BLOCK START

D5.1: Sector-specific DLT Maturity Assessment Report - 1st version

11/2020

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Participant Number	Participant Organisation Name	Short Name	Country
1	Bright Development Studio, S.A.	BRPX	PT
2	UAB CIVITTA	CIVT	LT
3	F6S Network Limited	F6S	UK

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List of Abbreviations and Acronyms	
DLT	Distributed Ledger Technology
Q	Question
M	Million
SME	Small and Medium-sized Enterprise
AI	Artificial Intelligence
AML	Anti-Money Laundering
CAGR	Compound Annual Growth Rate
DLT	Distributed Ledger Technology
EHR	Electronic Health Record
GDPR	General Data Protection Regulation
ICT	Information and Communication
IoT	Internet of Things
KYC	Know Your Customer
MVP	Minimum Viable Product
PoC	Proof of Concept
P2P	Peer-to-Peer
R&D	Research and Development
RFID	Radio-frequency identification
SME	Small and Medium-sized Enterprises

1. Executive summary

Despite the fact that the period of hype around the blockchain has ended and the technology has largely ceased to interest the wide public and media, DLT remains a promising and rapidly growing technology. International Data Corporation expects blockchain spending to grow at a steady pace over the 2018-2023 period with a five-year compound annual growth rate (CAGR) of 57.1% worldwide – with worldwide spend reaching $14.4 billion by 2023.[1] Originally devised to support the Bitcoin, blockchain has revolutionized the fintech industry, disrupting the approaches and business processes throughout the financial sector.

Blockchain is still a difficult technology—the effective use of it requires significant technical knowledge. This limits the adoption of the technology by end-users and turns blockchain into a niche technology available to only well-trained professionals. Moreover, governments remain wary of blockchain due to its "financial" origin, often imposing excessive restrictions on its applications in other areas or failing to provide regulation resulting in high uncertainty. In addition to legislative barriers, the development of existing solutions is slowed down by the lack of common technological standards, which limits the implementation of interesting solutions that require the involvement of many parties in the development of the blockchain ecosystem. Innovation ecosystem players who could support businesses in experimenting with blockchain solutions lack the knowledge of successful use cases and their knowledge can be limited to blockchain's application in financial sector. There is a strong need to further educate the intermediaries who, in turn, could educate SMEs on the applicability of the technology for their needs. Finally, blockchain is a technologically-challenging and cost-intensive technology. Most platforms are still aggressive towards newcomers, and a shortage of developers makes it extremely expensive to deploy solutions, resulting in the fact that major DLT-related advancements are made only by tech giants and market leaders.

However, the situation is changing rapidly. Every year, an increasing number of solutions appear on the market aimed at overcoming the existing shortcomings and challenges. Many governments are experimenting with DLT, signalling to the market the importance of this technology. The development of corporate and open-source platforms for launching blockchain solutions makes DLT implementation more and more affordable for SMEs. Furthermore, the awareness of the importance of end-user experience for technology adoption leads to the emergence of solutions that build back-end based on blockchain and offer users understandable value and convenient use.

The wholesale and retail, fintech, and ICT sectors are leaders in blockchain development, running the most impactful, feasible, and mature applications of distributed ledger technology. Each of these sectors has one or several well-developed directions of blockchain solutions with widespread industrial applications. Registering a high level of blockchain adoption, these sectors determine in which direction blockchain technology will develop in the coming years.

Today, blockchain-based solutions—ensuring digital assets management, bank payments, and settlements, data storage, and encryption systems, digital identification and KYC, supply chain management, and goods provenance tracking systems—are becoming widespread and transforming DLT into one of the key industrial technologies in these sectors.

1. https://www.idc.com/getdoc.jsp?containerId=prAP46625520

2. Introduction

Blockchain technology and the opportunities it created began about 10 years ago. The technology that we are most familiar with is Bitcoin, a cryptocurrency that uses the blockchain. With this fast-paced technology, blockchain has been introduced not only for digital currencies but also in other areas, such as: supply chain tracking, smart contracts, digital IDs, payments and other. However, there are sectors, which have more potential for this technology applicability than others.

The Sector-specific DLT Maturity Assessment Report distils information from the research on blockchain maturity and the prospects for distributed ledger technology implementation by SMEs. By bringing together insights obtained from various sources, the report offers a unique perspective on blockchain technology and the sectors in the economy where it has the most chances to create breakthroughs and to bring real-world impact. The report is a part of the broader ongoing European BlockStart project designed to help blockchain/DLT startups and SMEs to introduce their solutions to the market, bringing impact at scale.

The point of view presented in this document primarily relates to the real-world applications of blockchain aimed at practical, industrial, and operating goals. In addition, the presented analysis of DLT maturity and potential reflects views from the SME perspective. Research results, assessments, and conclusions primarily pertain to the real-world applicability of technology to the activities of SMEs.

The project has gathered important information about DLT and its use in various industrial sectors that would be useful for policy-makers and other stakeholders involved. The information has been gathered during the initial research stage, with the main goal of identifying target sectors for blockchain adoption. The research to identify the specific sub-sectors that are most suitable for implementing DLT included:

- Careful study of current DLT use cases by larger companies and SMEs gathering information on the number of use cases in each industry, number of companies adopting DLT, evaluating benefits it could bring, assessing the viability of using DLT and the maturity of technology. Each sector was mapped in terms of its importance to the EU economy.
- Consultations with DLT and Blockchain experts to discuss potential DLT use cases and what the problems they could solve for SMEs are. 30 experts were interviewed.
- Collected feedback from intermediaries regarding their understanding of blockchain technology and the ability to assist SMEs in blockchain implementation. Feedback was collected through webinars, workshops and individual consultations.
- European SMEs consulted through a survey aimed at identifying the proportion of SMEs willing to adopt the technology, the value it could bring to them, and the barriers of adopting blockchain based solutions.
- The project has gathered valuable information from the entries to the 'Do you need blockchain?' tool that has been developed. The responses reveal the types of organizations which are considering blockchain, technologies potential for solving operational and business challenges and sectors which dominate in terms of their interest in the technology.

3. Where DLT has the highest potential for impact

There is no universal way to make sure DLT brings value to a particular sector or company. However, as a result of analyzing more than 70 real-world blockchain applications and the results of expert surveys,[2] a number of common properties specific for companies or markets where blockchain has already been introduced were identified. The presence of these properties is repeating from one use-case to another, which allows us to conclude that there is a high potential for DLT implementation if these properties[3] (one or several at once) are also typical for a market or a company.

This inductive approach was used in the development of a special tool designed to help SMEs understand if they need blockchain. The tool called "Do you need blockchain?"[4] works according to the checklist principle. It checks the availability of certain properties of the SME or the market in which it operates and correlates these properties with the need for certain blockchain features. Thus, it is possible to provide an SME with an initial assessment of their need for blockchain.

The impact of blockchain is highest in the markets with:

A common interest

The presence of a common interest among many independent market players in the absence of trust is a condition for the possible use of the blockchain due to its immutable and decentralized nature.

Information flows with no sole owner

These market players may generate information that is used by all parties but has no sole owner. In this framework, blockchain may act as an impersonal holder enabling parties to trust the information without risks.

The need to remove intermediaries

Since, with the help of blockchain, parties may interact without having to trust each other, the idea of a trusted third-party becomes obsolete. Thus, blockchain ensures the elimination of an intermediary, providing trust and communication between the parties.

Contractual relationships

Due to the fact that blockchain may act as a trusted third-party substitute, contractual relationships that may be digitally recorded and verified can also be supported by it.

If This Then That logic DLT may be effectively used in case business processes can be automated on the IFTTT basis. Self-executing smart contracts bring value due to transaction costs reduction and process automation.

Digital asset transactions

2 In order to identify specific features of the markets and/or companies with highest potential for DLT adoption, experts were asked the following questions: "How to decide if a company should adopt blockchain?", "What would you need to know about an SME to assess if it needs to adopt a blockchain application?", "Why do companies choose to use blockchain?"

3 The presented list of properties includes only 7 of them and is not intended to be exhaustive

4 More info about DLT assessment tool at: https://www.blockstart.eu/dlt

Markets/businesses dealing with large flows of digital asset transactions that have to be tracked may use DLT to ensure its rapidity and safety. It also makes sense if there is a need for a digital reflection of the transfer of the physical assets.

Immutable, secure, and/or transparent action logs

Due to its features, DLT acts as an effective instrument in case of the need for secure, transparent, and immutable logs.

The company implementing blockchain has to be prepared for upcoming changes brought upon by the DLT adoption. Therefore, we highlight two important criteria for companies launching blockchain: the availability of an internal tech team and sufficient experience in implementing new technologies, i.e. aptness for innovation.

Availability of a tech team

Blockchain is a relatively new, though complex, technology. Even if it is launched through a connection to third-party ready-made solutions or relatively easy-to-use platforms, using blockchain-based solutions is not as easy as connecting to the internet, setting up a server, or navigating a CRM system. Therefore, a traditional IT department may not be enough to support even the simplest blockchain-based solutions. To run blockchain-based solutions with the required efficiency, companies implementing DLT employ a strong team of DLT-specialists—though it does not have to be large, it must be capable.

Aptness for innovation

A well-prepared development team alone may not be enough. Blockchain can significantly change the usual schemes and patterns of how a company operates. Therefore, a company not accustomed to innovation may not be able to cope with the ongoing changes. Aptness for innovation is a prerequisite for realizing the potential of blockchain.

Table 1. List of top companies exploring and implementing blockchain

Company	Affiliation	Blockchain use case	Short description	R&D spending, EUR B
Samsung	Tech	Supply chains	Use of DLT to enhance supply chain management when it comes to electronics shipments	13.3
Apple	Tech	Data management	Patented DLT for time-stamping data	12.8
Facebook	IT	Data management	Exploring the use of blockchain to enhance data security and users privacy	10.7
Walmart	Retail	Goods provenance	Using blockchain technology to track product movement from farmers to stores	9.4
Toyota	Auto	Data management	Planning to use blockchain technology to enhance autonomous driving technology	8.0
Ford	Auto	Data management	Leveraging blockchain technology to enhance mobility technologies	5.9
Alibaba	E-commerce	Goods provenance	Using blockchain technology to track luxury goods in its e-commerce platforms	5.1
Boeing	Aerospace	Goods provenance	Using blockchain to track and sale airplane parts	2.6
Baidu	IT	Digital assets	Using blockchain to enhance intellectual rights management	2.0
Nestle	Food & Drinks	Goods provenance	Using blockchain technology in supply management to track baby food products	1.5

The analysis of companies implementing and using industrial blockchain solutions shows that the most successful existing cases are linked to companies that are the leaders in innovative development. The

innovativeness of companies is in no way related to their industry affiliation—blockchain is successfully run by companies from both tech, and food and drinks industries. Each of the 10 companies listed in the table below has significant R&D spending volumes and is associated with innovative development, which allows them to effectively use blockchain in a variety of ways.

4. Key sectors with the highest potential

The project carried out extensive research to identify sectors that are the most mature and suitable for the implementation of blockchain-based solutions by SMEs. The set of qualitative and quantitative criteria was used in order to assess sector maturity and suitability. The criteria were selected based on the possibility to use its value in assessing sectors' suitability/maturity level: the greater/smaller the value of the criterion, the more/fewer opportunities the sector has to adopt blockchain.

4.1 Assessment criteria

The number of SMEs. The number of SMEs in the industry affects the ability to exploit the network effect. The more SMEs in the industry, the more interactions take place and the more complex the relationships and dependencies in the market. Thus, markets with fewer actors need blockchain less.

Share of value-added by SMEs. The logic behind this criterion is to show the impact of SMEs. A big share in the output could imply that there are many strong SMEs rather than several big ones. In turn, sectors with small shares have a low potential for running blockchain by SMEs since this curtails the network effect.

DLT maturity level. DLT-mature sectors are already running blockchain-based solutions which indicates that the industry has proven conditions for the implementation of DLT that are critical when launching new technologies. There are far too many DLT-based concepts existing only on paper due to lack of suitable conditions to launch.

DLT impact level. Blockchain impact shows how disruptive the technology is for business models within a sector.

Feasibility of blockchain solutions. Feasibility reflects the extent of the opportunity to launch blockchain-based solutions and the technology readiness level.

Legislative and regulatory barriers. Regardless of the level of technology development, without a favourable regulatory environment, a successful launch of DLT is improbable. Fintech is one of the most DLT-mature sectors that significantly suffers from regulatory barriers since many solutions cannot be legally implemented.

Blockchain-based solutions variety. This criterion reflects the number and variety of existing solutions already implemented in the sector. The range of running solutions shows how familiar the sector is with DLT.

4.1. Sectors analysed[5]

AGRICULTURE

CHARITY AND NON-PROFIT

CONSTRUCTION

EDUCATION

FINANCE AND INSURANCE (FINTECH)

HEALTHCARE AND MEDICINE

INFORMATION AND COMMUNICATION

MANUFACTURING

MEDIA, ARTS, ENTERTAINMENT

MINING AND QUARRYING

OTHER SERVICES

REAL ESTATE ACTIVITIES

TRANSPORTATION AND STORAGE

UTILITIES AND ENERGY SUPPLY

WHOLESALE AND RETAIL

The top-3 sectors were identified based on the aggregated ranks and values calculated as a weighted average of the sector's score in each criterion. The weight of each criterion is set to 1/7. Therefore, the final rank of the sector reflects its average position in a set of criteria.[6]

Sector's rank calculation

Criterion assessment. First, each criterion passed a two-step assessment. Values were gathered via desk research (a) and expert surveys (b). Second, two sources were combined into final values (with 50% weights). For example, if the values for 'impact' of sector X are 2.8 (a) and 2.6 (b), the final value is 2.7 (0.5a+0.5b).

Ranking. Sectors were ranked by each criterion and are arranged in ascending order based on criteria values. The first sector has the highest values, and the fifteenth sector has the lowest values.

Final rank. Since all ranks are calculated, the final rank of the sector is determined according to the average rank of the sector. In the example on the right, the average rank is 8, and due to it is 8th result among all the sectors (for example), the sector is 8th in the final ranking.

The research methodology was verified by experts and the final results of the research were validated by SMEs from the top-3 sectors identified. Primary values of the criteria are presented in the table below (aggregated from desk research and expert surveys). Eurostat data[7] has been used to determine the value added by SMEs and the number of SMEs in the industry.

5. Sectors identified based on: a. United Nations Statistics Division "International standard industrial classification of all economic activities (ISIC)," rev. 4. Available at: https://bit.ly/3f1XGng; b. Eurostat, "Statistical classification of economic activities in the European Community (NACE)," rev. 2. Available at: https://bit.ly/3cF7aDf

6. We use two types of criteria values there. The rank represents the processed assessment of the criterion, does not characterize the value of the criterion, and reflects the position of the sector in comparison with criterion values for other sectors. The primary values of the criteria reflect the natural units for quantitative criteria (f.e. % or thousands) or present a score on a 3-point scale for qualitative criteria (0 - low, 3 - high level).

7. Eurostat, "Structural business statistics & global business activities: Small and medium enterprises." Available at: https://ec.europa.eu/eurostat/web/structural-business-statistics/structural-business-statistics/sme

Table 2. Criteria values

Sector	Criteria values[8]							Final rank
	VA	# SMEs	Maturity	Impact	Feas.	Barriers	Sol. var.	
Wholesale and retail	70%	6 609	2.6	2	2.4	2	2.8	1
Fintech	59%	1 459	3	3	3	0.2	3	2
ICT	43%	1 107	2.4	3	2.8	2.6	2.8	3
Transportation and storage	46%	885	2.8	2.4	2.6	1.8	2.8	4
Media, arts, entertainment	75%	2 088	2	0.8	0.4	2.8	1.2	5
Real estate activities	86%	1 393	1.4	1.8	2	0.8	1.2	6
Other services	67%	3 129	1.8	0.6	1.4	1.2	1.8	7
Healthcare and medicine	46%	1 627	1.4	2.6	1.2	0.4	2.2	8
Agriculture	74%	501	0.6	2.2	0.6	3	1.6	9
Manufacturing	42%	2 204	1.4	1.6	1.2	2.6	1.2	10
Education	59%	699	0.8	1	2.2	2.2	2	11
Charity and non-profit	59%	162	1.8	1.6	2	1.4	1.6	12
Utilities and energy supply	36%	198	2.4	1.6	2	0.8	1.2	13
Construction	80%	935	0.4	0.2	0.8	1	0.4	14
Mining and quarrying	35%	18	0.4	0.6	0.2	1.6	0.2	15

4.2. Research results

Wholesale and retail, fintech, and ICT sectors have been determined to be the most prepared and suitable for wide-ranging blockchain adoption due to the DLT maturity level, ease of adopting new solutions, and a large number of existing solutions that could already be introduced by SMEs.

All the top-3 sectors have an average rank of above 4.6. Moreover, the average values of qualitative criteria are 2.36 for wholesale and retail, 2.44 for fintech, and 2.72 for ICT, which is approximately 50% higher than the average qualitative criteria value for all sectors (1.7). This means the top-3 sectors have consistently high levels of blockchain impact, feasibility, maturity, independence from legislative restrictions, and so on.

Table 3. Ranking results

Sector	Average Rank	Final rank
Wholesale and retail	3.9	1
Fintech	4.6	2
ICT	4.6	3
Transportation and storage	5.6	4
Media, arts, entertainment	7.3	5
Real estate	7.4	6
Other services	7.7	7
Healthcare and medicine	8.0	8
Agriculture	8.0	9
Manufacturing	8.0	10
Education	8.1	11
Charity and non-profit	8.4	12
Utilities and energy supply	9.6	13
Construction	11.0	14
Mining and quarrying	13.6	15

8. VA – the share of value added by SMEs, %; # SMEs – number of SMEs, thousands; Feas. – feasibility level; Sol. var. – solutions variety. All qualitative criteria present scores of a 3-point scale. Reverse scale selected to reflect the level of legislative and regulatory barriers level (score of 3 means regulatory independence, 0 - the highest level of barriers and legislative restrictions).

There is only one sector with scores close to those of the top-3 and that is transportation and storage, which is conceptually close to the wholesale and retail sector and has many adjacent DLT applications. The gap between the leading group and the others indicates the dominance of the industries from the top-3. In general, there are three groups of sectors in terms of their maturity level and suitability for DLT adoption:

1. Leaders in blockchain technology adoption. There are several sectors which show a stable high-level performance across all criteria (final rankings 1-4). In these sectors, most market participants may be interested in the adoption of blockchain or may be involved in the adoption in the long run. Most major market players are developing or have already developed and implemented blockchain solutions (especially in fintech, where all major banks are actively exploring DLT). The maturity level in fintech, ICT, and retail is the highest, and many solutions are already bringing value to users. In addition, companies from these sectors that are willing to implement DLT do not have to develop solutions from scratch—there are already a plethora platform-based solution, including those developed by technology giants such as IBM, Accenture, and Microsoft.

2. Growing sectors with high potential. Sectors with final rankings 5-12 have mostly good scores in some criteria, though the negative effect of external restrictions is noticeable at the same time. For example, the healthcare industry has a high impact level – blockchain-based solutions could bring real value and disrupt the way processes are organized. Nevertheless, the proliferation of many DLT-based solutions for healthcare is significantly restricted by the existing legislative barriers, while the feasibility level stays low due to the lack of single technological and normative standards in the industry.

For all of these sectors, there are many existing blockchain solutions. A substantial number of them is currently used in real-world applications, others are on the way to adoption while running as an MVP or in the PoC state. For example, today we see blockchain in education and healthcare successfully carrying out education certificate authentication activities or being used to store transactions of electronic health records. However, the scale of solutions and their ability to reach the majority of market participants in these industries are inferior to those of the leading industries.

3. Low potential sectors. There are also several sectors that need little or no blockchain. Despite the possibility of blockchain application, in most cases, traditional solutions will remain more effective in mining, construction, and utilities. In addition, these sectors are more distant from technologies both in the physical and in the conceptual senses and are the last in line for blockchain adoption by SMEs keeping in mind the current level of technology.

Blockchain maturity level

Several sectors show a high readiness for the uptake of blockchain technology. Fintech seems to be the most mature sector due to its inseparability from cryptocurrency. Sizeable cryptocurrency advancements and the development of decentralized finances are the focal points of what makes the fintech sector the most mature.

Both transportation and storage, and wholesale and retail sectors have significantly advanced in the development of supply chain-based solutions. Today, there are plenty of well-developed solutions aimed at goods provenance, supply chain management, and proof of goods origin.

The utilities and energy supply sector have several well-developed but not widely adopted applications for the decentralized marketplace for household electricity. However, at this point in time, there are no big opportunities for SMEs to implement it in an effective way.

Table 4. Blockchain maturity: the top 5 sectors

Rank	Sector
1	Fintech
2	Transportation and storage
3	Wholesale and retail
4	Utilities and energy supply
5	ICT

Blockchain impact level

Fintech is the leader in the way blockchain disrupts the existing approaches and technologies in the sector. The main effect of blockchain implementation is the increased efficiency, i.e. the reduction in time and money spent by data reconciliations and information exchanges going back and forth among industry participants.

Since blockchain is mostly about data, ICT ranks 2nd in terms of the impact—most processes in the industry are related to data. DLT improves the way data is handled. As sensitive data requires reliable management, the adoption of blockchain can bring the data directly to the owners, rather than allowing them to be stored on corporate hard drives.

In the transportation industry as well as in wholesale and retail blockchain may change the way the supply chain is organized. DLT brings a new concept of goods provenance, providing participants with the ability to track goods from the stage of them being raw materials to the final delivery to end-users.

Table 5. Blockchain impact: the top 5 sectors

Rank	Sector
1	Fintech
2	ICT
3	Healthcare
4	Transportation and storage
5	Agriculture

Blockchain feasibility level

Feasibility shows the ease of blockchain solution implementation in terms of time, money, and resources required for its development. Since the value of DLT is undeniable, there is also an understanding of why the industry needs it. Most market players are familiar with the technology; thus, it is easier to justify the adoption of new solutions and to attract new parties to use them.

ICT has a strong and tech-savvy background as well as the greatest experience in introducing new technologies. There are no notable restrictions and tech standards are applicable to all participants which ensure high feasibility of DLT-based solutions. Retail and transportation sectors already have the tech-framework in place for goods tracking. Therefore, it is feasible to install blockchain to already existing systems for transparent data management.

Table 6. Blockchain feasibility: the top 5 sectors

Rank	Sector
1	Fintech
2	ICT
3	Transportation and storage
4	Wholesale and retail
5	Education

4.1. An overview of the top 3 sectors

Wholesale and retail, Fintech, and ICT are leading the way in exploring blockchain. The sectors show a high level of DLT adoption developing a wide range of blockchain-based applications in B2B, B2C, and public segments. Due to the historical development of DLT, these sectors have the most favourable conditions for the improvement of existing solutions and the introduction of new ones. Importantly, a high level of DLT maturity is made possible thanks to high technological readiness and flexibility as well as a clear understanding of the value blockchain can bring to these sectors. Furthermore, each of these sectors is characterized by the presence of common interests among many market participants, which ensures the rapid adoption and diffusion of the technology.

1st place: wholesale and retail

The wholesale and retail market has made significant progress in blockchain adoption and has the most prospects in the area of supply chain management.

The adoption of DLT in retail is aimed at improving product authenticity, tracking, tracing delivery throughout the supply chain, and accountability of suppliers.

Drivers

- Need for increased efficiency and speed in retail due to a high level of competition in the market.
- Rapid transformation of the international trade and retail industry, e. g. growing online market.
- Increasing requirements for environmental friendliness and purity of origin of goods.
- Compulsory labelling and supply chain security legislation.
- Active participation of leading technology companies in the development of blockchain-based supply chain solutions.

7%

will adopt blockchain in 2 years

The IBM Institute for Business Value revealed that 7% of companies in retail expect to have a commercial blockchain solution at scale in the next 2 years.

Barriers

- Attracting suppliers to the blockchain-based supply chain management system and convincing them of the benefits of transparent operations.
- Lack of infrastructure, i.e. a unified approach to storing data and the lack of employment of IoT-sensors are an obstacle to creating an effective supply chain tracking system.

2.1B

value of blockchain reached by 2023

Blockchain in retail market is expected to grow from EUR 140M in 2019 to EUR 2.1B by 2023, at CARG of 96%.

Feedback from SMEs in the industry

The project aimed to identify the opportunities and challenges for blockchain application that SMEs operating in the wholesale and retail industry identify and to weigh them against the feedback collected from the experts and through the desk research. The survey questions were formulated according to the drivers and barriers that have been identified.

Respondents see the highest value of blockchain in improving efficiency, tracking as well as trust in provenance and certification (4.2 from total of 5). In terms of increased business efficiency and speed, SMEs saw the benefits of blockchain as average compared to existing solutions on the market (3.3 from total 5).

In terms of barriers of entry, SMEs did not signify that it is particularly difficult to convince suppliers to use blockchain-based supply chain management solutions (3.1 from total 5), which could indicate high potential for a better blockchain applicability rate in the future.

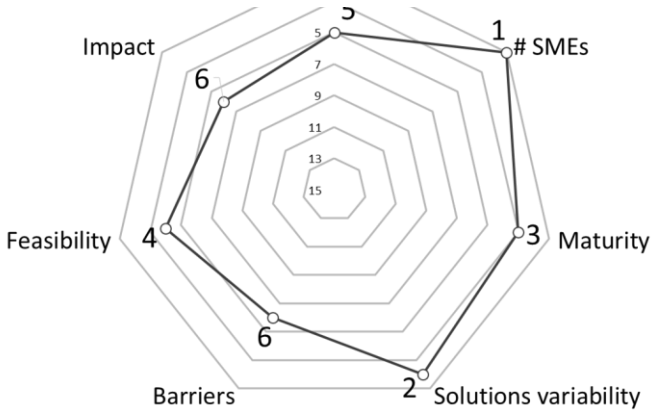
However, respondents have also identified that the lack of proper infrastructure and differing needs of the parties involved make it difficult to adopt decentralized supply chain solutions (the score for this obstacle was 3.8 out of 5). The other concerns that SMEs expressed during the survey included issues such as: not enough understanding of blockchain and its application processes, lack of real-life examples and general knowledge and understanding of the technology—an obstacle that this project is trying to address as well.

Wholesale and retail have strong opportunities to turn DLT into a prominent industry technology.

The wholesale and retail sector has the highest number of operating SMEs which produce about 70% of the sector's value-added. A large number of participants, coupled with a common interest in the market, drives the sector towards greater blockchain adoption. The wholesale and retail sector is unique — all market participants represent differing supply chains.

Moreover, many parties on each stage of the supply chain are brought together

Figure 1. Radar chart: Wholesale and retail



ensuring that the connection between manufacturers and their customers is maintained. Thus, wholesale and retail may become a driver of the technology development, connecting new participants from related industries to its platforms.

PETERIS ZILGAVIS

CO-CHAIR

FINTECH TASK FORCE

"Blockchain provides significant opportunities for transparent product history tracking, but it requires collaboration between a number of intermediaries and the approach for forming consortia to acquire common technology would likely take years to achieve."

The presence of many players with common interests as well as a clear understanding of the impact of blockchain adoption ensured a high position of the wholesale & retail sector in terms of DLT maturity level. In addition, the current success of the sector is largely due to the fact that the companies running blockchain-based solutions were able to offer easy-to-use applications that are understandable to businesses and end-users.

Further development of the industry largely depends on how these companies will overcome the existing barriers and restrictions. Although there are no significant legislative barriers in the sector, there is still a lack of common standards. In addition, one of the key advantages of the sector – a large number of strong players in the market – is also a key disadvantage. That is to say, the development of effective blockchain-based systems requires cooperation among parties without which this would be an insurmountable obstacle to building global systems.

Selected use-cases

Supply chain

Blockchain and DLT technologies may improve supply chain tracking for retailers. The transition to a blockchain-based supply chain provides retailers with the opportunity to verify the origin of goods, monitor the conditions of cargo transportation, track cargo movement, and automate the supply processes.

Proof of provenance and anti-counterfeiting

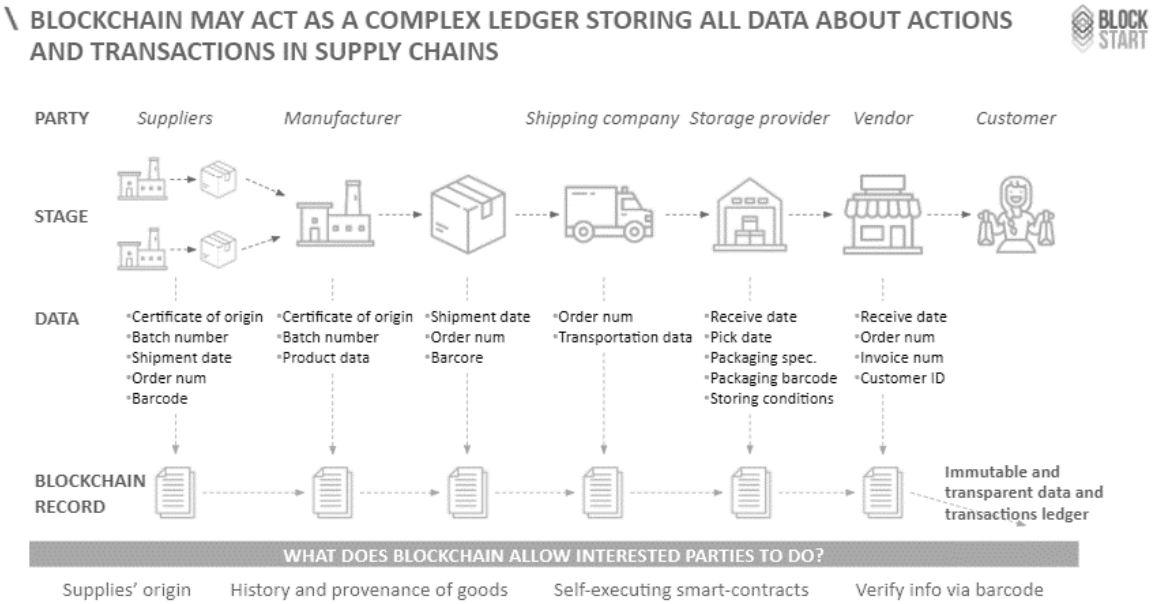
With supply chain improvements, DLT technologies can enable the manufacturer of original goods to issue digital certificates that are freely available to the public. This could be later scanned by the customers or regulatory bodies to find out the real origin of the product.

Loyalty programs

Retailers in e-commerce can create automated reward programs for customer purchases. This would lower the required time for managing the rewards as it would be automated and, at the same time,

retailers would gain more trust and resilience. American Express has already implemented blockchain for its rewards program.

Figure 2. Example of DLT usage in supply chain management



Smart contracts for wholesale and retail transactions

Smart contracts are one of the core elements of the blockchain and DLT technology. Two parties select the underlying collateral assets and an immutable contract is formed. These contracts may eventually help to automate supply chain settlements where the payments are automatically deducted upon confirmation of obtained supplies (usually with a QR code).

Smart contract-driven digital advertising and merchandising

Blockchain may help retailers automate settlements with merchandising companies, providing confidence about the safety of information storage about the placement of goods and the timely display of advertising. Self-executing smart contracts ensure the automation of contractual settlements, i.e. once the advertisement is shown and the corresponding confirmations are entered on the blockchain, a smart contract will signal the need for payment.

Customer identification

Blockchain-based customer identification provides retailers and online-stores with an opportunity to study the behaviour of their consumers on other trading platforms and to better understand consumer preferences.

Data management and processes automation

Blockchain may significantly reduce the paperwork involved in digitizing the information about cargo transactions. Accompanied by smart contracts and their integration with IoT-devices, blockchain ensures the implementation of business processes according to the "If This Then That" logic.

Examples of solutions on the market

Wine Block Chain[9] developed by EZ Lab is a blockchain-based technology designed for wine and other consumer goods provenance tracking. Several wine producers are operating within the platform: Riseria Campanini, Vignalta & Parco del Venda, and Formaggio Asiago.

Information about each bottle is recorded on blockchain at each stage of the value chain—from grape production to selling bottles in a store. In the end, consumers can scan the barcode via the mobile application and receive full information about the origin of a particular bottle. Blockchain makes data immutable, transparent, and easily accessible.

Blood Oranges of Sicily IPG Consortium[10] together with the technology provider Almaviva develops blockchain solutions to ensure the traceability of oranges and prevent counterfeit. As in the Wine Block Chain case, this solution is aimed at collecting all information about oranges provenance and transportation. The consumer is able to find out the whole story of each package. Thus, it instils the customer with confidence about the origin of the oranges they buy.

Walmart is developing a food traceability system based on Hyperledger Fabric.[11] Walmart, together with its technology partner IBM, ran two PoC projects to test the system tracing mangos sold in Walmart's US stores and pork sold in its China stores. At the moment, it allows for the uploading of certificates of authenticity to the blockchain, bringing more trust to the system where trust used to be a serious issue. As a result, the time needed to trace goods provenance decreasing from 7 days to an astounding 2.2 seconds.

Alibaba[12] combines IoT and AI with blockchain to improve its supply chains. The pilot project is aimed at tracking orders made through the company's Food Trust Framework using blockchain technology to improve supply chain traceability.

9. https://www.ezlab.it/case-studies/wine-blockchain
10. https://bit.ly/3hvR9mF
11. https://www.hyperledger.org/learn/publications/walmart-case-study
12. https://zd.net/30kt76y

2nd place: fintech

Fintech is leading the way in expanding blockchain capabilities. It has been the originating sector of DLT and has seen the most development during the last 12 years.

Currently, decentralized finance is a harbinger of the transformation of the entire financial sector. The sector is leading in the number of already running solutions that have been met with widespread approval and interest from the largest institutional players.

Drivers

- The proliferation and importance of customer data protection legislation (e.g., the European Union's General Data Protection Regulation), and fraud prevention and anti-money laundering programs
- The role of DLT in significantly accelerating transactions and eliminating intermediaries.

Barriers

- High legislative barriers that get in the way of blockchain opportunities in the financial sector.
- The specifics of the sector limit the widespread use of blockchain. DLT-based solutions often need to bring together many market actors, which requires the development of common standards for data storage, processing, and protection.

Feedback from SMEs in the industry

Respondents to the survey circulated to BlockStart acceleration programme applicants agree that customer data protection is one of the key drivers to implement blockchain technology in the financial sector (4.5 from total of 5). Also highly agree that the role of DLT can significantly accelerate transactions by eliminating third party institutions (5 from total of 5). The well-known issues of legislative gap in the blockchain technology regulation also brings SMEs to a consolidated answer that lack of regulatory framework makes it difficult to implement blockchain technology in the financial sector (5 from total of 5).

47%

of blockchain spending is directed to fintech

The financial sector occupies about 47% of the blockchain solution spending in the EU, and it is expected to continue to grow in the following years.

2B

investment in blockchain fintech in 2019

In 2019, the global blockchain finance market size exceeded EUR 2B and it is expected to reach EUR 19.5B by the end of 2025 with a CAGR of 48% during 2020-2025.

The case of Fintech specifics which might limit the widespread adoption of the blockchain technology (i.e. common standards for data storage, data processing, etc.) wasn't indicated as a very strong barrier in this technology adoption (3 from total of 5). And the main concern towards the technology implementation was expressed as the need of continuing market education.

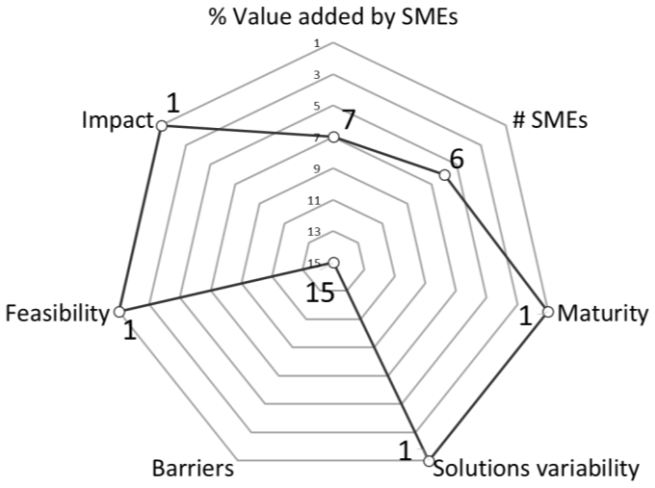
Results of the assessment

Fintech is the absolute leader in impact, feasibility, and the maturity of blockchain, however, legislative barriers are among the highest of all industries. Over the decade of development, DLT has matured into enterprise-grade software, demonstrating the following benefits[13]:

Security. A distributed consensus framework eliminates single points of failure and reduces the need for data intermediaries such as messaging system operators, transfer agents and inefficient monopolistic utilities.

Transparency. DLT brings about mutualized standards, protocols, and shared processes, acting as a single shared source of truth for network participants.

Figure 3. Radar chart: Fintech



KEN TIMSIT
MANAGING DIRECTOR
CONSENSYS

"Mostly, the great potential of blockchain in the Fintech area may be explained by its ability to reduce time and money wasted by data reconciliations and information exchanges back and forth between industry participants. It also drives the market to the creation of new business models around digital assets as a new class of financial products."

13. Based on Consensys materials: https://consensys.net/blockchain-use-cases/finance

Trust. A high level of DLT-based ledger transparency and immutability ensure ease of collaboration, data management, and agreements for different parties in a business network.

Programmability. As tamper-proof, deterministic, and programmable software, self-executing smart contracts offer the automation of business logic, ensuring increased trust and efficiency.

High-performance transactions. DLT networks enable the processing of hundreds of transactions per second.

Scalability. DLT supports interoperability between private and public chains, offering each enterprise solution the global reach, tremendous resilience, and high integrity.

Examples of solutions on the market

KYC-Chain[14] is a compliance dashboard and whitelabel customer onboarding portal enabling companies to perform due diligence of their customers in accordance with AML/KYC requirements. KYC-chain uses biometric matching neural networks and blockchain-based identity credentials to provide safe KYC procedures.

Circle[15] is is a peer-to-peer payment, investing, and global internet finance company that is re-imagining payment processing to combine the benefits of stablecoins and blockchain with traditional forms of payment like cards and banks and bring to market a next-generation payment processing solution for business. USD Coin is stablecoin developed by Circle which represents a breakthrough in how money is used. Digital dollars work like other digital content—they move at the speed of the internet, can be exchanged in the same way we share content and are cheaper and more secure than existing payment systems.

J.P. Morgan[16] is running the Interbank Information Network (IIN) that is a scalable, peer-to-peer network powered by blockchain technology. It minimizes friction in the cross-border payment process and enables payments to reach beneficiaries faster and in fewer steps. The IIN aims to address the longstanding challenges of interbank information sharing. By 2020, the total number of banks signed up for the IIN will have reached 320.

Tradle,[17] starting with KYC on the blockchain, is building a global trust provisioning network to give retail, wealth, SMEs, and institutional customers of financial institutions faster access to capital and risk allocation. Tradle's blockchain-based bot framework enables companies to build new customer interactions and customize compliance rules.

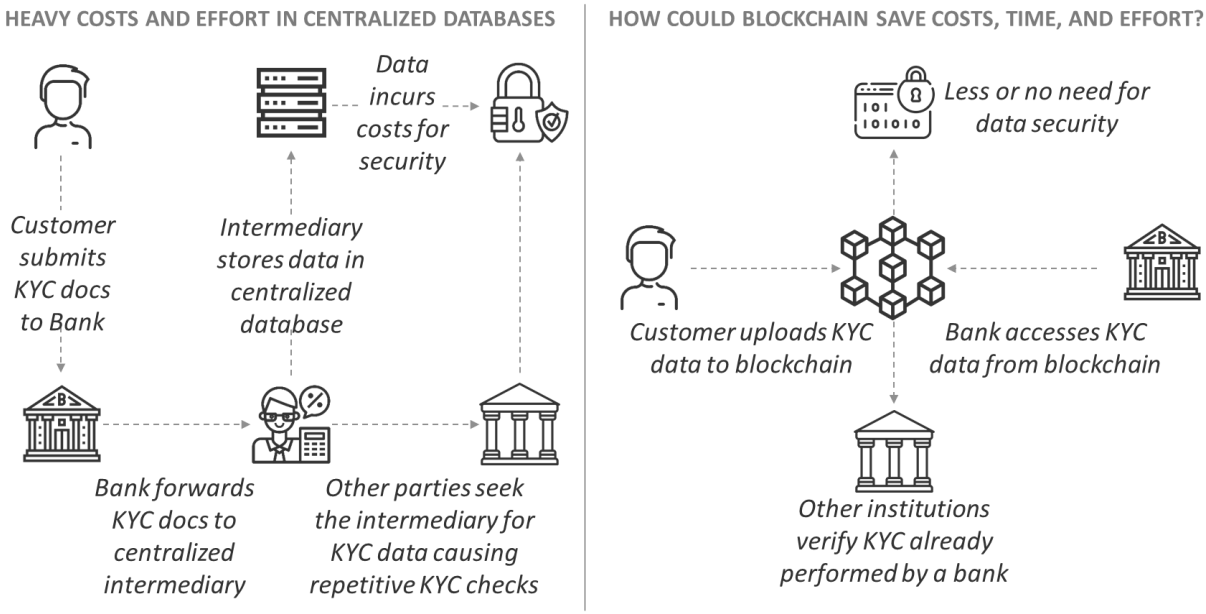
14. https://kyc-chain.com
15. https://www.circle.com/en/usdc
16. https://www.jpmorgan.com/global/treasury-services/IIN
17. https://tradle.io

Selected use-cases

KYC and identity management

Blockchain provides great opportunities for customer identification with a high level of immutability and security of data. Moreover, blockchain-based KYC-solutions provide a solid identification tool for complex banking networks—each verification made by one organization would be accessible for others to use so that the KYC process does not have to be restarted again and all client data updates become accessible to all network participants in near real-time.

Figure 4. Blockchain in KYC systems



Records and data sharing and storage

Blockchain provides a securely protected data storage system (e.g. for client data) that is shared in a way that doesn't violate data protection regulations. Thus, insurance companies or banks can use a common database of fraudsters, credit history registries, etc. Besides, the blockchain can act as a viable tool for managing internal document flow, reducing the time for document processing and manual labour.

Peer-to-peer insurance

Blockchain-based P2P solutions allow participants to share the risk of an accident or damage along with other people. Smart contracts could be used to execute insurance payments. Members of a certain group are locked into a smart contract and use these contracts to transparently vote and execute payment for each claim.

Digital asset management[18]

In digital asset management, the security and resilience of transactional data are imperative. This is increasingly difficult to achieve as the transaction channels differ with companies managing transactions from a myriad of digital sources and not only traditional bank transfers.

Blockchain ensures the creation of systems consisting of the technology and processes of third-party providers and internal systems, revolving around a single source of truth for asset management activities. This makes adding new partners easier through transactions managed with blockchain.

Since transactions performed on the blockchain are immutable, this creates an accurate, unchangeable record for asset managers to use, verifying the transactions. Asset management organizations use these records to analyze their performance and risks as a part of their planning cycles. This also allows asset managers to share sensitive data such as asset history with relevant providers and partners in a secure and fluid way.

Blockchain-based payments[19]

Blockchain technology promises to facilitate fast, secure, low-cost international payment processing services and other transactions through the use of encrypted distributed ledgers that provide trusted real-time verification of transactions. Conveniently, this is done without the need for intermediaries, such as correspondent banks and clearinghouses.

3rd place: Information and communication

For ICT, DLT ensures the safety and security of data which can be shared among multiple devices or platforms. The data are logged, stored, and shared safely.

In this sector, high rankings in terms of impact and feasibility raise the level of technology adoption considerably.

18. https://bit.ly/2Ove58n
19. https://amex.co/2B2Nyfo

Drivers

- Increasing security and privacy of data blockchain that provides better data access control proliferation.
- Reducing the cost of data storage and extending it – it allows users to get 300 times more space than in the traditional cloud and rent out their excess storage.

Barriers

- The danger of hackers or intruders stealing private keys. Thus, the challenge is to provide a guarantee of confidentiality of information.
- Lower processing speed using blockchain. This is because validation from all participants is required for a modification to be made in the data
- The efficiency of blockchain when it comes to storing big amounts of data.

Feedback from SMEs in the industry

Respondents to the survey circulated to BlockStart acceleration program applicants highly agree that for ICT blockchain adoption would considerably increase safety and security of data (4.6 from total of 5). Acceleration programme applicants rather agree than disagree that compared to traditional cloud, blockchain would be beneficial in terms of costs of data storage (3.5 from total of 5).

SMEs highly agree that blockchain technology can help in enhancing personal data and privacy protection (4.6 from total of 5), but do not really agree that this is the best solution for storing big amounts of data (3.1 from total of 5).
Companies don't see that the lower speed of processing data in comparison to centralized solutions is a major factor when making the decision to use blockchain technology (3.1 from total of 5).
Other opinions that SMEs expressed during the survey included issues such as: the need of evolving public blockchains, technology might be difficult to adopt/integrate with existing IT architectures if the company doesn't have in-house know-how or lack of knowledge and understanding.

73%

or more of all sectors may be influenced by blockchain in ICT

ICT is widely acknowledged sector and is interrelated with the majority of other sectors where technologies are being deployed.

0.7T

spending on new ICT in 2019

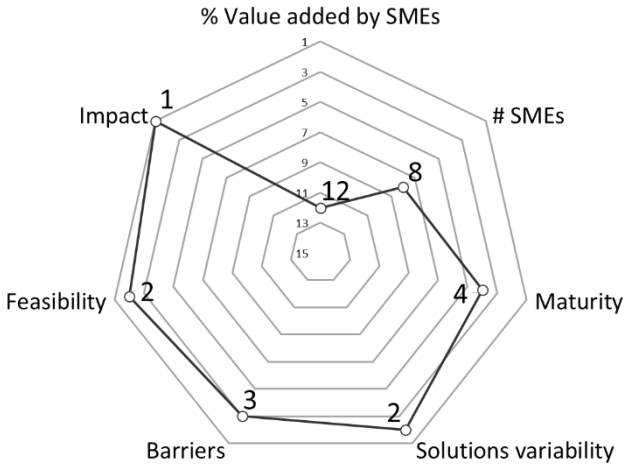
ICT is the leading sector by new technologies adoption. The volume of global spending on new technologies in ICT will exceed EUR 1.3T by 2023.

Results of the assessment

Originally devised to support the Bitcoin, DLT is expected to be applied to a broad range of data processing applications. These applications require several technical challenges, including data privacy protection and better processing performance to be addressed.

Data are quickly becoming one of the most valuable resources. The market is now dominated by data-centric companies like Facebook, Alphabet, Microsoft, Amazon, and others. It means your data is now a prime target for cybercriminals, and, most likely, you aren't as protected as you think. Even giant companies like Anthem, Target Corp, and Home Depot have had major data breaches over the last few years, affecting hundreds of millions of people20.

Figure 5. Radar chart: ICT



MATTHIAS FELDER
PORTFOLIO MANAGED
DB SYSTEL

"Companies in the information and communication sector have a savvy tech background, are digital and rapidly adopt new technologies, so they create new ways of data management with blockchain."

The ICT sector is mainly operating with data flows and has a strong tech background with a history of flexibility and adoption of innovations. Since there is a rising number of challenges related to data protection all over the world and in all sectors of the economy, ICT may change the way we store data by introducing blockchain as a core instrument in order to ensure a high level of data security.

ICT shows one of the highest levels of DLT maturity and it is unique in terms of harmonized development. There are no significant barriers to adopting blockchain as there is a clear understanding of its value and high feasibility of DLT-based solution implementation. Together with retail and fintech, ICT will play the leading role in the development of DLT in the following year.

20 https://www.dataversity.net/blockchain-can-used-secure-sensitive-data-storage

Examples of solutions on the market

Data storage is the most developed direction of DLT application in ICT. However, there are still many other solutions to be sought out.

Storj[21] provides open-source encrypted software for secure cloud storage. Files are encrypted on the client's side before being uploaded to Storj's network. Encrypted files are split into smaller fragments and distributed among optimal nodes across a secure global network. The system attracts hosts by paying for running storage nodes where fragments of files are privately stored, making data breaches a thing of the past.

Sia.tech[22] is one of the leading decentralized cloud storage platforms. The system operates without any signups, servers or trusted third-parties. Sia leverages blockchain technology to create a data storage marketplace that is more robust and affordable than traditional cloud storage providers.

IBM[23] has developed a complex solution for blockchain-based data storage. IBM Storage for blockchain, engineered for multi-cloud and built for performance and scalability, delivers an off-chain, decentralized on-premises storage repository for customers deploying their blockchain peer in any cloud. The core benefits of the system are the rapid deployment of an open and flexible compute-to-storage platform, multi-cloud-enabled with secure access to public cloud services.

Microsoft[24] is developing a global solution for decentralized identity management. Enforced with blockchain, digital ID will seamlessly integrate into daily life and give complete control over data access and use. The solution will provide end-users with the ability to have complete ownership and control over their digital identity and protect their privacy with secure user experience. In addition, Microsoft is going to bring its solutions to the B2B segment and providing businesses with opportunities to engage with less risky activities, use electronic claim verification, and improve transparency and auditability.

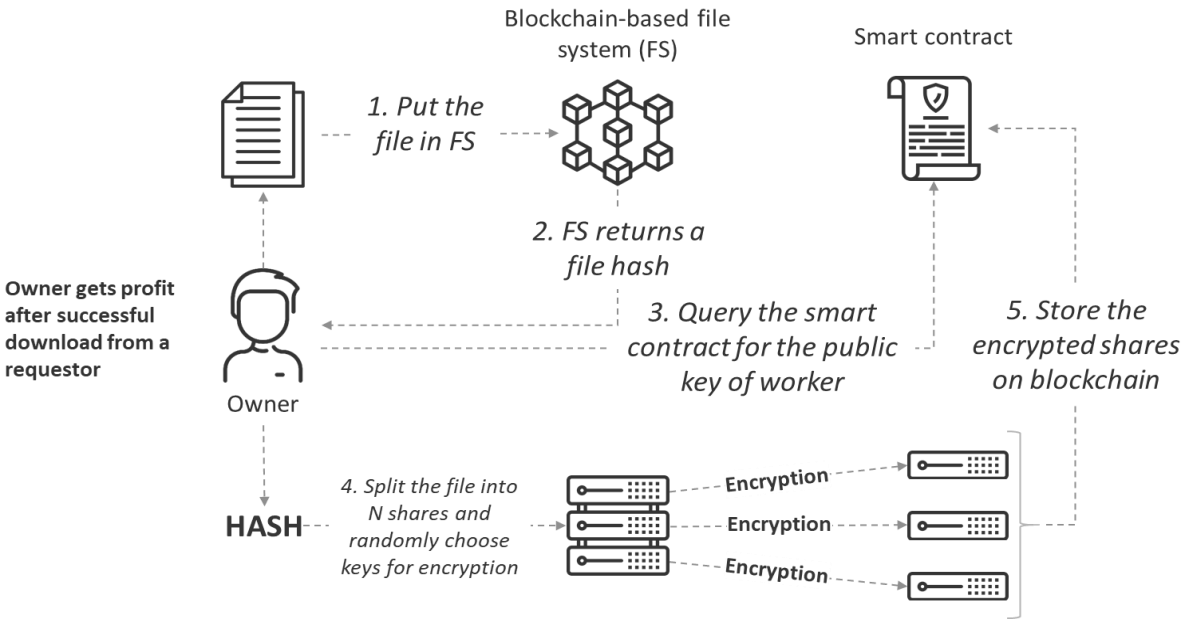
Selected use-cases

Distributed cloud storage

Blockchain helps to create an application where users can store data, similar to cloud storage, but more securely as they allow access to the data only if you have a special key. Blockchain solutions can ensure that data storage is decentralized, and, thus, more secure and trustworthy.

21. https://storj.io
22. https://sia.tech
23. https://www.ibm.com/it-infrastructure/storage/blockchain
24. https://www.microsoft.com/en-us/security/business/identity/own-your-identity

Figure 6. Blockchain in encrypted data-sharing system



Blockchain-based data management

Software workflows can be automated and data generated by various parties can be logged. This means one can keep record logs secure and accessible only for authorized users.

Identity management

A unified blockchain-based identity solution is capable of transforming the management of online identity. The technology allows your personal data to be securely stored in distributed ledgers and grants access to parties specifically selected by the user, thus ensuring that data are used for the intended purpose.

Distributed VPN

A P2P VPN network may be set up similarly to a distributed cloud storage. One user provides network access for a reward, while other users “rent” the network for their own use, thus allowing peer-driven internet exchange network.

Document encryption

Using a secret sharing scheme, a secret key is divided into several fragments whereby each party possesses a unique piece. The information before the division of the secret key can be restored since the number of (not necessary all) fragments can be used to recover secret keys if needed.

Unified communication

Sensitive information within a department can be beneficial for a company-wide collaboration initiative. Using blockchain, departments can securely share their most guarded information without having to tear down silos or expose any data for misuse.

Decentralized social media

There are already-existing social media networks that allow users to be rewarded for posting high-quality content. It operates like ordinary social media networks the only difference being that users are paid for positive engagement with their content. Reddit is a recent example of adopting this approach.

5. Challenges for wider application

Many limiting factors do not allow blockchain to transform into a mainstream technology. Some of these factors are:

Difficulty to grasp the idea of blockchain for end-users. For many applications, the use of blockchain requires a significant level of tech-awareness, which makes DLT a niche technology and prevents it from becoming massively popular like the internet or mobile applications. While using the Internet does not require knowledge about how it works, in most cases, the use of blockchain demands at least minimal expertise. However, the use of DLT in the back-end infrastructure and its combination with technologies that are familiar to users in the front-end components provide significant progress in this area. For example, in the case of using DLT in wine provenance verification, users do not directly encounter DLT—they verify bottles via a mobile application by scanning the barcode.

Lack of standardization. The lack of standards restricts the development of the technology and fragments the applicability of solutions to various scenarios. Even in DLT applications where the interest of the parties is obvious and the protocols used are more or less the same (e.g. in the supply chain use-cases), the creation of unified blockchain systems is faced with significant technical difficulties and requires considerable effort to ensure the adherence to the necessary standard.

Legislative barriers. We see many industries such as healthcare, financial and insurance activities, real estate, and others suffer from the existing legislative barriers. Many interesting solutions are existing as PoCs, which cannot be launched due to the rigidity of the industry and the current barriers. In this framework, a possible way out is to run solutions by private companies (e.g. DLT-based EHR processing in private clinics) and cooperate with governments on launching complex platforms.

A technologically-challenging and cost-intensive framework. It is also too expensive and technically difficult to run solutions developed in-house, especially for SMEs. Until recently, DLT remained the privilege of large corporations that could afford blockchain experiments. With the development of platform solutions—both corporate, such as those by IBM, and open-source, such as Ethereum and

EOS - technology has become more accessible and fewer companies are forced to build their applications from scratch.

6. Feedback from intermediaries

Over the past years, the progress of blockchain adoption and implementation has been witnessed as an integral part of the global business community and the traction of the technology rises each year. The new cutting-edge solutions are being created in various sectors. At the same time the creation of blockchain-enabled solutions requires more intermediaries assistance and guidance for organizations and the challenges they face in cybersecurity, global digital identity, compliance, financial reporting, taxes frameworks. And as companies adopt and implement blockchain solutions, the underlying level of uncertainty about current and future technology application remains.

Nevertheless, recent studies show a growing interest in blockchain, and recognition of the relevance of the technology. A survey by Deloitte showed that 55% of organizations see blockchain as one of the top-5 priorities in 2020.[25] In addition, the survey found that a growing number of executives felt that their organization would lose competitive advantage if they don't implement blockchain based solutions (83% in 2020 compared to 68% in 2018) suggesting that awareness of the technology is raising as well as leaders' understanding that it is here to stay.

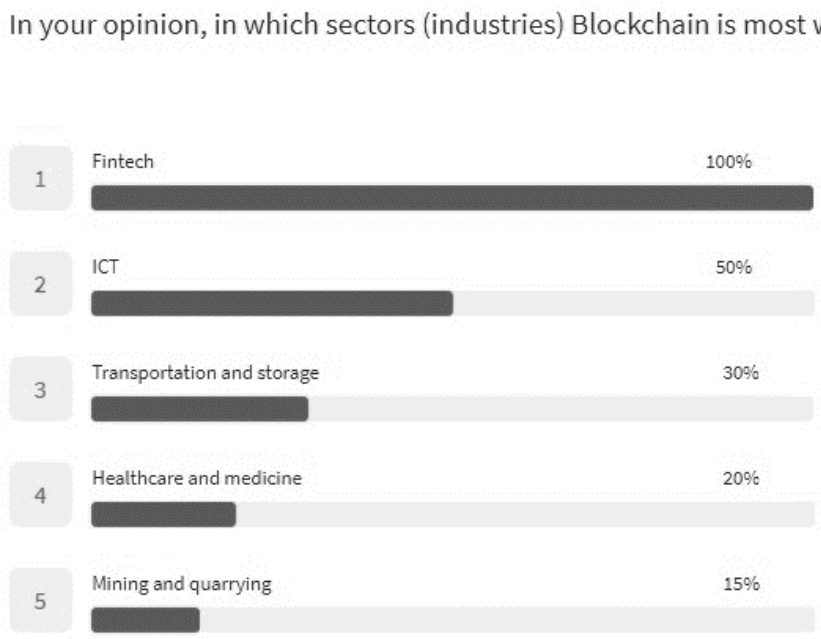
Within the framework of the BlockStart project, the webinars and workshops organized for intermediaries (incubators, accelerators, national and European investment, business support agencies, and similar organizations) have demonstrated a lack of knowledge by those who are already somewhat interested in the technology. Participants particularly lacked information of the applicable solutions, especially in industries other than fintech. Intermediaries also often lack experience with the blockchain based business applications to be better positioned to advise other innovators on the applicability of the technology to their product development.

In order to gather more measurable data on the experience with and understanding of blockchain, we have designed and circulated a 10-question that has been circulated to 200 European organizations. We targeted organizations that do not focus on blockchain technology as part of their day to day operations in order to obtain an unbiased feedback. The key objective of the survey was to find out how often intermediaries encounter startups/SMEs, which potentially could implement blockchain technology in their businesses, what, if any, pre-judgements of the concept they might have, and if they have sufficient knowledge of the technology's application in real life use cases.

[25] Deloitte, 2020: https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain-survey/DI_CIR%202020%20global%20blockchain%20survey.pdf

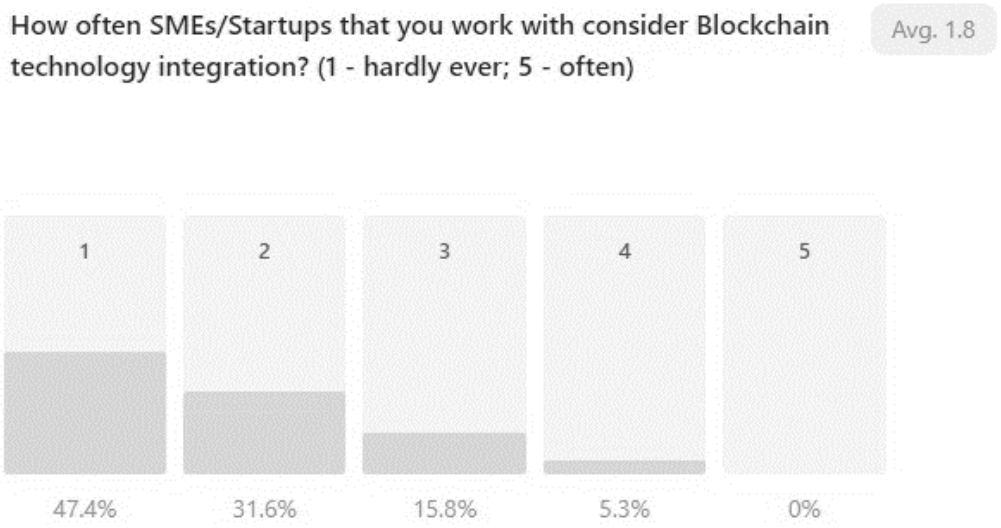
The majority of survey respondents represented business support organizations, such as innovation agencies, incubators, accelerators. The survey revealed that the intermediaries general understanding of how blockchain technology works is rather average (2.6 out of total 5). As expected, the associations which occur when hearing blockchain, mainly consist of cryptocurrencies and financial technologies, which can be assumed as pre-judgements of the narrower technology application opportunities. When asked to select top-3 sectors/industries, the most popular ranked was: 1st place Fintech, 2nd – ICT, 3rd – Transportation and storage (see figure 7). The results are notably similar to the report "Blockchain in SMEs Maturity Report 2020" top sectors analysis, mentioning fintech and ICT industries as most popular among blockchain technology adopters, however Wholesale and Retail wasn't mentioned among the top industries.

Figure 7. Survey answers on selecting top-3 sectors



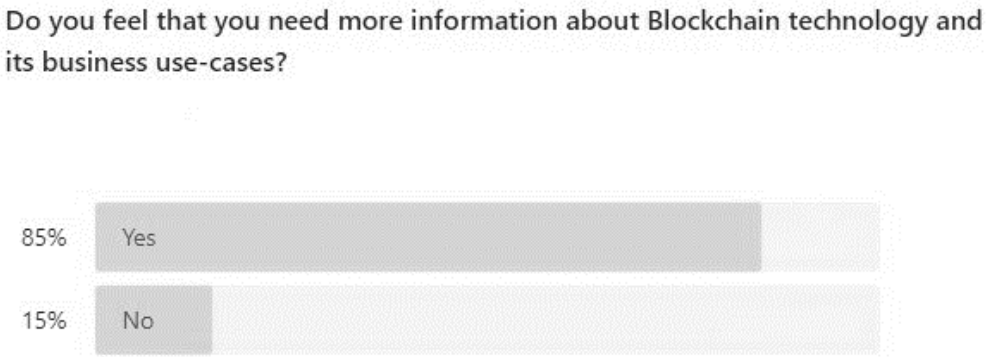
Almost all survey respondents closely work with Startups/SMEs, however they rarely encounter companies which would be interested in blockchain technology integration. Intermediaries hardly ever/rarely work with companies which would consider Blockchain technology implementation within their solutions (1.8 from total 5) (see Figure 8). This could potentially be related with intermediaries' lack of knowledge of the technology which leads to insufficient promotion or introduction for SMEs to consider try blockchain. Lack of understanding and knowing how widely blockchain technology could be applied in terms of other industries than fintech.

Figure 8. Score of how often SMEs/Startups consider blockchain technology



85% of respondents (mainly business support organizations) answered that they would need additional trainings on blockchain. Breaking down what trainings would be the most relevant, the vast majority mentioned practical guide of use-cases examples and basic information about the technology and its application examples.

Figure 9. Intermediaries feedback on the need of additional information



Overall, the intermediaries who play a vital rool in SMEs/Startup support through guidance and assistance, according to the survey, might not have sufficient capacity to advise companies on blockchain related matters, simply because they lack the certain knowledge to be able to fully promote or encourage companies to try this emerging technology.