BLOCK START

D2.7: DLT Assessment Tool – final version

07/2021

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Abstract	Summary of questions and logic behind DLT Assessment Tool, which is published on the project's website. Additionally, cost-benefit assessment included.

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BlockStart Consortium			
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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
IoT	Internet of Things
CCTV	Closed-circuit television
PoW	Proof of Work
PoS	Proof of Stake

1. Introduction

BlockStart project has created and published a DLT Assessment Tool, which aims to evaluate SMEs/ startups capacity and potential to start using the technology. The first version of the DLT Assessment Tool was made available in BlockStart's website (www.blockstart.eu/dlt/) in M4 of the project (December 2019) and has been updated according to the insights from internal and external discussions with the consortium partners and experts that participated in the programme.

This deliverable overviews the main insights from the previous version of the tool, the changes made to the updated version as well as the traction and responses collected from the introduction of the updated tool in M10 until this point (M23, roughly 13 months). Since the last iteration in M10, no significant changes have been made to the content and questions of the tool. This allows us to collect a larger amount of significant responses and statistical data, outlined in detail below.

The DLT Assessment Tool has been published using Typeform's platform, due to its convenient functionality and user-friendliness. The platform allows building custom logic on the questions flow based on the answers. It also provides useful statistics on the drop-off rate and allows the questionnaire to be embedded into the BlockStart's website.

2. Initial insights of the first DLT Assessment Tool version

The first version of the DLT Assessment Tool has been active since M4 (December 2019) until M10 (June 2020).

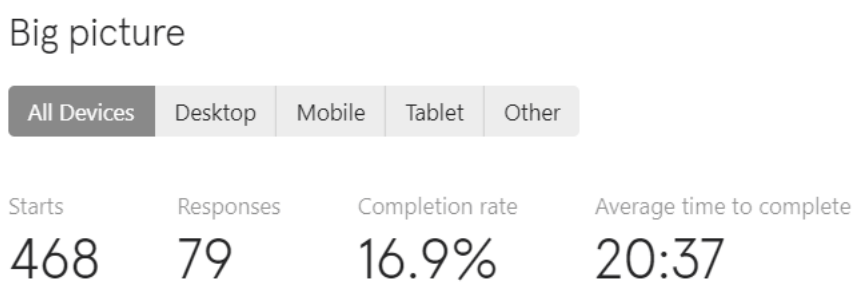
This was the testing version aimed at validating the methodology that would help prepare for the wider usage. In order to gather feedback from a number of different stakeholders, the tool was disseminated through:

- BlockStart's webpage
- BlockStart's events
- Partner networks (social media accounts, other projects that consortium partners are implementing)
- At local and international blockchain events (Blockchain relaunch Lithuania, Coimbra Sustainability Summit, Block.IS cluster mission)
- Directly to startups, SMEs and blockchain experts (through expert interviews, SMEs surveys and directing open call applicants)

During approximately 6 months, the tool gathered 79 responses from industry newcomers and experts that were evaluating their potential blockchain adoption.

In total, the tool has been started to be filled in 468 times, with an average of 20 minutes required for completion.

Figure 1. DLT Assessment Tool Typeform statistics



2.1 Initial results regarding blockchain potential

The first version of the DLT Assessment Tool produced a wide range of insights that could help to determine the overall willingness to adopt blockchain and DLT for SMEs. The tool has provided a positive answer (that the organisation has high potential to adopt blockchain) for 58% of respondents. These organisations have been provided with exemplary applications that could be taken as a starting point to imagine where DLT and blockchain could stand in for them. Other insights and statistics that can be derived from the answers are as follows:

- 96.1% of respondents are SMEs
  - 36.5% are startups
  - 31.1% are micro enterprises
  - 24.3% are small enterprises
  - 6.8% are medium-sized enterprises
- There is a variety of different sectors representatives
  - 24.7% of respondents come from the ICT sector
  - 15.1% from fintech
  - 12.3% from agriculture
  - 11% from other services
  - Others less than 7%
  - Construction and mining and querying are the only sectors with no responses
- 82.2% of respondents have high innovativeness and are open to new ideas and their implementation
- 84.9% of respondents have experience in implementing innovations in IT business processes
- 67.1% have internal IT departments with the capacity to develop innovations, 13.7% do not have a IT department
- 80.9% of respondents have a high or very high familiarity with blockchain and DLT technologies
- 76.7% state that there are many participants with common technological advancements in their respective markets
- 78.6% state that market participants contribute together to the creation of horizontal or vertical flows of information that is used by all market participants but no one is the sole owner of it
- 59.1% express that these market participants know and trust each other
- 61.6% state that they and their business partners need to rely on a trusted third party

- 93.3% think that the trusted third party could be replaced by an information system
- 87.7% are managing contractual relationships under which performance of work, provision of services or other actions that influence the contractual obligations can be digitally recorded and verified
- 93.2% of respondents state that their business processes or relations with business partners and customers can be automated based on 'if this then that' logic
- 87.7% say that they work with digital assets or need to track the creation and movement of those assets
- 84.9% replied that the issuance of digital certificates for physical assets (tokenization) would help their businesses
- 97.3% state that they need to collect, store and analyse data and information and at least one of the following applies:
    - They need to know by whom, when and where various information records are created;
    - They need to collect, analyze and store information received from various devices;
    - They need to maintain immutable and secure stored logs of transactions, movement of goods, maintenance or other actions.
- 76.7% responded that their businesses are part of the supply chain and at least one of the following applies:
    - They need to be confident in the origin of goods that they receive from manufacturers or suppliers;
    - Their customers need to be confident in the origin of goods they buy or be able to confirm the conditions of production, storage or transportation of your goods;
    - Their business suffers from a complicated and intricate supply chain: for example, from frequent delays, downtime, loss of goods, lack of ability to check the location and condition of the goods transported, etc.
- 91.8% state that their business depends on internal and external transactions and at least one of the following is a suitable characteristic:
    - Their business requires high-performance, trusted, traceable and rapid transactions;
    - Their transactions should be transparent to the wide range of users (clients, regulators, etc.);
    - They use internal accounting units for settlements within the company.
- 83.6% think that partial disclosure of the information they store may increase customer confidence in their company

2.2 Insights into user experience and usability

- 55% of the respondents start filling out the DLT assessment after opening it. The statistics is reasonable, as it is usual to have 30-70% of bounce rate in the websites (DLT Assessment Tool is embedded into the BlockStart's website). In result, it could be counted that the first tool version has been started around 257 times (55% of 468).
- The drop-off rates in Typeform platform are provided as a percentage and provides the rate of exits on the particular question.
- According to Typeform's functionality, it is required that the respondent would press 'Next' and 'Submit' buttons in order that these would be counted as full response. Those that leave

at any step of the questionnaire are counted into general statistics on the drop-off rate, however their filled-out information is not kept neither by the platform nor by BlockStart.

- The questions that have the highest drop-off rate are the ones that provide the negative answer in terms of blockchain adoption and innovation assessment, with 47% and 33% drop-off rates respectively. Users are directed to the assessment at the very end when the assessment is almost complete.

Overall, all other questions had more than 90% fill in rate, which means that filling in the questionnaire did not cause any major headaches for the responders. The number of questions and typology seems to be reasonable and relevant; no major issues were raised by any stakeholders of DLT and blockchain world. Based on the feedback and insights received on the first iteration of the DLT Assessment Tool, it has been updated and the updates are highlighted in the sections below.

3. DLT Assessment Tool methodology

For the first iteration of the DLT Assessment Tool, Typeform's platform was used, as it provides the required functionality and logic jumps needed to conduct a decent assessment tool. After exploring other potential solutions (WordPress plugins had less functionality and custom programming option requires unreasonably high resources allocation) it was decided to keep using the same platform as it is user-friendly, convenient, and works well with "if then" logic questions.

3.1 Changes compared to the initial version

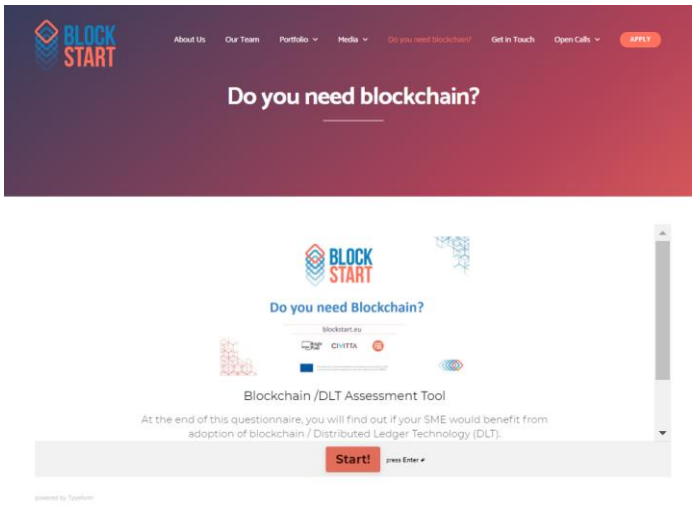
Discussions with external experts and internally between consortium partners have been held to find out if and what improvements are needed to the DLT Assessment Tool. External experts suggested that the tool is working well and provides relevant answers, however for some the language may seem too technical.

Based on this feedback, the following changes have been introduced to the second version of the assessment tool (from M11 or July 2020 onwards):

- The 'DLT Assessment Tool' has been rebranded to 'Do you need Blockchain?'. The approach was decided internally based on the fact that the majority of the people are aware of the terminology blockchain, while only industry experts are more aware of Distributed Ledger Technology term; also the new title (in the form of a question) communicates the purpose of the tool in a very clear and user friendly manner.
- The most technically intensive questions have been rephrased in simpler terms to make it more understandable for not so technical users. For example:
    - *'Could the issuance of digital certificates for physical assets (tokenization) help your business?'* was replaced with '*Could it help your business to issue digital certificates for physical assets?'*
    - *'Do these participants (competitors, suppliers, business partners, regulators, etc.) contribute together to the creation of horizontal or vertical flows of information that is used by all market participants but no one is the sole owner of it?'* was replaced with *'Do these participants (competitors, suppliers, business partners, regulators, etc.) generate information that is used by all market participants but no one is the sole owner of it?'*

- Previously non-SME companies and organisations were prompted that the tool is not for them and directed to the final window, while the new tool allows industry associations, non-profits and other types of organisations to fill out the form with a disclaimer that answers may be less accurate as they were designed for SMEs. The team reviewed the questions and the logic and the conclusion was reached that the logic would still work for other types of companies. Such an approach is expected to increase the scope and reach of the tool, which will result in a larger database of industry data. At the same time, the team will be able to gather more feedback about the use of the tool with other types of legal entities and in case of successful performance, ensure a much wider application and dissemination.
- A question if the respondent wants to be contacted by the BlockStart team has been added.
- A question on how users found out about the tool has been added to allow us to better evaluate our marketing efforts.

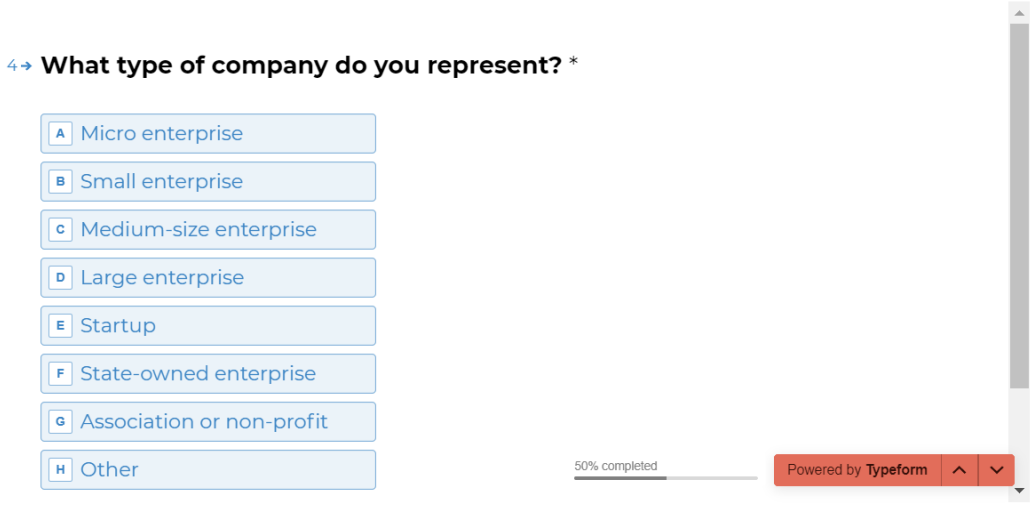
Figure 2. Updated 'Do you need Blockchain' tool version in the BlockStart's website



3.2 Type of the company

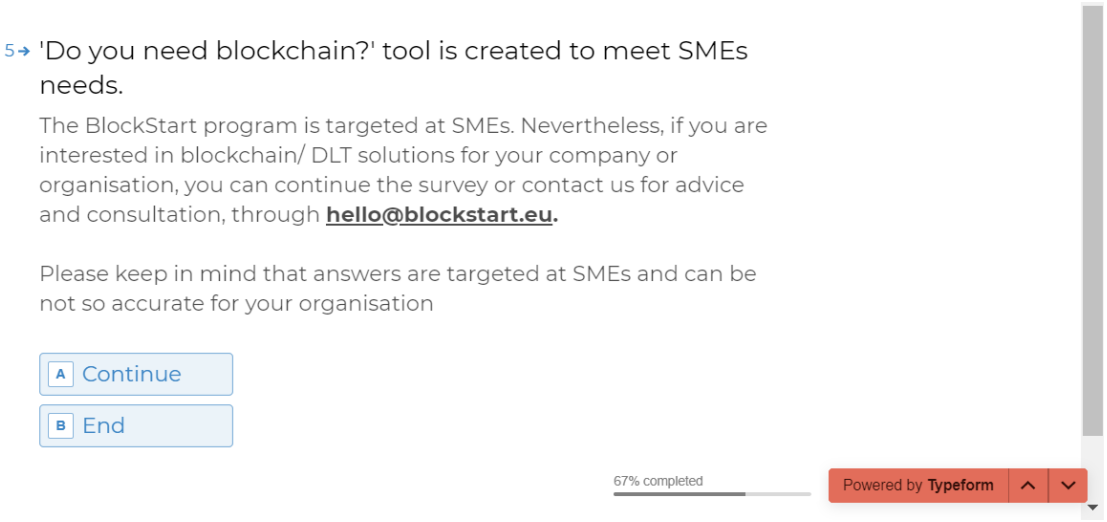
'Do you need Blockchain?' tool, first of all, aims to find out if a company is a SME / startup, as the main goal is to determine the potential of DLT and blockchain for SMEs / startups. It is achieved by asking the companies to confirm if they meet SME conditions as per EC official description (less than 250 employees, turnover of less than €50M and balance sheet less than €43M). Also, participants are asked to provide information about their company type, to double-check if the respondent represents SME / startup. (Q3 & Q4)

Figure 3. Questions on company type



Change from the first version: If a company is determined to be not an SME, i.e. industry association, innovation agency, etc., they are suggested that the tool was created reflecting SMEs needs but they can continue the questionnaire. By this, it is expected that results may not be particularly accurate, however, it provides BlockStart partners a better overview of the situation throughout the entire industry.

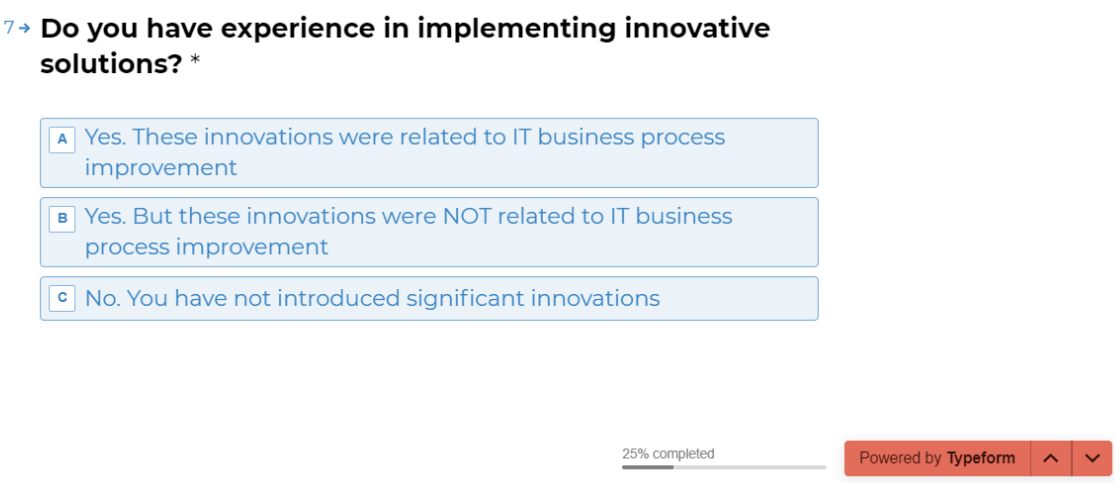
Figure 4. Information on tool's applicability for SMEs



3.3. Innovation readiness assessment

After determining the type of company, the questionnaire measures the innovation capacity of the particular organisation to find out if it is ready to implement new solutions into their processes. During the research, it was found that DLT / blockchain implementation requires an understanding of the principles of technology and extensive knowledge to use the best features that it brings, therefore questions on the know-how and experience follow.

Figure 5. Innovation assessment in the 'Do you need Blockchain?' tool



Innovation readiness is determined by gathering information on the level of innovation in the company, experience in implementing the innovations, the capacity of the IT department and know-how about the DLT / blockchain technology. According to this information at the end of the assessment, respondents receive feedback on the level of innovation readiness (high or low). By this, it is expected that the respondents will evaluate their availability for DLT / blockchain implementation rationally and if they have low innovation readiness, will take steps to become more innovative (Q7, Q8, Q9, Q10).

3.4 DLT / blockchain potential assessment

Furthermore, during the initial DLT / blockchain research it was identified that these are the main solutions that motivate SMEs/startups to adopt blockchain:

- Abundance of Intermediaries (Q11, Q12, Q13, Q14, Q15, Q16)
- Management of Digital Assets (Q18, Q19)
- Data Management and Storage (Q20)
- Supply-chain Complexity (Q21)
- Transactions Management (Q22, Q23)

In the 'Do you need Blockchain?' tool we aim to identify if the company faces any of the challenges and could potentially solve them with the technology.

Figure 6. Blockchain / DLT potential assessment in the 'Do you need Blockchain?' tool

Such challenges as potential intermediaries' automation, trust between stakeholders, need for digital assets and other questions are named and allows to create a short overview of the situation in the industry that organisation is participating in.

At the end of the assessment, SMEs / startups receive feedback, based on their answers, if DLT / blockchain could have a high impact on the company's processes. The high impact result is provided if the company provides positive answers to any of the identified challenges that could be overcome by implementing DLT / blockchain solutions and low impact if the technology would not solve any challenges.

3.5 Other collected data

In the DLT Assessment Tool we collect this additional data:

- To begin the DLT Assessment potential every respondent has to accept Blockstart's privacy policy *(mandatory)*
- Respondents are asked to provide information on where did they find out about the tool *(optional)*
- Respondents are asked to provide the industry of their operations, which will be used for future research *(mandatory)*
- At the end of the assessment respondents are asked if they want BlockStart to get in touch with them for further cooperation in the scope of the BlockStart programme *(optional)*
- At the end of the assessment respondents are asked to provide their professional email address, if they want to receive updates on further development of the project *(optional)*
- At the end of the assessment respondents are asked to provide the name of the company they represent *(optional)*

Figure 7. Privacy policy page in the 'Do you need Blockchain?' tool

This particular data allows to receive insights on the different industry fields and to identify the fillers for future communication on project activities. The data collected on the 'Do you need Blockchain?' tool is managed under the GDPR requirements and users have a possibility not to provide any personal data.

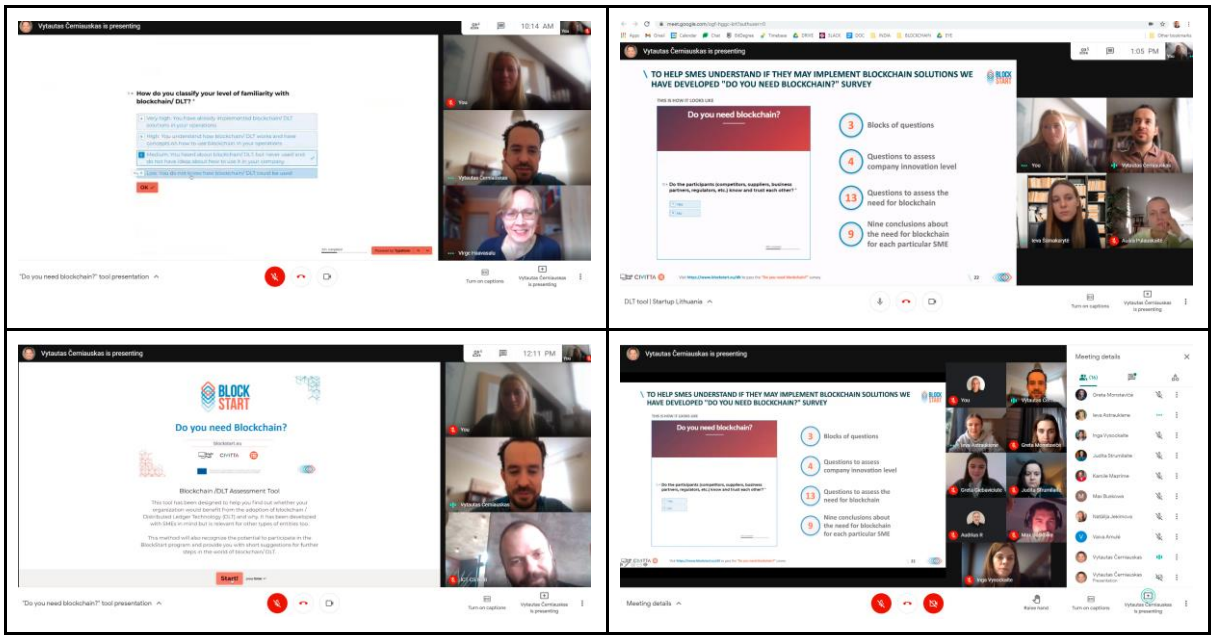
4. Results and traction of the last version of the DLT Assessment Tool

The last version of the DLT Assessment Tool has been active since M10 (June 2020) until July 2021.

As detailed above, this is the updated version improved based on the feedback and insights received on the first iteration of the tool. In order to gather results and feedback from a number of different stakeholders, the tool was disseminated through various channels, including:

- BlockStart's webpage, including blog post intended to guide the respondents of the tool;
- BlockStart's events and other events, where Blockstart was invited to present (e.g. Rockit Coffee Club);
- Partner networks (social media accounts, other projects that consortium partners are implementing);
- Various intermediaries to whom we presented the DLT Assessment Tool and who used it and disseminated information about the tool (Antiopea, Blockchers, ICT Cluster of Central Serbia, GovTech Lab Lithuania, Estonian Association of SMEs, Startup Lithuania, Lithuanian Innovation Agency and others; see Picture 8 "Screenshot of "Do you need blockchain?" demo presentations for intermediaries");
- At local and international blockchain events (European Blockchain Convention, Blockchers working breakfast with the European Parliament, R3 Start-up Series webinar, EU-Startups Summit, etc.);
- Directly to intermediaries, startups, SMEs and blockchain experts (through direct contact, video calls, expert interviews, SMEs surveys and directing open call applicants).

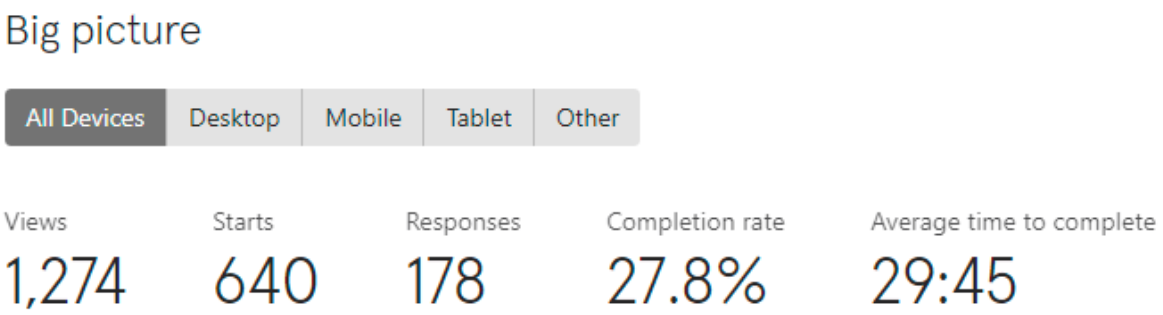
Figure 8. Screenshots of "Do you need blockchain?" demo presentations for intermediaries



During approximately 13 months the tool gathered 178 responses from SMEs, startups, intermediaries, experts and other players that were evaluating their potential blockchain adoption.

In total, the tool has been started to be filled in 640 times with completion taking an average of 30 minutes. Compared to the initial version of the tool, the completion rate has almost doubled from 16.9% to 27.8%.

Figure 9. "Do you need blockchain?" insights from Typeform (July, 2021)



4.1 Results of the updated tool regarding blockchain potential

The updated version of the DLT Assessment Tool produced a wide range of insights that help to determine the overall willingness to adopt blockchain and DLT for SMEs. The tool has provided a positive answer (that the organisation has high potential to adopt blockchain) for 53% of respondents. These organisations have been provided with exemplary applications that could be taken as a starting point to imagine where DLT and blockchain could stand in for them. Other insights and statistics that can be derived from the answers are as follows:

- 96.4% of respondents are SMEs

  - 28.9% are startups
  - 42.2% are micro enterprises
  - 17.5% are small enterprises
  - 7.8% are medium-sized enterprises
- There is a variety of different sectors representatives
  - 26.9% of respondents come from the ICT sector
  - 12.6% from fintech and insurtech
  - 12.6% from other services
  - 10.9% from wholesale and retail
  - 8.6% from agriculture
  - Others less than 6%
  - Non-profit and charity is the only sector with no responses
- 74.9% of respondents have high innovativeness and are open to new ideas and their implementation
- 73.1% of respondents have experience in implementing innovations in IT business processes
- 53.7% have internal IT departments with the capacity to develop innovations, 13.7% do not have an IT department
- 54.9% of respondents have a high understanding of how blockchain and DLT technologies work and have concepts on how to use blockchain in their operations
- 70.9% state that there are many participants with common technological advancements in their respective markets
- 73.4% state that these participants generate information that is used by all market participants but no one is the sole owner of it
- 53.8% express that these market participants know and trust each other
- 61.1% state that they and their business partners need to rely on a trusted third party
- 85% think that the trusted third party could be replaced by an information system
- 80.6% are managing contractual relationships under which performance of work, provision of services or other actions that influence the contractual obligations can be digitally recorded and verified
- 89.7% of respondents state that their business processes or relations with business partners or customers can be automated based on 'if this then that' logic
- 78.9% say that they work with digital assets or need to track the creation and movement of those assets
- 77.7% replied that the issuance of digital certificates for physical assets would help their businesses
- 93.1% state that they need to collect, store and analyse data and information and at least one of the following applies:
  - They need to know by whom, when and where various information records are created;
  - They need to collect, analyse and store information received from various devices;
  - They need to maintain immutable and secure stored logs of transactions, movement of goods, maintenance or other actions.
- 76% responded that their businesses are part of the supply chain and at least one of the following applies:
  - They need to be confident in the origin of goods that they receive from manufacturers or suppliers;

  - Their customers need to be confident in the origin of goods they buy or be able to confirm the conditions of production, storage or transportation of your goods;
  - Their business suffers from a complicated and intricate supply chain: for example, from frequent delays, downtime, loss of goods, lack of ability to check the location and condition of the goods transported, etc.
- 85.7% state that their business depends on internal and external transactions and at least one of the following is a suitable characteristic:
  - Their business requires high-performance, trusted, traceable and rapid transactions;
  - Their transactions should be transparent to the wide range of users (clients, regulators, etc.);
  - They use internal accounting units for settlements within the company.
- 85.7% think that partial disclosure of the information they store may increase customer confidence in their company

4.2 Insights into user experience and usability of the updated tool

- 50% of the respondents start filling out the DLT assessment after opening it. The statistics is reasonable, as it is usual to have 30-70% of bounce rate in the websites (DLT Assessment Tool is embedded into the BlockStart's website). There have been 1 276 views of the tool and it has been started 642 times (50%).
- The drop-off rates in Typeform platform are provided as a percentage and provide the rate of exits on the particular question.
- According to Typeform's functionality, it is required that the respondent would press 'Next' and 'Submit' buttons in order that these would be counted as a full response. Those that leave at any step of the questionnaire are counted into general statistics on the drop-off rate, however their filled-out information is not kept neither by the platform nor by BlockStart.
- The questions that have the highest drop-off rate are:
  - The first one, which asks to read agree to the privacy policy (11%)
  - At the very end of the assessment, the conclusion is that based on the answers, we believe that blockchain/ DLT will not have a significant impact on the market in which you operate [...]. Nevertheless, we have conducted a preliminary assessment of the challenges for your company that can be overcome with the help of blockchain/ DLT, as well as certain aspects of your company that can be improved through the use of blockchain/ DLT. The tool gives specific areas where blockchain/DLT implementation could be beneficial. Being one of the very last questions/answers, it has a bounce rate of 10%.
  - Do you wish us to get in touch with you for further cooperation in the scope of BlockStart program? (16%)
  - Professional email: (18%)

Overall, all other questions had more than 90% fill in rate, which means that filling in the questionnaire did not cause any major headaches for the responders. The number of questions and typology seems to be reasonable and relevant, no major issues were raised by any stakeholders of DLT and blockchain world and the intermediaries we made live demonstrations of the tool to.

5. Cost-benefit analysis by using DLT compared to current solutions

Cost-benefit assessment template as an addition to DLT tool "Do you need blockchain?" shall help SMEs address simple yet crucial questions while developing a blockchain business case:

- What are the expected benefits?
- What are the expected costs?

Before any decision it is important to know what to pay attention to and therefore the analysis criteria for three different sectors will be presented below.

5.1 Cost-benefit analysis and how to conduct it?

When it comes to emerging technologies such as blockchain, business decision makers are often faced with a difficult and yet crucial choice, either keep the status quo and do not change or evolve and adopt these new solutions. It is a challenge that goes beyond the definition of these technologies and involves answering the questions "how does this technology change and actually improve the business?", "what are the costs?". The cost-benefit analysis may help companies to estimate what's the actual advantage of using blockchain technology and evaluate if the costs do not exceed the benefits.

The framework and examples of such analysis will be presented in more detail analysing top 3 industries (according to DLT Maturity Assessment report D5.2):

- Wholesale and Retail;
- Fintech;
- ICT;

and their specific cases (e.g., fintech - banking and finance services; wholesale and retail - food supply-chain electronic traceability system; ICT - IoT for smart cities). The presented framework and exemplary analysis could be used as a guiding tool analysing any business case not necessarily in the aforementioned industries.

How to conduct a cost-benefit analysis?

A more general cost and benefit analysis framework, which could be applied when analysing advantages (benefits) and disadvantages (costs) to business processes when implementing blockchain technology is presented in Figure 10.

Figure 10. General cost-benefit analysis framework

Cost (weaknesses)	Benefit (strengths)
Purchasing costs	Privacy
Transaction costs	Cost reduction
Energy costs	Transparency
Storage costs	Enhanced security
Maintenance/running costs	Efficiency
Support costs	Immutability
	Speed (transactions)
	Trust
	Confidentiality
	Robustness

Source: Osmani, M., El-Haddadeh, R., Hindi, N., Janssen, M., & Weerakkody, V. (2020). Blockchain for next generation services in banking and finance: cost, benefit, risk and opportunity analysis. Journal of Enterprise Information Management, 34(3), https://doi.org/10.1108/JEIM-02-2020-0044

To understand the determinants of blockchain adoption the presented framework reflects **blockchain strengths that relate to benefits and weaknesses that relate to costs**. Costs of blockchain technology are mainly related to operating costs such as transaction costs, energy and storage costs while benefits are mainly related to the technical aspects such as privacy, transparency, security, trust and faster transactions.

5.2 Fintech (the case of banking and financial services)

While there has been a wide range of traditional banking products from payments to investment services, blockchain technology has challenged this by offering innovative, safer and faster transfers at a lower cost. Blockchain is essentially a distributed database of records or a public ledger of all transactions or digital events that have been executed and shared among the parties involved. In the current financial system, some payments can take up to a week to finally settle. The reason for this is mainly the presence of multiple intermediaries in the system.

Blockchain technology provides a way for untrusted parties to agree on the state of a database without using an intermediary. By providing a ledger that no one manages, a blockchain could provide certain financial services - such as payments or securitization - without the need for a bank. In addition, the blockchain enables the use of tools such as "smart contracts," which are self-executing contracts based

on the blockchain that could potentially automate manual processes - from compliance to processing claims to distributing the contents of a will.

The **costs** of using blockchain technology for banks can be classified into 2 main factors:

- One-time costs: purchasing costs;
- Operating costs: transaction costs, energy costs and storage costs.

Blockchain provides banks with operational **benefits** such as privacy, transparency, enhanced security, cost savings, immutability and faster transactions. Cost reduction (or cost savings) will always play an influential role in the adoption of blockchain technology, as it can reduce infrastructure costs by 30% for banks and will result in cost savings of 8–12 billion USD annually[1]. Making banking transactions more efficient (by eliminating the need for intermediaries and associated charges) will result in further cost reduction. Public blockchain has an openness attribute, and as a result, it provides transparency in data when applied to an area requiring the disclosure of data. Therefore, due to such benefits, blockchain can be utilized in diverse areas, including the financial sector and its applications are expected to expand. More detailed description of costs and benefits criteria of the fintech sector is presented below (see Table 1).

Table 1. Cost-benefit analysis criteria for Fintech

Type of costs / benefits		Description
Cost	Purchasing costs	One-time cost, usually it is the most significant portion of the entire system cost. The hardware and the setup cost.
	Transaction costs	The future rise in energy costs and storage cost will increase the transaction cost of blockchain affecting the cost per transaction.
	Energy costs	The increase in transaction volumes will raise energy required to assist blockchain algorithms throughout the performed financial transactions.
	Storage costs	Blockchain databases must store data indefinitely, which means that the database will grow substantially over time, as will the storage costs for relevant financial institutions.
Benefits	Privacy	Blockchain transactions can provide users with better privacy, allowing users to own their data and not allowing third-party intermediaries to misuse and obtain data.
	Transparency	Transparency is strengthened because the transactions are shared across the network.
	Enhanced security	Blockchain provides financial institutions with higher security compared to storing all data in a central database and helps prevent damage from attacks on the database.
	Efficiency	Blockchain-based solutions offer banks a quick reduction in overhead costs which makes transactions quicker and more efficient. Moreover, blockchain

[1] Osmani, M., El-Haddadeh, R., Hindi, N., Janssen, M., & Weerakkody, V. (2020). Blockchain for next generation services in banking and finance: cost, benefit, risk and opportunity analysis. Journal of Enterprise Information Management, 34(3), 884-899. https://doi.org/10.1108/JEIM-02-2020-0044

		can help in making banking transactions more productive by eliminating the need for intermediaries resulting in cost reduction.
	Immutability	Transaction history in the blockchain cannot be modified since the blockchain ledger can remain permanent and unaltered.
	Faster transactions	Blockchain will allow payments to reach beneficiaries faster with fewer steps.
	Trust	Blockchain relies on collaborative governance to provide trust in the financial markets to ensure that all play by agreed rules.

Sources: Osmani, M., El-Haddadeh, R., Hindi, N., Janssen, M., & Weerakkody, V. (2020). Blockchain for next generation services in banking and finance: cost, benefit, risk and opportunity analysis. Journal of Enterprise Information Management, 34(3), 884-899. https://doi.org/10.1108/JEIM-02-2020-0044

5.3 Wholesale and Retail (case of electronic traceability system for food supply chain)

Chain traceability is the traceability between links and companies. It depends on the data recorded in the internal traceability system being transmitted and then read and understood in the next link in the chain. For traceability, it is important to "access any or all information relating to that which is under consideration", so this means that the information recorded in the first link of the chain must somehow be made available in (or transported to) the next link of the chain. This is what the traceability system does - it makes sure that the recorded information is made available elsewhere and it is not lost. Blockchain-enabled food traceability system, which can be used in supply chains for food products, was taken as exemplary business case for the wholesale and retail industry.

Similarly, as in fintech sector, the **costs** can be break down into:

- One-time costs - purchasing costs;
- Operating cost - energy and storage costs;
- And other costs, related to speed, efficiency and interoperability.

Analysing blockchain **benefits** in the wholesale and retail industry, they are mostly related to: suitability of database; data quality and veracity; immutability and integrity; security; confidentiality; transparency; robustness and trust.

When deciding between a traditional implementation of an electronic traceability system and a blockchain-based one, it is important to determine which system qualities are most important. If transparency, integrity and robustness of the database are most important, then a blockchain solution can be very relevant. On the other hand, if speed and data confidentiality are considered to be the most important system attributes, a traditional electronic traceability system is probably better. The relevance and utility of improved interoperability should not be underestimated (it is difficult to get a large and diverse group of companies to agree on what standards and data formats to use). See more detailed descriptions of costs and benefits in the table below[2].

[2] Petter Olsen, Melania Borit, and Shaheen Syed (2019). Applications, limitations, costs, and benefits related to the use of blockchain technology in the food industry

Table 2. Cost-benefit analysis criteria for Wholesale and Retail

Type of cost / benefit		Description
Costs	Purchasing costs	One-time cost, usually it is the most significant portion of the entire system cost. The hardware and the setup cost.
	Energy costs	After the block has been signed it becomes part of the blockchain and fees are split between the miners and validators who signed off on the block. The downsides of Proof of Activity - PoW (high energy costs due to enormous computational power) and Proof of Stake - PoS (double signing of blocks) still exist.
	Storage costs	Blockchain database must store data indefinitely, which means that the database will grow substantially over time, as will the storage costs.
	Speed and Efficiency	A blockchain implementation will always be slower than a traditional implementation, it needs to verify signatures / identities using cryptography and to execute a consensus algorithm to determine which blocks get added to the blockchain during the next update.
	Interoperability	In principle, interoperability, i.e., how well different systems exchange information, could be seen as independent from the traditional / blockchain choice. Unfortunately, there are too many competing standards in this area, so the current level of interoperability is fairly low.
Benefits	Suitability of database	A traditional database can store anything, and it is normally state-based. A blockchain stores transactions, and as transformations in a (food) supply chain are similar to transactions, the blockchain is well suited for storing data related to food (or product) traceability.
	Data quality and veracity	Blockchain offers advantages such as the ability to provide full audit trails of transactions and verify entities that align with data quality improvements as defined in the Confirmed Dimensions of Data Quality: completeness, accuracy, consistency, validity, timeliness, currency, integrity, accessibility, lineage, and representation.
	Immutability and integrity	The data recorded in a blockchain is immutable by design, which means that recorded data has never been overwritten. Thus, a traditional database has no built-in integrity; it stores the latest recorded (or claimed) state of each data element independently.
	Transparency	Transparency is strengthened because the transactions are shared across the network.
	Confidentiality	In a blockchain implementation confidentiality and tiered data access protocols are designed externally and on an ad-hoc basis. Blockchain scores highly on transparency, and in this context transparency and confidentiality are to some degree mutually exclusive qualities.
	Privacy	Blockchain transactions can provide users with better privacy, allowing users to own their data and not allowing third-party intermediaries to misuse and obtain data.
	Enhanced security	Prevention of criminal actions (through verifiable identification and deterrence).

		Blockchain provides higher security compared to storing all data in a central database and prevents damage from attacks on the database.
	Robustness	Robustness indicates how sensitive the data and the database is to mistakes, errors or incidents, including things like power-outs, hacking, server crashes and malfunctioning software or hardware. The more sensitive data the more benefit blockchain can bring.
	Trust	Blockchain was designed to work without trusting any particular organisation; the trust in the veracity of the data would be supplied by the design of the blockchain system.

Source: Petter Olsen, Melania Borit, and Shaheen Syed (2019). Applications, limitations, costs, and benefits related to the use of blockchain technology in the food industry

5.4 ICT (IoT - CCTV for smart cities business case)

The video created by surveillance cameras play a crucial role in crime prevention and examinations in smart cities. The closed-circuit television camera (CCTV) is essential for a range of public uses in a smart city, combined with Internet of Things (IoT) technologies they can turn into smart sensors that help to ensure safety and security. Many studies combine blockchain and image and video processing algorithms. Applications include combating deepfake videos, image encryption and digital content rights management. A CCTV system within a smart city may involve hundreds or thousands of IP based IoT cameras that operate 7/24 and generate a vast amount of digital content daily. Blockchain enables proving that video has not been tampered based on time stamping, allowing it to be presented as proof in the court. This innovative protocol empowers information to be traded among different entities inside a system.

A data verification system for CCTV surveillance cameras using blockchain technology in smart cities was taken as an exemplary business case for the ICT industry[3].

There are mainly two types of initial **costs** in such a system:

- Purchasing - one-time costs and usually these costs make up the most significant portion of the entire system costs. It includes the purchase of initial hardware and the setup cost.
- Running - include the maintenance costs, which can vary according to the lifetime of the hardware. Also, personnel costs could be added to this category as this consist of the salaries and these are continuous costs to run the system effectively.

Additionally, for the aforementioned case it is recommended to use an open-source blockchain technology, which will help in security issues related to CCTV camera recordings. It will also reduce the centralized storage and maintenance costs, as blockchain provides a distributed environment with the guarantee of immutability, security and privacy. Aside from that, one of the key blockchain-based solution **advantages** is the possibility to limit the issue of a single point of failure by dispersing and sharing a number of CCTV pictures among blockchain participating nodes. Also, the use of smart contracts makes it easy to automate the business logic and helps in time-saving with the surety of zero

[3] Prince Waqas Khan, Yung-Cheol Byun, and Namje Park (2020). A Data Verification System for CCTV Surveillance Cameras Using Blockchain Technology in Smart Cities; Theodorou Sophocles, Sklavos Nicolas (2019). Blockchain-Based Security and Privacy in Smart Cities DOI: 10.1016/B978-0-12-815032-0.00003-2

error. The blockchain also provides data integrity, which ensures that the stored data does not get tampered with. Blockchain solution is a cost-effective way to authenticate data for surveillance cameras. Another critical aspect worth mentioning is decentralization, which will be helpful in fault tolerance. The data is distributed in different nodes, hence, in case of any failure in any node, the data can be retrieved easily.

Table 3. Cost-benefit analysis criteria for ICT sector

Type of cost/benefit		Description
Costs	Purchasing costs	One-time cost, usually it is the most significant portion of the entire system cost. The hardware and the setup cost.
	Running costs	System running costs are related to personnel costs consisting of the salaries of the staff. It is a continuous cost to run the system effectively. Running costs include the maintenance costs, which can vary according to the life of the hardware. It may also include the energy costs.
	Storage costs	Blockchain database must store log-fixed data indefinitely, which means that the database will grow substantially over time.
Benefits	Privacy	There is a strong belief that the elimination of the third party in the process of the closing of a transaction will have, as an effect, a faster and less costly transaction with higher privacy.
	Data quality and veracity	It is about data distribution and decentralization. Since the data is distributed in different nodes, hence, in case of any failure in any node, the data can be retrieved easily.
	Efficiency	The use of smart contracts makes it easy to automate the business logic and helps in time-saving with the surety of zero error.
	Transparency	This benefit can be calculated according to the need of ensuring transparency while sharing data, in this case a number of pictures among blockchain participating nodes
	Integrity	The data (CCTV image) integrity as an advantage of keeping the data unchanged. To forge a video, the intruder has to decompress the video, change its data, and re-compress again.
	Security	The ease of checking video forgery and detect forgery by applying high-security blockchain technology to CCTV.
	Immutability	History in the blockchain cannot be modified since the blockchain ledger can remain permanent and unaltered.

Sources: Prince Waqas Khan, Yung-Cheol Byun, and Namje Park (2020). A Data Verification System for CCTV Surveillance Cameras Using Blockchain Technology in Smart Cities; Theodorou Sophocles, Sklavos Nicolas (2019). Blockchain-Based Security and Privacy in Smart Cities DOI: 10.1016/B978-0-12-815032-0.00003-2

5.5 Overview of cost-benefit assessment

After exploring cost-benefit analysis criteria for the top 3 sectors (fintech, wholesale and retail, ICT) for blockchain, the **costs criteria** were identified as very similar to all three analysed sectors and are the following:

- One-time costs – such as purchasing costs;
- Running costs – costs that are related to support the project, including maintenance costs and operating costs.

Most of the blockchain solution costs are similar to those of traditional IT projects, however certain costs are likely to be higher because of the use of new technology and involvement of external parties. Also, blockchain is new to most of the enterprises, therefore initial projects are likely to identify certain one-time infrastructure costs (purchasing costs). Other costs, such as running costs, which include maintenance and personnel costs are applied in all sectors' business cases. There were some additional costs (related to speed, efficiency and interoperability) noticed at wholesale and retail sector's business case, however worth mentioning that same costs could be applied for other industries and business cases as well.

Research suggests that the primary reasons for organisations adopting blockchain (or the intention to adopt) were related to benefits such as reduced costs, efficiency, enhanced security, privacy and transparency of the transaction. After exploring cost-benefit analysis criteria for the top 3 sectors (fintech, wholesale and retail, ICT) for blockchain, the common **benefit criteria** were identified:

- Security
- Transparency
- Privacy
- Immutability

Additionally, having in mind quicker reduction of overhead costs and smart contracts, speed and efficiency were noticed as business benefits to fintech and ICT. However, the same criteria can also be assessed as business costs for wholesale and retail sector (traceability system business case), because blockchain implementation is actually slower than a traditional system implementation.

Data quality, veracity and integrity have been marked as sector specific benefits for the selected business case of the ICT sector. Trust was more emphasized in the fintech industry, while in the wholesale and retail sector one of the additional benefits of adopting blockchain was confidentiality.

Before developing and implementing blockchain-based solutions, it is important to assess not only the costs and benefits but also the external factors that may influence the development of such projects. Therefore, it is recommended to perform a deeper and wider analysis including the assessment of opportunities and risks (in accordance to the SWOT theory). **Opportunities** are related to whether the market would embrace the technology or not, as well as businesses, including entrepreneurs, are willing or not to explore prospects for exploiting this innovative technology as a new entrant to offer new products and services in order to achieve competitive advantages. Although blockchain may bring enormous benefits and opportunities to various industries and give birth to a whole new generation of services, there still remains significant **risks** of adopting the technology. For example, risks of using blockchain technology can be referred to the technical, operational and regulatory legal risks. For instance, legal risks arise due to ambiguity and uncertainty related to legal rights. This risk is primarily amplified through issues arising from customer privacy and disclosure, money laundering and liability concerns of banks, which have links to other websites.

6. Conclusion

The first iteration of DLT Assessment Tool brought a high number of valuable insights and allowed for further improvement and upgrade of the methodology, which evolved into the user-friendly 2nd version 'Do you need Blockchain?' evaluation tool. Based on the insights, comments and suggestions, the second iteration was prepared and implemented by updating the tool. Similarly, the last tool version (last updated in April, 2021) was created with updated minor details only. By encouraging SMEs to use "Do you need blockchain?" assessment tool, BlockStart team also recommends conducting additional cost-benefit analysis, which might have an influence on the final decision. Additionally, exploring such external factors as risks and opportunities, which do not depend on the organization itself but affect its operations, should be taken into account for the full assessment execution.

Since the beginning of the project BlockStart has addressed large audiences while promoting the tool, and it helped several SMEs, startups and other intermediaries to evaluate their potential for blockchain-based solutions and a large number of responses has been gathered. Besides collecting a significant amount of DLT and blockchain industry data, BlockStart has also helped the SMEs and startups to more efficiently find the best technological solution for them. As all the applicants to the BlockStart SME adopters open calls need to fill in the Assessment Tool (it is one of its evaluation criteria), the tool was instrumental in the corresponding open call 1 (December 2019 - July 2020) and open call 2 (July 2020 - March 2021). It will be of equal importance for open call 3 for SME adopters (March - November 2021). The tool is public and can be accessed on BlockStart project's website. It is continuously being shared with the community through the project's and partners' public dissemination channels.

Annex 1. DLT Assessment Tool Questions and Possible Answers

'Do you need Blockchain?' tool questions and possible answers that assess the company's DLT / blockchain technology potential are provided in the table below.

No.	Question	Answers' choices	Logic
1.	Before you start, please read our privacy policy (click here).	1. Start 2. Leave	If 'Start', then to question 2; If 'Leave', then to the 'Thank you' screen (last question).
2.	How did you find out about this blockchain readiness tool?	1. BlockStart website 2. BlockStart social media 3. European Commission's online library 4. Block.IS 5. B-HUB for Europe 6. SMEs association 7. Other	All answers lead to question 3.
3.	Does your company meet each of the following conditions? 1. The number of employees in your company is less than 250; 2. The annual turnover of your company does not exceed €50M; 3. The annual balance sheet total of your company does not exceed €43M.	1. Yes 2. No	If 'Yes', then question 4; If 'No', then question 5.
4.	What type of company do you represent?	1. Micro enterprise 2. Small enterprise 3. Medium-size enterprise 4. Large enterprise 5. Startup 6. State-owned enterprise 7. Industry association or non-profit	If 'Micro', 'Small', 'Medium' enterprise or 'Startup', then to question 6. If any of the rest, then question 5.
5.	(only if determined to be non-SME) 'Do you need blockchain?' tool is created	1. Continue	All answers lead to question 6;

	to meet SMEs needs. Disclaimer! 'Do you need blockchain?' tool has been designed with SMEs in mind. We have not specifically tested it out with other types of entities but the logic is still relevant. Some statements might not be accurate for your organization. To consult us, drop us a line at hello@blockstart.eu		
6.	Choose the industry that matches your activities the best:	1. Agriculture 2. Construction 3. Education 4. Financial and Insurance activities 5. Healthcare and Medicine 6. Information and Communication 7. Manufacturing 8. Media, Arts, Entertainment, Recreation 9. Mining and Quarrying 10. Non-profit and Charity 11. Other services 12. Real estate activities 13. Transportation 14. Utilities and Energy supply 15. Wholesale and Retail	All answers lead to question 7.
7.	What is the level of innovativeness in your company:	1. High. You are open to new ideas and often implement them in. You embrace innovations and see it as a continuous process 2. Medium. You are willing to implement new ideas and are open to innovation 3. Low. You have no policies regarding innovation. You see innovations as a one-	All answers lead to question 8.

		time event and accept it reluctantly	
8.	Do you have experience in implementing innovative solutions?	1. Yes. These innovations were related to IT business processes improvement 2. Yes. But these innovations were NOT related to IT business processes improvement 3. No. You have not introduced significant innovations	All answers lead to question 9.
9.	Do you have an IT department?	1. Yes. IT department has capacity to develop and implement new systems and/or provide integration of own systems with external software 2. Yes. You have an IT department but it is handling specific systems and applications and is not capable of new software development 3. Yes. But IT department only provides maintenance and support 4. No	All answers lead to question 10.
10.	How do you classify your level of familiarity with DLT/ blockchain?	1. Very high. You have already implemented DLT/ blockchain solutions in your operations 2. High. You understand how DLT/ blockchain works and have concepts on how to use blockchain in your operations 3. Medium. You heard about DLT/ blockchain, but never used and do not have ideas about how to use it in your company	All answers lead to question 11.

		4. Low. You do not know how DLT/ blockchain could be used	
11.	Are there many participants (competitors, suppliers, business partners, regulators, etc.) with common technological advancement interests in your market?	1. Yes 2. No	If 'Yes', then to question 12; If 'No', then to question 14.
12.	Do these participants (competitors, suppliers, business partners, regulators, etc.) generate information that is used by all market participants but no one is the sole owner of it?	1. Yes 2. No	If 'Yes', then to question 13; If 'No', then to question 14.
13.	Do the participants (competitors, suppliers, business partners, regulators, etc.) know and trust each other?	1. Yes 2. No	All answers lead to question 14.
14.	Do you and your business partners need to rely on a trusted third party (government organisation, guarantor, etc.)?	1. Yes 2. No	If 'Yes', then to question 15; If 'No', then to question 16.
15.	Could a trusted third party be replaced by an information system?	1. Yes 2. No	All answers lead to question 16.
16.	Are you managing contractual relationships under which performance of work, provision of services or other actions that influence the contractual obligations can be digitally recorded and verified?	1. Yes 2. No	All answers lead to question 17.
17.	Could your business processes or relations with business partners or customers be automated based on "if this then that" logic?	1. Yes 2. No	All answers lead to question 18.
18.	Do you work with digital assets or need to track the	1. Yes 2. No	All answers lead to question 19.

	creation and movement of digital assets?		
19.	*Could it help your business to issue digital certificates for physical assets?*	1. Yes 2. No	All answers lead to question 20.
20.	Do you need to collect, store and analyze data and information and at least one of the following characteristics is suitable for your business?	1. Yes 2. No	All answers lead to question 21.
21.	Is your business part of the supply chain and at least one of the following characteristics is suitable for your business?	1. Yes 2. No	All answers lead to question 22.
22.	Does your business depend on internal and external transactions and at least one of the following characteristics is suitable for your business?	1. Yes 2. No	All answers lead to question 23.
23.	Does partial disclosure of the information you store may increase customer confidence in your company?	1. Yes 2. No	All answers lead to innovation readiness assessment.

Following the collection of answers to these questions, the consortium partners have developed a logic tree based on 'if this then that' logic and by the end of questionnaire, the respondents are instantly provided with the answers listed in the next section.

Annex 2. DLT Assessment Tool Results provided for respondents

Answers on the questions for the respondents are presented in the table below.

Short answer	In depth answer
Innovation readiness answers	
Your company has a high level of	You have already implemented DLT/ blockchain solutions and have a clear idea of the principles of DLT/ blockchain. You also have a strong IT department that can participate in the development of the solution, customize the integration of the solution with your IT systems and maintain the solution after the launch.

readiness for innovation.	Thus, the introduction of new DLT/ blockchain solutions is not an insurmountable challenge for your company. We recommend you contact us for the further development of this area. At the end of the questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
	You have already implemented DLT/ blockchain solutions and have a clear idea of the principles of DLT/ blockchain. But you do not have a strong IT department that could participate in the development of the solution, customize the integration of the solution with your IT systems and maintain the solution after the launch. The introduction of new DLT/ blockchain solutions is not an insurmountable challenge for your company, but we recommend you consider the possibility of creating your own IT department or the possibility of attracting a company that will help you integrate and maintain the solution after launch. We also recommend you contact us for the further development of this area. At the end of the questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
	You have an idea about the principles of DLT/ blockchain and, perhaps, considered several solutions for your company. You also have a strong IT department that can participate in the development of the solution, customize the integration of the solution with your IT systems and maintain the solution after the launch. Thus, the development and implementation of DLT/ blockchain solutions for your company is a difficult but feasible task. We recommend you contact us for the further development of this area. At the end of the questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
	You have an idea about the principles of DLT/ blockchain and, perhaps, considered several solutions for your company. But you do not have a strong IT department that could participate in the development of the solution, customize the integration of the solution with your IT systems and maintain the solution after the launch. The development and implementation of DLT/ blockchain solutions for your company is a difficult but feasible task, but we recommend you consider the possibility of creating your own IT department or the possibility of attracting a company that will help you integrate and maintain the solution after launch. We recommend you contact us for the further development of this area. At the end of the questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
Your company has a low level of readiness for innovation.	You have an idea of how DLT/ blockchain works, but you are not ready to innovate. Thus, the implementation of DLT/ blockchain solutions can be a daunting task for your company. Before proceeding with its development and implementation, we recommend you carry out work to develop and improve the company's innovation strategy and strengthen your IT department. Next, we will show you DLT/ blockchain solutions that may suit your company. We recommend you contact us for advice on what needs to be done in order to implement these solutions in the company's activities. At the end of the

	questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
	You do not have a broad understanding of the principles of DLT/ blockchain. Thus, the implementation of DLT/ blockchain solutions can be a daunting task for your company. Before proceeding with its development and implementation, we recommend you to know more about the blockchain technology and principles of DLT. Next, we will show you DLT/ blockchain solutions that may suit your company. We recommend you contact us for advice on what needs to be done in order to implement these solutions in your company's activities. At the end of the questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
	You do not have a broad understanding of the principles of DLT/ blockchain. Thus, the implementation of DLT/ blockchain solutions can be a daunting task for your company. Before proceeding with its development and implementation, we recommend you carry out work to develop and improve the company's innovation strategy and strengthen your IT department. Also, we recommend you to know more about the blockchain technology and principles of DLT. Next, we will show you DLT/ blockchain solutions that may suit your company. We recommend you contact us for advice on what needs to be done in order to implement these solutions in the company's activities. At the end of the questionnaire, you will find a field to share your email, in case you wish us to get in touch with you for further cooperation.
DLT/ blockchain potential assessment answers	
Your company has a high potential for implementing and using DLT / blockchain	Based on your answers, we believe that your company has a high potential for implementing and using DLT/ blockchain. In the market in which you operate, there are many participants united by common interests. At the same time, the lack of trust between the participants makes DLT/ blockchain a solution that can ensure interaction on a transparent and at the same time "trustless trust" basis. Also, DLT/ blockchain can help you get rid of the trusted third party by providing trust between you and your partners without intermediaries. In addition, we have conducted a preliminary assessment of the challenges for your company that can be overcome with the help of DLT/ blockchain, as well as certain aspects of your company that can be improved through the use of DLT/ blockchain.
	Based on your answers, we believe that your company has a high potential for implementing and using DLT/ blockchain. In the market in which you operate, there are many participants united by common interests. At the same time, the lack of trust between the participants makes DLT/ blockchain a solution that can ensure interaction on a transparent and at the same time "trustless trust" basis. In addition, we have conducted a preliminary assessment of the challenges for your company that can be overcome with the help of DLT/ blockchain, as

	well as certain aspects of your company that can be improved through the use of DLT/ blockchain.
	Based on your answers, we believe that your company has a high potential for implementing and using DLT/ blockchain. DLT/ blockchain can help you get rid of the trusted third party by providing trust between you and your partners without intermediaries. In addition, we have conducted a preliminary assessment of the challenges for your company that can be overcome with the help of DLT/ blockchain, as well as certain aspects of your company that can be improved through the use of DLT/ blockchain.
Your company has a low potential for implementing and using DLT / blockchain	Based on your answers, we believe that DLT/ blockchain will not have a significant impact on the market in which you operate, due to the lack of a network effect, the absence of common goals of market participants, or a high degree of trust between key players. Nevertheless, we have conducted a preliminary assessment of the challenges for your company that can be overcome with the help of DLT/ blockchain, as well as certain aspects of your company that can be improved through the use of DLT/ blockchain.