilot partners, and (in some cases) finance, reducing the perceived risk of experimenting with a new technology.

Across the partner countries, SME decision-makers report that blockchain adoption is still generally at an early stage inside their organisations, and many rate integrations in business processes as weak. Only about one third report having established internal mechanisms to acquire and integrate blockchain-related skills; where mechanisms exist, they typically rely on R&D activity and short training/workshops rather than hiring specialized blockchain staff. The most frequently cited barriers are budget constraints, data security concerns, and the need for clearer commitment and regulation; the strongest drivers relate to new business models, security/trust, efficiency and cost reduction, and traceability/transparency.

Blockchain skills development remains uneven across countries and sectors, and it is often delivered through short, practice-oriented formats rather than standardized national frameworks. For SMEs and entrepreneurship support organisations, the most useful initiatives tend to combine:

- Business-facing literacy (what blockchain is good for, procurement choices, vendor and network selection).
- Risk management (data protection, cybersecurity, governance, compliance)
- Applied learning through pilots and case work.

This section summarizes the most relevant support and competence-building initiatives in Spain and Italy (as sources of EU expertise) and in Palestine and Tunisia (as priority adoption contexts), with a focus on what SMEs and entrepreneurship educators can realistically access and use.

Blockchain support initiatives for SMEs and high growth companies

In Palestine, blockchain-related support is most often accessed through broader entrepreneurship and digital innovation structures (accelerators, tech hubs, university-linked entrepreneurship units) that can host blockchain workshops or connect SMEs to specialized trainers when a concrete use case exists. Leaders Organisation has played a long-running ecosystem role through initiatives such as FastForward Accelerator and eZone (technology hub and coworking space), convening seminars, workshops, and training activities that strengthen founders' readiness to engage with emerging technologies.

Palestine Techno Park has organized blockchain-focused talks and workshop formats (e.g., "Smart Talks – blockchain"), typically bringing together entrepreneurs, students, and finance/banking professionals to connect fundamentals with practical applications. At the training level, SMEs can also access short professional offerings that include blockchain within fintech and digital payments topics, and capacity-building programs (e.g., AMIDEAST) that provide a pathway to more advanced digital upskilling when needed.

Blockchain competences initiatives (SME-facing and educator-relevant)

Formal blockchain coverage appears primarily through university courses and short professional programs. Examples include fintech and blockchain-related courses at Birzeit University and bootcamp-style programs associated with ecosystem actors in Ramallah and the West Bank. These initiatives are particularly relevant for SMEs exploring payment modernization, cross-border trade constraints, and digital trust in B2B relationships—provided that cost, security, and regulatory constraints are addressed early in the learning journey.

The market feedback from surveyed companies highlights that the most immediate competence needs sit at the intersection of entrepreneurship and digital capability: innovation management, business scalability, financial analysis, and domain risk management. On the technical side, respondents prioritize cloud computing, AI, and blockchain familiarity over programming depth, reinforcing the value of applied, decision-oriented training for SME managers and entrepreneurship educators.

Tunisia

Blockchain support initiatives for SMEs and high growth companies

In Tunisia, blockchain-related skills and ecosystem support are increasingly visible through a mix of university-linked entrepreneurship structures and private/community initiatives. The university ecosystem has expanded entrepreneurship support in recent academic years, including activities under national entrepreneurship-oriented policies and the development of career/certification structures (such as Centers of Careers and Certifications of Competences), which can serve as institutional channels for emerging-technology awareness and training.

On the practitioner side, Tunisia also shows examples of structured blockchain education delivered through partnerships that combine training, hackathons, and certification pathways (e.g., large-scale developer training programs and university collaborations). While these initiatives can be developer-oriented, they create spillover benefits for SMEs by strengthening the local talent pipeline and by increasing the availability of local partners able to deliver pilots.

Blockchain competences initiatives (SME-facing and educator-relevant)

Tunisia-accessible training options include:

- University modules that build foundational distributed-ledger competence and provide talent pipelines.
- Short, business-oriented courses suitable for non-technical SME managers who need to evaluate feasibility and risk.
- Sector-specific offerings are particularly relevant to Tunisian SMEs in agri-food and export-facing supply chains, where traceability, provenance, and certification are practical entry points.

Consistent with the broader market feedback, key barriers remain budget constraints and data security concerns, alongside the need for clearer commitment and regulatory confidence; the strongest adoption drivers relate to traceability/transparency, efficiency, and new business models. This supports a pragmatic training emphasis on “how to evaluate and pilot” rather than “how to build from scratch

Italy

blockchain support initiatives for SMEs and high growth companies

Italy combines a relatively broad training market (universities and private providers) with a growing set of SME-relevant applications, especially in certification, public administration workflows, and supply-chain traceability. For SMEs, a key advantage is the availability of multiple formats: from short executive-style courses for managers to longer professional programs that create “bridge profiles” (project managers, legal/compliance tracks, and business-focused roles able to work with technical teams).

A practical illustration of Italy’s applied ecosystem is the entrepreneurial journey of *Flosslab*, which used blockchain first for diploma verification (Almacert) and then expanded toward production-chain solutions (e.g., B-Supply). The case highlights common SME realities: the need for awareness-building with traditional industries and public institutions, the importance of integrating blockchain into existing IT systems while remaining compliant with data protection requirements, and the benefits of partnerships that provide stability and scaling capacity.

Blockchain competences initiatives (SME-facing and educator-relevant)

Italian training options include university courses that combine technology, business applications, and regulatory context, and private programs oriented to managers and entrepreneurs (e.g., “blockchain Technology & Management” formats, project-manager tracks, and multi-track schools covering marketing/legal/developer profiles). For entrepreneurship educators, these offerings are useful references for structuring modular learning pathways: a short “decision literacy” layer for SME managers plus optional deeper tracks for staff who will lead pilots or manage vendors.

Spain

Blockchain support initiatives for SMEs and high growth companies:

- **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:** 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.

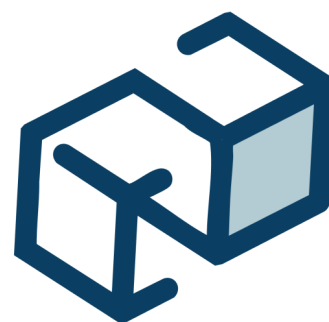
There are also initiatives supported by large companies and mature ecosystem actors that help SMEs test blockchain-adjacent

business models through mentoring, corporate challenge programs, and pilot access. Telefónica's Open Future has previously hosted calls and venture-building activity linked to deep-tech and digital trust themes, and Madrid/Barcelona continue to concentrate many of the convening spaces where SMEs can find peer learning and specialist contacts. In practice, these channels are most useful when SMEs start from a concrete problem (e.g., provenance/traceability, credential verification, trusted data sharing) and use the ecosystem to identify partners and reduce first-pilot cost and risk.

Blockchain competences initiatives

In Spain, higher-education and professional training in blockchain has expanded beyond a handful of early specialist master's programs into a broader mix of postgraduate options and short, practice-oriented courses. A review of national offerings indicates that multiple universities run blockchain-related master's level programs, complemented by shorter courses delivered by companies, associations, and entrepreneurship-oriented providers—often focused on

business applications, compliance, and use-case evaluation rather than deep engineering. This blended landscape is particularly relevant for SME managers who need decision capability and for entrepreneurship educators who need teachable case material and structured learning outcomes.⁸⁴ Notably, INCYDE offers vocational educational programs oriented to entrepreneurs in blockchain.



⁸⁴ MiCA timeline and application milestones (EU-level regulatory context shaping SME confidence and compliance planning)

3.4. Practical snapshot for entrepreneurs and educators: what matters in each country

What entrepreneurs in Palestine and Tunisia should take from “supranational” practice

Entrepreneurs do not need to master the technology. They need a decision checklist for when blockchain is worth a pilot and how to reduce risk.

- **Start with the business problem:** choose use cases where trust, traceability, or multi-party coordination are the bottleneck (not “because blockchain is innovative”).
- **De-risk with pilots and sandboxes:** controlled pilots with regulators/partners reduce uncertainty before scaling.
- **Legal clarity matters early:** ambiguity around crypto-assets, data protection, and liability is a common stop-factor for SMEs.
- **Avoid lock-in** prioritize interoperability, security, identity, and governance standards when selecting vendors/networks.
- **Skills should be decision-oriented:** SMEs benefit most from training that builds capability to evaluate feasibility, costs, partners, and compliance—not only developer skills.

Palestine: what to know (entrepreneur-facing)

ADOPTION STATUS: SME adoption is early and mostly exploratory; integration into business processes is limited.

Main friction points

Regulatory fragmentation/uncertainty, data security and trust concerns, and limited internal capacity to assess solutions; broader structural constraints (market access, mobility) shape priorities.

Most realistic opportunities

Fintech-relevant applications (payments/remittances/digital services) and trust-building in constrained cross-border or multi-party settings.

Training reality

Access is mainly through hubs/accelerators and university-linked initiatives (talks, workshops, bootcamp-style offers); competence needs are strongly business-facing (innovation management, scalability, financial analysis, risk management) rather than deep programming.

Tunisia: what to know (entrepreneur-facing)

ADOPTION STATUS: early/uneven, with more visible fintech experimentation than Palestine.

Enabling elements

A stronger digital entrepreneurship framework

(notably the Startup Act) and sandbox-style

experimentation around fintech, though participation remains limited to higher-capacity firms.

Most realistic opportunities

Fintech services and, especially, export- and agri-

food-facing use cases where traceability, provenance, and certification create clear business value.

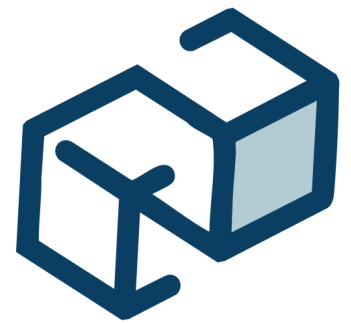
Training reality

A mix of university modules and community/private initiatives; some large-scale training is developer-oriented but strengthens the talent pipeline. SMEs still need short, practical courses focused on feasibility, costs, risks, and piloting.

Comparative map

Country	Adoption level (SMEs/start-ups)	Main barriers	Real opportunities for entrepreneurs (near-term)	Training availability (practical access)
PALESTINE	Early, exploratory; low integration	Regulatory fragmentation/uncertainty; data security & trust; limited internal capacity; structural constraints (market access, mobility)	Fintech services (payments/remittances/digital services); trust-building for constrained cross-border/multi-party transactions	Mostly workshops/talks via hubs/accelerators/universities; short offers embedded in fintech; demand is business-facing (innovation, finance, risk)
TUNISIA	Early/uneven; more visible fintech experimentation	Budget constraints; data security; limited applied feasibility/risk skills; limited access to regulatory experimentation	Export and agri-food supply chains (traceability/certification); fintech and digital services pilots	University modules + community/private initiatives; some developer-oriented pipelines; need for short manager-focused evaluation/piloting courses
SPAIN	More mature ecosystem activity; embedded in broader digital/R&I agendas	SME decision-maker training still limited vs. technical offers; need ROI and organisational-impact capability	Easier access to hubs/associations/partners; practical pathways to reduce pilot risk when starting from a concrete problem	Broad HE + short courses; associations active; entrepreneurship-oriented offers exist, but manager decision literacy remains a gap

ITALY	Steadily evolving; pragmatic, use-case led	Compliance and data protection; governance and multi-organisation coordination; integration effort with existing systems	Certification, public workflows, traceability/logistics; platform/SaaS solutions that integrate with existing processes	Strong training market; emphasis on governance/compliance and “bridge profiles” for SMEs
--------------	--	--	---	--



4. PEEB 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

Experts' consultation and surveys

Evidence was gathered through structured surveys with companies and academic staff in Palestine, Tunisia, Spain, and Italy, complemented by targeted consultation with practitioners and educators familiar with blockchain adoption and entrepreneurship education. The evidence collection aimed to:

1. Capture practical needs, barriers, and drivers for blockchain adoption in SMEs and start-ups
2. Identify priority competences for managers/founders to assess, evaluate, and integrate blockchain where it adds business value
3. Inform the competence profile and facilitation skills needed by entrepreneurship educators to



Case studies

A set of 10 business-oriented use cases was compiled to illustrate how blockchain can support SME and start-up objectives through practical mechanisms such as traceability, transparency, trusted record-keeping, and process automation.

The use cases were selected to serve as concrete learning anchors for managers, founders, and educators—highlighting the business problem addressed, how blockchain is used in practice, and the main implementation lessons that inform skills and competence needs

(technical literacy for decision-making, but also innovation management, risk awareness, and stakeholder coordination).

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>EntreComp (European Entrepreneurship Competence Framework)</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).</p> <p>EntreComp classifies 3 main entrepreneurship competence areas: 1) Ideas & Opportunities, 2) Resources, and 3) Into Action.</p> <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>DigiComp (European Digital Competence Framework)</p>	<p>DigiComp offers a tool to improve citizen's digital competence. DigiComp classifies 5 main digital competence areas: 1) Information & Data Literacy, 2) Communication & Collaboration, 3) Digital Content Creation, 4) Safety, and 5) Problem Solving.</p>

Limitations

This study has some limitations. A market needs analysis was carried out with SMEs, start-ups, and academic staff, and the findings reflect the perspectives and readiness levels of the participating organisations. As a result, the evidence may not fully represent the diversity of business sizes, sectors, and maturity levels across Palestine and Tunisia.

In addition, the analysis combines perception-based evidence with practical examples and use cases to support decision-making and skills development. While this approach is well suited to guiding SMEs and educators, it does not replace detailed sector-specific benchmarking or long-term quantitative impact assessments of blockchain deployments.

Finally, the use cases analysed show that blockchain adoption is uneven across application areas. Some uses, such as traceability or verification of records, are already relatively mature,

while others remain experimental or context dependent. This means that the guidance provided should be periodically reviewed and updated to remain aligned with technological, regulatory, and market developments relevant to SMEs and start-ups.

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

The main motivations for integrating blockchain or developing a blockchain-enabled business typically relate to trust, transparency, traceability, and automation across multi-party processes (e.g., supplier documentation, provenance claims, credential verification, or shared records), which can translate into efficiency gains, risk reduction, and competitive differentiation when applied to a clearly defined business problem.

Although attractive, blockchain initiatives may face non-negligible challenges, starting with misconceptions (often linked to confusion between blockchain applications and speculative crypto-assets) that can reduce stakeholder confidence. Integration can also be costly—especially when internal expertise is limited—because SMEs may need external support for solution design, vendor selection, security reviews, and operational integration. Additional barriers include skills shortages, reluctance among partners to share data without clear governance, and regulatory uncertainty in some jurisdictions.

From a practical standpoint, many blockchain systems are not suitable for storing large volumes of data directly on-chain, and performance varies by design (public vs. permissioned networks). As a result, many business deployments use off-chain storage with on-chain proofs (e.g., hashes) to keep records verifiable without overloading the ledger.⁸⁵

Nevertheless, evidence gathered on SME/start-up needs and readiness highlights recurring success factors: defining clear use cases early, building basic internal literacy (enough to manage vendors and make informed decisions), starting small with early testing/prototyping, and being part of networks that share practical know-how and reduce adoption uncertainty.

Practical Screening Questions for SMEs Considering blockchain

Before investing time, financial resources, or organizational effort into a blockchain initiative, SMEs and start-ups should carry out a structured pre-assessment. Blockchain is not a universal solution, and in many cases traditional databases or contractual arrangements may be more appropriate. The following questions can help managers determine whether blockchain is strategically justified in their specific context:

1. Are multiple parties involved who do not fully trust each other?

Blockchain creates shared records across organizations without requiring a single central authority. If all actors already operate under strong trust and

centralized control, a conventional system may be sufficient.

2. Is immutable traceability genuinely required?

Blockchain is particularly useful where tamper-resistant records are critical

⁸⁵ NIST, *Blockchain Technology Overview (NISTIR 8202) – limitations/misconceptions; on-chain data constraints; immutability nuance.* (<https://nvlpubs.nist.gov/nistpubs/ir/2018/nist.ir.8202.pdf>)

(e.g., supply chains, certifications, compliance documentation). If data does not require long-term verifiability or auditability, simpler solutions may achieve the same outcome at lower cost.

3. Is there sufficient regulatory clarity for the intended use case?

SMEs should assess whether relevant regulations (e.g., data protection, financial compliance, sector-specific rules) allow or constrain blockchain deployment. Regulatory uncertainty can increase legal and operational risk.

4. Would automation of agreements create measurable value?

Smart contracts can automate predefined rules and reduce administrative overhead. However, automation only adds value when processes are clearly defined, stable, and suitable for codification.

5. Are simpler or more cost-effective alternatives available?

Blockchain integration can involve infrastructure costs, vendor selection, security reviews, and organizational adaptation. Managers should compare blockchain against centralized databases, APIs, or platform-based solutions before deciding.

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.

Data integrity, auditability, and controlled sharing

A practical driver is the ability to create an append-only audit trail: once records are written, they are difficult to alter without detection, which supports accountability across multiple parties. In many SME deployments, sensitive or large data are not stored directly on the blockchain; instead, systems store data off-chain and record cryptographic references (e.g., hashes) on-chain to prove integrity.⁸⁶

“Data ownership” is not automatic: it depends on governance, access rights, and

⁸⁶ See 104

contractual arrangements (often easier to manage in permissioned networks where participants and permissions are defined).

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

Key Challenges

Based on evidence collected on training supply and market needs in the partner countries, several recurring challenges and barriers may limit the ease of integrating blockchain technologies for SMEs and start-ups.

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.

Regulatory barriers

Some barriers are regulatory in nature, particularly where crypto-asset activities, digital identity, data protection, and cross-border transactions intersect. Legal uncertainty can slow adoption, increase compliance costs, or discourage pilots. Regulatory clarity varies by jurisdiction: for example, the EU context relevant to Spain and Italy has been strengthened through MiCA's framework for crypto-assets and service providers, while approaches in other contexts continue to evolve.⁸⁷ In Tunisia, regulatory support mechanisms such as fintech initiatives and sandbox approaches have been noted as important enablers for experimentation under oversight.

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.

⁸⁷ ESMA overview of MiCA (www.esma.europa.eu/esmas-activities/digital-finance-and-innovation/markets-crypto-assets-regulation-mica).

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

Compared to mature enterprise databases and conventional IT architectures, many blockchain solutions still involve trade-offs (e.g., coordination overhead, integration complexity, and design choices that can affect throughput). Many blockchain systems are not designed to store large amounts of data on-chain, and performance varies significantly by network type and configuration—so SMEs often combine blockchain with traditional systems and off-chain storage.

Key Success Factors

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

Clearly 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

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

Funding and support may be provided privately or publicly (e.g., incubators/accelerators, innovation programmes, or supervised experimentation mechanisms). Such support can help SMEs scope and validate a use case, evaluate vendors, and reduce early implementation risk. In Tunisia, fintech support initiatives and sandbox mechanisms are examples of structures that can help innovators test solutions with regulatory visibility. Open-source tools and managed “blockchain-as-a-service” offerings can also reduce initial technical barriers when chosen carefully.

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.



4.3. Cost considerations for blockchain adoption in SMEs

For SMEs and start-ups, the cost of adopting blockchain depends less on the technology itself and more on how it is used, how deeply it is integrated, and in which ecosystem it is deployed. Costs are therefore relative: a small pilot can be manageable within an innovation budget, while full integration into core business processes can become a strategic investment requiring long-term commitment.

Partial vs. Full Adoption

A limited or pilot-based adoption — for example, using blockchain to certify documents, track a specific product line, or automate a narrow workflow — usually involves moderate costs. These projects often rely on existing platforms or managed services and do not require deep restructuring of the organization. For most SMEs in Palestine and Tunisia, this approach is financially and operationally realistic, as it reduces risk and allows experimentation without major capital exposure.

By contrast, full integration — such as redesigning supply chains, implementing multi-party smart contract systems, or embedding blockchain into financial and ERP systems — significantly increases costs. This includes technical integration, governance design, compliance checks, cybersecurity safeguards, and staff training. Such transformation is more feasible in Spain and Italy, where infrastructure, regulatory clarity, and access to technology providers reduce uncertainty and coordination costs. However, even in these ecosystems, full adoption represents a medium- to long-term investment rather than a quick efficiency gain.

Building internally vs. Hiring specialists

Contextual cost differences between countries

Ecosystem maturity plays a significant role in relative cost. In Spain and Italy, access to funding instruments, digital infrastructure, and regulatory frameworks aligned with EU standards reduces

Developing a blockchain solution internally is generally the most expensive path for an SME. It requires hiring or training specialized staff, managing infrastructure, ensuring regulatory compliance, and maintaining security over time. In Spain and Italy, competition for skilled blockchain professionals drives salaries upward. In Palestine and Tunisia, the limited availability of advanced blockchain expertise can make recruitment even more challenging relative to SME budgets. Internal development only makes economic sense when blockchain is central to the company's core business model.

Hiring external specialists or using blockchain-as-a-Service models is usually more cost-effective for SMEs. This approach converts fixed development costs into service-based expenditures and reduces technical risk. In Spain and Italy, the presence of established provider ecosystems lowers search and coordination costs. In Palestine and Tunisia, reliance on foreign providers may increase contractual and currency-related costs but outsourcing still tends to be less risky than building internal teams from scratch. For most SMEs, especially at early stages, outsourcing for pilot implementation is the most economically rational option.

uncertainty and compliance risk. Although labour costs may be higher in absolute terms, the predictability of the environment lowers indirect costs and improves ROI estimation.

In Palestine, structural constraints related to mobility, regulatory fragmentation, and market access increase perceived risk. Even moderate investments can represent a higher relative burden for SMEs with tighter margins. However, in sectors such as fintech or cross-border digital services, blockchain may reduce long-term transaction costs, partially offsetting initial expenditure.

In Tunisia, budget limitations are frequently cited as a barrier. While regulatory experimentation mechanisms exist, many SMEs lack the internal skills to properly assess feasibility and risk. In such contexts, the cost of poor decision-making – adopting the wrong solution or misjudging ROI – can exceed the cost of the technology itself. Managerial competence therefore becomes a critical cost factor.

Hidden and indirect costs

Entrepreneurs often focus on technical setup costs and underestimate indirect expenses. These include legal review, governance arrangements with partners, staff training, change management, and ongoing maintenance. In multi-party environments, coordination and compliance costs can surpass infrastructure expenses. Blockchain adoption is therefore not merely a technological purchase but an organizational commitment.

Practical conclusion

For SMEs across all partner countries, the lowest-risk path is usually a small-scale, outsourced pilot focused on a clearly defined business problem. Full internal development is the most expensive and highest-risk option.

Adoption becomes economically justified when blockchain reduces coordination costs, strengthens trust among multiple actors, enables traceability required by markets or regulators, or supports a new revenue logic. Without these conditions, simpler and less expensive digital solutions are often preferable.



4.4. 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: <u>Ideas and opportunities</u>	
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>

Self-awareness & self-efficacy

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. *“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”* 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.

Mobilising others

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 because misconceptions and uneven awareness of blockchain persist in many markets, so entrepreneurs often need to clearly explain what blockchain changes (and what it does not), the expected business value, and the operational implications, on top of pitching their business idea. As Wilhelm Myrer the CEO of Empower mentioned, *“Develop excellent communication skills. While blockchain has been available for over a decade, awareness and practical understanding are still uneven, and entrepreneurs need to invest time and resources at marketing/selling their ideas, explaining how the technology can solve certain issues.*

Motivation & Perseverance

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.

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: *“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”.*

Financial & economic literacy

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: *“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."

EntreComp Area of Competence: Into Action

Taking the initiative

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.

Working with others

In line with the *Taking the Initiatives* competence, entrepreneurs will have to learn to build a team, consortia and networks based on the needs of their blockchain activity.

Most blockchain entrepreneurs interviewed actively participated in relevant networks, consortia, or communities of practice as they sought peer-learning and experience sharing, and in some cases to create a more united voice and contact point to communicate and exchange with public stakeholders on regulations and infrastructure. Blockaviation CEO John Roberts said: *“Build a consortium of industry, technology and business experts, a team is greater than the sum of its parts”*. In addition, Cuneyt Eti, CEO of CapexMove, mentioned that collaborating with all stakeholders in the development of a solution can lead 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.

Coping with uncertainty, ambiguity & risk

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.

Planning & Management

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.

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.

Cuneyt Eti, co-founder & CEO of Capexmove: *“Use this as an opportunity to upskill your team”*

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.

DigiComp Area of Competence: <u>Digital Content Creation</u>	
Programming	<p>For most SME managers and founders, the priority is not becoming blockchain developers, but being able to commission, scope, and supervise digital work: translating business needs into requirements, understanding what a technical team or vendor will build, and evaluating feasibility, cost, risks, and timelines. Where in-house development is planned, more advanced skills (e.g., software development practices, cybersecurity, testing and debugging) become relevant, but they can also be covered through collaboration with specialists. AS mentioned by the co-founders of Relica, Daniel & Jeremy Street: <i>“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.”</i></p>
DigiComp Area of Competence: <u>Problem Solving*</u>	
<p>* All competences of the DigiComp area Problem Solving are important to develop when working with blockchain, with the two following ones in particular:</p>	
Identifying needs and technological responses	<p>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).</p> <p>Peter Lind Damkjaer, co-founder and CTO of Diplomasafe, says: <i>“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”</i></p>
Creatively using digital technologies	<p>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.</p> <p>Peter Bainbridge-Clayton, CEO and Founder says: <i>“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”</i></p>

DigiComp 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 is important to develop blockchain-risk-management considerations, regulatory and compliance requirements, financial implications, liability concerns, etc.

Blockchain Technical Skills

Blockchain-related knowledge and competences are inherently multidisciplinary, as the technology often interacts with other digital systems and business processes. For entrepreneurs and SME managers, having a general understanding of key blockchain concepts can be highly beneficial when exploring potential applications or evaluating external providers. However, it is not necessary to become a technical expert in order to introduce blockchain into a company.

In practice, entrepreneurs can approach blockchain adoption by developing a basic conceptual awareness of how it works, what problems it can realistically solve, and what limitations it presents. When more specialized knowledge is required, they may choose to collaborate with qualified professionals or external partners who provide the necessary technical expertise. This approach allows business leaders to make informed strategic decisions without needing to master the technical details themselves.

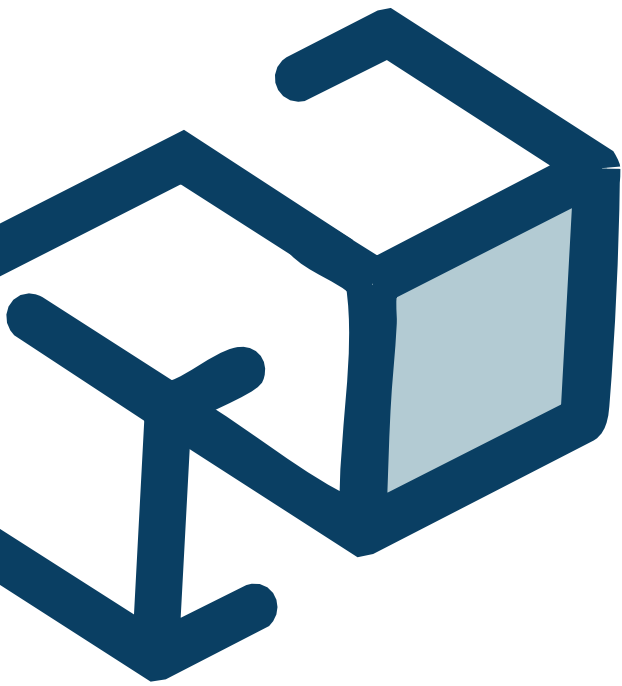
Key technical competences generated from the interviews with blockchain experts are:

blockchain Technical Skills	Description
<i>Open-Source Stewardship model</i>	How companies that develop open source get benefit from that, or how open-source projects get the funding to develop. This is relevant because many widely used permissionless blockchain ecosystems publish significant parts of their software as open source, but licensing and openness vary by project and component (e.g., core clients, tooling, hosted services).
<i>Decentralised business models</i>	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.
<i>Funding from blockchain</i>	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.
<i>Financial inclusion</i>	Understand the ways blockchain might address problems of

	financial exclusion or bankless individuals.
<i>Fundamentals: distributed systems</i>	Understand the problems of communication in computer networks, network failures and malicious communication.
<i>Fundamentals: cryptography</i>	Understand asymmetric cryptography, cryptographic hashes, digital signatures and digital certificates.
<i>Fundamentals: consensus models and block inclusion in blockchain</i>	<p>Understand models of consensus depending on types of computer networks and understand classical consensus algorithms and how these drive leader selection.</p> <p>Reason that these mechanisms are the key to the fact that blockchains are tamper proof and immutable.</p> <p>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.</p>
<i>Fundamentals: blockchain types</i>	Be able to discuss the differences of open, permissionless blockchains and private, permissioned ones and other hybrid schemes.
<i>Fundamentals: governance models in blockchain</i>	Understand how changes in blockchains, especially permissionless ones, are made, including the idea of forking and the idea of on-chain governance.
<i>Fundamentals: smart contract essentials</i>	Understand the concept of smart contract and how it can be used to implement
<i>Complements: the concept of oracles</i>	Understand how external data can be included inside blockchains with some degree of credibility.
<i>Fundamentals: key management, addresses and pseudonymity</i>	Understand key management, wallets and its types, and how addresses of transactions make blockchain pseudonymous. Know about privacy-oriented blockchains as Monero or ZCash.
<i>Cryptoeconomics: token economies</i>	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.
<i>Complements: decentralised file systems.</i>	Understand the complementary role of decentralised file systems as IPFS to blockchain solutions.
<i>Cryptoeconomics fundamentals</i>	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.
<i>Applications: traceability</i>	Know and discuss how different blockchain solutions, decentralised

and transparency

or not, apply to the case of traceability of products and services, or to make transparent existing processes.



4.5. 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.

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 in 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.	Coordinator of postgraduate studies in blockchain Trainer of entrepreneurs in blockchain

Fundamentals: cryptography	Understand asymmetric cryptography, cryptographic hashes, digital signatures and digital certificates.	Coordinator of postgraduate studies in blockchain
---------------------------------------	--	---

<p>Fundamentals: consensus models and block inclusion in blockchain</p>	<p>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.</p> <p>Reason that these mechanisms are the key to the fact that blockchains are tamper proof and immutable.</p> <p>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.</p>	<p>Coordinator of postgraduate studies in blockchain.</p> <p>Trainer of entrepreneurs in blockchain.</p>
<p>Fundamentals: blockchain types</p>	<p>Educators should be able to discuss the differences of open, permissionless blockchains and private, permissioned ones and other hybrid schemes.</p>	<p>Coordinator of postgraduate studies in blockchain.</p> <p>Teacher of legal aspects of blockchain</p>
<p>Fundamentals: governance models in blockchain</p>	<p>Understand how changes in blockchains, especially permissionless ones, are made, including the idea of forking and the idea of on-chain governance.</p>	<p>Coordinator of postgraduate studies in blockchain</p>
<p>Fundamentals: smart contract essentials</p>	<p>Understand the concept of smart contract and how it can be used to implement</p>	<p>Coordinator of postgraduate studies in blockchain</p>
<p>Fundamentals: the concept of oracles</p>	<p>Understand how external data can be included inside blockchains with some degree of credibility.</p>	<p>Coordinator of postgraduate studies in blockchain</p>

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.

4.6. Suggested andragogical approaches 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. 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.⁸⁸

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

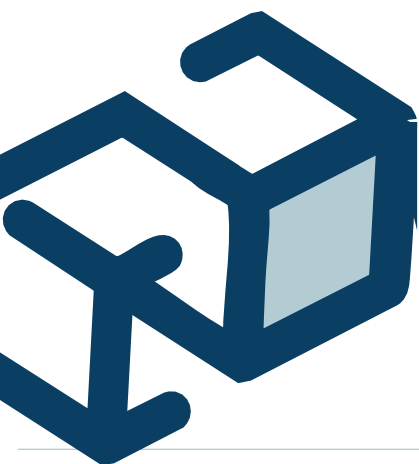
Online courses may be a good option for teaching blockchain-related skills, particularly active digital learning methods. Different concepts of how courses can be delivered online exist: e.g., Massive Open Online Courses (MOOCs), Small Network Online Courses (SNOCs).

⁸⁸ Laufs, D., & Sandner, P. (2020). *Implementing blockchain projects in banks. Banking & Financial Services Policy Report*, 39.

5. Conclusion and 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.

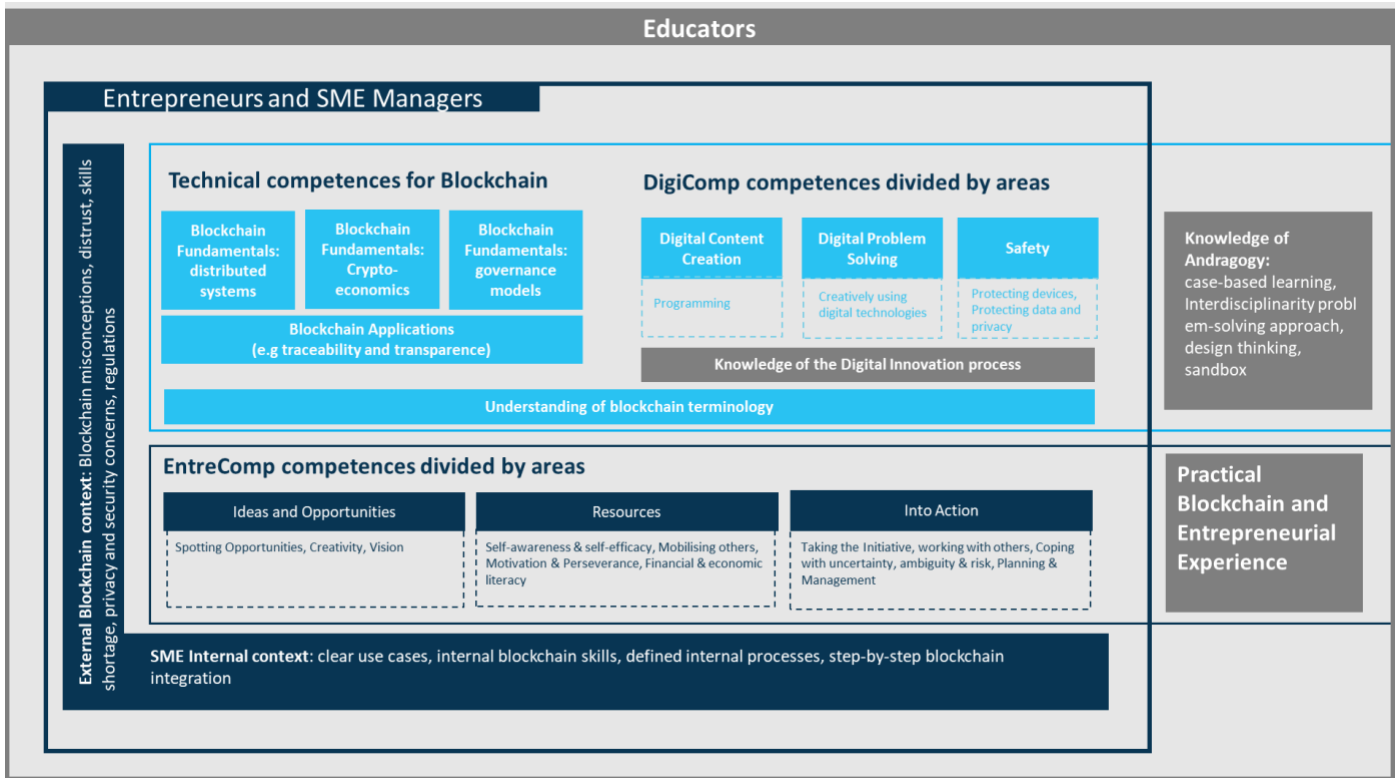


Figure 3. PEEB blockchain competences summary

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)

Knowledge of blockchain Terminology	<p>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.</p>
EntreComp Framework	<p>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.</p>
DigiComp Competences For entrepreneurs And for educators	<p>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.</p>
Technical competences for blockchain	<p>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.</p>

Knowledge and Competences for Entrepreneurship Educators

Specific andragogical approaches to teaching blockchain	<p>To ensure blockchain competences can be taught and assimilated successfully by the learners, educators need to have experience of diverse andragogical approaches 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 an environment where learners can quickly prototype and test their solution in a close-to-real life scenario is important learning experience.</p>
Digital Innovation process/ Lean Startup and	<p>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</p>

<p>Agile Methodology</p>	<p>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.</p>
<p>Practical Experience of Entrepreneurship and blockchain</p>	<p>It has been recommended by experts for educators to possess entrepreneurial experience as well as digital skills 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.</p>