



TRAINCHAIN TRAINER'S GUIDE

ERASMUS+ Programme

2021-1-IE01-KA220-VET-000032943

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Table of Contents

1.	Welcome to TrainChain!	4
1.1.	Purpose of the Trainer’s Guide.....	5
1.2.	Learning Needs of Managers and SMEs Owners concerning Blockchain Technologies	6
1.3.	Blockchain: New Opportunities and Benefits for Businesses.....	7
2.	TRAINCHAIN BLOCKCHAIN TRAINING FOR START UPS	9
2.1.	Introduction	9
2.2.	Learning Objectives and Competencies.....	9
3.	TRAINCHAIN BLOCKCHAIN TRAINING CONTENT.....	13
3.0	Module 0 – Introduction to Blockchain Technology	14
3.0.1	Module goals and objectives	14
3.0.2	Session 1	14
3.0.2	Session II	16
3.1.	Module 1 – Cryptocurrencies / Payment Gateways	17
3.2.	Module 2 – NFTs	29
3.3.	Module 3 – Smart Contracts	36
3.4.	Module 4 – Supply Chain & Logistics	50
3.4.1.	Introduction.....	50
3.4.2.	Module Goals	51
3.4.3.	Learning Objectives and Competencies.....	51
3.4.4.	Supply Chain.....	52
3.4.5.	Logistics introduction	53
3.4.6.	BlokChain Introduction	54
3.4.6.	Emerging Trends in Blockchain	55
3.4.7.	Barriers to development of Blockchain in Supply Chain	56
3.4.8.	Players	56
3.4.9.	How can Blokchain be utilized in Supply Chain.....	57
3.4.10.	What opportunities does Blockchain provide in Supply Chain and Logistics?.....	58
3.4.11.	Real-life implementations with details	58
1.1.	Module 5 – Smart Contracts hands on programming tutorial	58

3.5.1 Overview	59
3.5.2 Environment setup Introduce Remix IDE REMIX IDE	65
3.5.3 Writing our first Smart Contract	65
3.5.4 Metamask Configuration	66
3.5.6 Connect Remix to the RISK TESNET	66
3.5.7 RSK Explorer	66
3.5.8. Interact with your first Smart Contract.....	67
3.5.9 Wrap up	67
2. Further Resources on Blockchain.....	68
3. References.....	70

1. Welcome to TrainChain!

The number of start-ups in Europe is growing (Start-up Hubs Europe: more than €10 billion in investment in 2018). However, there is less job stability, and the year-to-year corporate survival rate in Europe was less than 50%. There are very few official qualifications available, and there is no strategy or money for professional growth and training.

In response to the demands of early-stage companies to give training and development opportunities to its employees, who are frequently young and inexperienced, **TrainChain** project will provide a tailored environment in which learners may learn how to utilize blockchain technology efficiently by delivering methods and activities. The initiatives will concentrate on two primary areas where blockchain technology might be used: IoT and banking.

Moreover, the project intends to respond to the needs of the target groups in Europe, while having a good impact on SMEs and international realities. Some of the key contents include the development of a pan-European blockchain for public services, the promotion of blockchain for sustainability, cybersecurity, legal security, interoperability, and data protection.



1.1. Purpose of the Trainer's Guide

TrainChain project is a response to the needs of early-stage companies to provide training and development opportunities to their, often young and inexperienced, staff. The need for innovative methods for including newly created techniques and training tools is affecting the whole European Union, making necessary a change in the transmission of the information and training of the SMEs in new and trendy topics. In line with the EC objectives and priorities to support digital development and inclusion in the companies and SMEs and integrating blockchain on their procedures, the **TrainChain** project aims to have an international impact.

Building a pan-European public services blockchain, promoting blockchain for sustainability, cybersecurity, legal certainty, interoperability or data protection are some of the core contents of the project, coinciding with the European needs, highly necessary to all the countries equally. **TrainChain** aims to give a response to the necessities of the target groups in Europe as well as to impact positively the SMEs and international reality.

Considering this context, this Trainer's Guide has been developed in order to compile different instructions for each module of the **TrainChain** Programme, including the necessary notes, plans, activities, evaluations, and preparation required for the member of staff to feel confident and comfortable in delivering the module to their team. Moreover, the target groups for this training are, as described before, VET trainers, VET training organizations, Corporate Trainers, Coaches, Chambers of industry and commerce, business incubation services, and accelerators.

The expected impact of this Trainer's Guide, considering its use and dissemination, will be significant among the SME target group as they will have at their disposal a practical implementation plan for adopting blockchain technologies that are essential for their business and while doing so achieve a positive impact on their balance sheet through increased productivity and sales and a reduction in costs. This can translate to reduced pricing for customers and thus increased competitiveness which is key for financial sustainability.

The innovative component of this material can be traced in the approach of creating and accompanying each module of the **TrainChain** programme with a dedicated delivery guide so that the instructor can achieve maximum benefit by directly addressing the "quick wins" which will break the natural resistance of the SME audience.

All in all, the ultimate purpose of this Trainer's Guide is that educators are provided with all the content necessary to successfully train new entrepreneurs on business and management skills in terms of Blockchain.

1.2. Learning Needs of Managers and SMEs Owners concerning Blockchain Technologies

To implement the next steps of the project, which were the production of this Trainer's Guide, a research methodology was developed so the background of SMEs in need of this training were fully comprehended, and this result could be proved successful at all levels. Therefore, the methodology followed in this research consisted in the conduction of surveys by all partners of the **TrainChain** project on their corresponding countries to collect responses from a questionnaire that included questions about the training experience and capacities of VET trainers, VET training organizations, Corporate Trainers, Coaches, Chambers of industry and commerce, business incubation services, accelerators, SME and Start-Ups workers and entrepreneurs.

With this questionnaire, the consortium tried to understand what experience they have of training, in all contexts (e.g. receiving and giving), as well as the capacity that exists within their roles for preparation, delivery, and evaluation. Once the five partners collected their results, a National Report Compilation was developed, and the conclusions reached pointed out the necessity of this project's materials when it comes to the formation of trainers in this sector.

Results showed varied responses since the people answering the questionnaire came from different professional backgrounds: corporate trainers, coaches, and entrepreneurs. These differences proved this research to be enriching for this project and, therefore, for its material, because different views and opinions made partner's contributions further improved and better adapted to their context and necessities, meaning that the focus was put on the needs that these trainer's highlighted from their experience.

By analyzing the survey data, we can conclude that the project will be very beneficial. The current knowledge that trainers have of these disciplines can be improved, and it needs to be considered when it comes to the development of teaching materials. This idea is reinforced if we take a look at the question regarding experience, since it is a new discipline and, therefore, there is a lot of information unknown to trainers. Cryptocurrencies and payment gateways are, undoubtedly, the most known disciplines that use blockchain technology and have been experiencing an increase in popularity over the last few years.

Overall, the conclusion of the completed survey is that, although the trainers are aware of blockchain technology and the role it can play in today's context, they do not seem to have a comprehensive understanding of its specific aspects, such as its technical functions. The most frequently taught subjects are cryptocurrencies and smart contracts while NFTs and supply chain and logistics aren't included at all, showing that this topic requires further development.

Finally, despite the lack of expertise of trainers in this sector, all surveys show that trainers are willing to teach these types of disciplines if they are provided with educational materials since students are highly interested and willing to learn about it.

1.3. Blockchain: New Opportunities and Benefits for Businesses

Considering that this guide acts like a solid base for the trainer by providing and delivering almost every necessary instrument and “know-how” about the topic in question, the many opportunities, and benefits for business when it comes to Blockchain must be addressed.

Blockchains are recognized as the “fifth evolution” of computing because they’re a new trust layer for the Internet. Before blockchains, trust was established by central authorities that would issue certificates.

As one of its benefits for business purposes, Blockchains establish trust in novel ways. For instance, private blockchains build confidence by distributing data across a network of connected but independent participants that are known by each other and can be held accountable.

Each type of blockchain uses different incentive systems to establish trust that each participant in the network will cooperate in keeping a full and unaltered history of “each transaction or entry that is made within the database they share.

As other of its benefits, when data is permanent and reliable in a digital format, you can transact business online in ways that, in the past, were only possible offline. Everything that has stayed analog, including property rights and identity, can now be created and maintained online. Slow business and banking processes, such as money wires and fund settlements, can now be done nearly instantaneously. The implications for secure digital records are enormous for the global economy.”

In addition, Blockchains are important because they allow for new efficiency and reliability in the exchange of valuable and private information that once required a third party to facilitate, such as the movement of money and the authenticity of identity.

This is a big deal due to the fact that a fundamental part of both our society and economy has been structured around establishing trust, enforcing trust when it's broken, and third parties that facilitate trust. You can imagine how this simple software can be utilized to fix areas that have proven to not be foolproof, such as voting, supply chain management, money movement, and the exchange of property.

More specifically, regarding the use of cryptocurrencies for business purposes, there are many advantages to consider, as this brings security to payments, which makes manipulation by third parties hardly impossible since transactions by this method are verified and bundled in a Blockchain network.

Secondly, considering the fact that most SMEs and more specifically start-ups need to make payments abroad (for instance, for suppliers, manufacturers, or external partners), cryptocurrencies make these foreign payments easier than traditional methods and in a lower commission, since there is no geographical limitation on a crypto payment by general rule. In addition, this process is faster and more and more usual nowadays, as it is considered innovative by many industries.

Finally, even though there are many other benefits that will be explored throughout this Trainer's Guide, it is interesting to note that the use of cryptocurrencies also generates non-economic advantages for your business. This means that cryptocurrency payments can be used as a marketing strategy for your company, improving your image and, therefore, attracting investors and clientele interested in this sector, which will generate brand awareness in your industry and will even increase your sales.



2. TRAINCHAIN BLOCKCHAIN TRAINING FOR START UPS

2.1. Introduction

Regardless of the innovation, creativity and motivational mechanisms encapsulated by the **TrainChain** Training Programme, there are certain aspects that cannot be ignored to implement the project in this sector. Firstly, the SME audience is known for its high degree of disbelief in the benefits of VET training and therefore any VET training programme targeting SMEs faces a natural resistance that needs to be overcome before achieving the level of penetration which will make the training programme sustainable. Then, VET trainers need all-inclusive solutions which they can immediately integrate into their training service, efficiently and being in the position to take full advantage of its benefits for the SME audience.

It is interesting to note that the approach of creating an accompanying each module of the **TrainChain** programme with a dedicated delivery guide has been developed in this way so that the instructor can achieve maximum benefit by directly addressing the “quick wins” which will break the natural resistance of the SME audience.

By “quick wins” we refer to the actions which are relatively simple to implement and once adopted by an SME they will have an immediate positive impact on the balance sheet. Such actions will “wet” the appetite of an SME for implementing more actions and thus achieve “buy-in” for the **TrainChain** programme. That is why this document concerns the development of a trainer's guide which will directly address these issues of high importance to the success of the project. This guide is aimed to be used by the member of staff or person that is delivering the **TrainChain** educational modules.

2.2. Learning Objectives and Competencies

TrainChain Trainer's Guide aims to be a tool to improve the knowledge, experience, and skills in terms of Blockchain that are required for SMEs and start-up members so they can properly train their staff in the European context. Through this guide, it is expected that users acquire all relevant documentation, resources, and guidance to become capable trainers who will later instruct on the use of these methods.

All training resources included have the main objective to assist trainers in developing their training programs using the project outputs, as a method to promote the development of

relevant knowledge on Blockchain among their trainees, as well as increasing their willingness to use this technology in their own business.

The Trainer's Guide intends to incentive communication, leadership, creativity and innovation, resilience, and motivation by using not only paper-based descriptions but also visual and media content, as well as linked information to properly follow every step in this learning experience. Therefore, this training content will include modules that especially address these competencies and will constitute an effective and sustainable model that can be disseminated and implemented in European Union countries.

More concretely, the objectives and competencies of this training program are the following:

Learning Objectives

On completion of this training experience, participants should be able to:

- Take profit from the resources provided according to their profile at local level;
- Use the units for producing their personalized training adapted to their business;
- Adapt, apply, and promote best practices to their workplace;
- Understand the main concepts included in each module;
- Analyse the case studies and highlight the lessons learned;
- Deliver the module to their team confident and comfortably;
- Embrace Blockchain practices for the benefit of businesses;
- Identify the advantages and risks of Cryptocurrencies, Payment Gateways, Smart Contracts, and Blockchain technology in general;
- Grasp the Security Principles of cryptocurrencies and Blockchain;
- Use this technology by their own and implement it in their business.

Competencies

On completion of this training experience, participants should develop the following competencies:

- Capacity to motivate staff members to use Blockchain technology;

- Capacity to choose the appropriate Blockchain technologies, solutions, and methods for their business in order to make the business process more effective and innovative;
- Critical and creative thinking and adoption of a decision-making attitude in this innovative field;
- Ability to face challenges and solve problems that may arise with a problem-solving attitude;
- Capacity to adapt traditional methods to innovative ones.

2.3. Content Outline

The **TrainChain** Trainer's Guide is formed by 5 modules aimed at exploring some of the most common and fundamental knowledge regarding Blockchain for SMEs all over Europe. In the following points, it will be possible to take a deeper look at each of the skills needed explored through the materials.

➤ Module 1 – Cryptocurrencies / Payment Gateways

1. Module goals and learning objectives
2. General overview of Cryptocurrencies
3. History of Cryptocurrencies
4. Different types of Cryptocurrencies
5. How to invest safely in Cryptocurrencies
6. Types of Digital Wallets
7. Cryptocurrency Payment Gateways
8. How to buy, create and invest in Cryptocurrencies
9. Advantages and threats of using Cryptocurrencies.

➤ **Module 2 – NFTs**

1. Module goals and learning objectives
2. General view of NFTs
3. State of Art: Current situation and existing problems
4. Blockchain and NFTs
5. Benefits of NFTs for your business
6. NFT in practice
7. NFT: Use cases

➤ **Module 3 – Smart Contracts**

1. Module goals and leaning objectives
2. State of the Art: Current situation and existing problems
3. Blockchain and Smart Contracts
4. How Smart Contracts work
5. Smart Contracts in untrusted and semi-trusted environments
6. Problems that will be addressed
7. Real life implementations with details
8. Conclusions

➤ **Module 4 – Supply Change & Logistics**

1. Introduction
2. Module goals
3. Learning objectives and Competencies
4. Supply Chain introduction
5. Logistics introduction
6. Blockchain introduction

7. Emerging Trends in Blockchain
 8. Barriers to the deployment of Blockchain in Supply Chain
 9. Key Players
 10. How can blockchain be utilized in Supply Chain
 11. What opportunities does blockchain provide in Supply Chain and Logistics
 12. Real life implementations with details
- **Module 5 – Smart Contracts hands on programming tutorial**
1. Module goals and learning objectives
 2. Overview
 - The lifecycle of a smart contract
 - Basic programming components
 - The Solidity programming language and the REMIX Integrated Development Environment
 - The needs for fees and a digital wallet.
 3. Environment setup REMIX IDE
 4. Writing our first Smart Contract
 5. Metamask Configuration
 6. Connect Remix to the RISK TESNET
 7. RSK Explorer
 8. Interact with your Smart Contract
 9. Wrap up

3. TRAINCHAIN BLOCKCHAIN TRAINING CONTENT

3.0 Module 0 – Introduction to Blockchain Technology

3.0.1 Module goals and objectives

This module's goal is to introduce the world of blockchain to readers, to understand the basic principles and know basic types and uses. It will give a broad view of the technology by providing a high-level description and categorization of it, to help readers prepare for the following modules that cover in more detail, specific areas of interest. After finishing the module, the learner should be able to understand the nature of this technology, the underlying structure and basic differentiators from the earlier paradigms and the benefits they bring along. The learner would be ready then to seek further knowledge in specific areas that can affect positively her/his professional life either as a member of a team or as an entrepreneur.

Methodology suggestion / proposed activity: Use presentation slides to explain key concepts. Encourage questions and discussion throughout the lesson. Provide real-world examples to illustrate applications of blockchain technology. Use a whiteboard or flip chart to emphasize and summarize key points.

Assessment: Ask participants to identify a potential use case for blockchain technology in their own business or industry. Facilitate a group discussion on the pros and cons of using blockchain technology in different scenarios.

3.0.2 Session 1

Objective: To provide an overview of blockchain technology and its applications to our target group (startuppers, SME owners, young workers etc) helping them understand the potential benefits, types, and structure of blockchains.

Duration: 90 minutes

Materials: Computer and projector, presentation slides, whiteboard, markers, handouts

Agenda:

Introduction (5 minutes)

Welcome participants and provide a brief overview of the lesson plan.

Explain the importance of understanding blockchain technology for startups and SME owners.

History and Evolution of Blockchain (10 minutes)

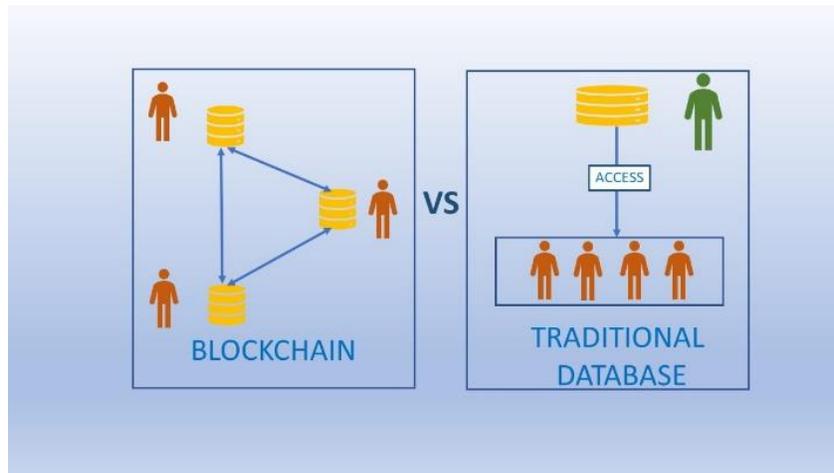
Explain the origins of blockchain as a computer science term.

Discuss the evolution of blockchain and its recognition as the fifth evolution in computing.

Blockchain vs. Traditional Databases (10 minutes)

Compare and contrast blockchain and traditional databases.

Explain the benefits of decentralization in blockchain technology.



Blockchain Applications (15 minutes)

Describe the initial use of blockchain for Bitcoin and its expansion to other industries.

Discuss potential applications in finance, supply chain management, voting systems, and more.

Types of Blockchains (15 minutes)

Present the main types of blockchains: public, private, consortium, hybrid, sidechain, and federated/permissioned.

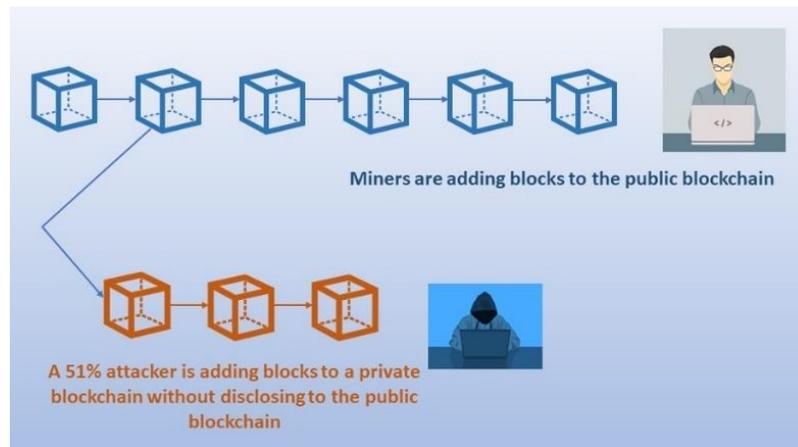
Discuss the advantages and disadvantages of each type and provide examples.

Common Characteristics of Blockchains (10 minutes)

Explain the common characteristics shared by all types of blockchains, such as decentralization, immutability, cryptography, consensus mechanisms, smart contracts, and more.

The 51% Attack (5 minutes)

Describe the concept of the 51% attack and its implications for blockchain security.



How Blockchains Operate (10 minutes)

Explain the decentralized nature of blockchains and the role of nodes in maintaining the network.

Discuss the use of cryptocurrencies as incentives for network participants.

Why Blockchains Matter (5 minutes)

Summarize the significance of blockchain technology for startups and SME owners.

Highlight the potential impact on various industries and the global economy.

Structure of Blockchains (10 minutes)

Explain the structure of blockchains using Bitcoin as an example.

Discuss the concepts of blocks, chains, and networks in the context of blockchain technology.

Conclusion (5 minutes)

Recap the main points covered in the lesson.

Methodology: Encourage participants to explore further and consider how blockchain technology could benefit their businesses. Open the floor for questions and discussion.

Assessment: Participants will engage in group discussions throughout the lesson, reflecting on the potential applications of blockchain technology in their respective industries. At the end of the lesson, participants will complete a short quiz to assess their understanding of the presented concepts.

3.0.2 Session II

To provide an overview of blockchain technology, its evolution, and

Duration: 1.5 hours

Materials: Computer and projector, presentation slides, whiteboard, markers, handouts

Outline:

Introduction to Blockchain (10 minutes)

Definition and basic concepts

Importance of blockchain technology

History and Evolution of Blockchain (15 minutes)

Creation of Bitcoin and its original use

Ethereum and smart contracts

Ongoing developments and future trends

Consensus Mechanisms (20 minutes)

Definition and importance of consensus algorithms

Different types of consensus mechanisms (e.g., proof of work, proof of stake)

Balancing performance, scalability, consistency, and security

Current Blockchain Applications (25 minutes)

Money transfer and value exchange

Security measures in software systems (e.g., IoT devices)

Initial Coin Offerings (ICOs) and their advantages

Self-clearing and self-settling tokens

Future Blockchain Applications (20 minutes)

Government-backed land record systems

Identity management and international travel security

Potential social and economic implications

Conclusion (5 minutes)

Recap of key concepts

Q&A session

3.1. Module 1 – Cryptocurrencies / Payment Gateways

3.1.1. Module goals and learning objectives

This first educational module has been developed with the objective of providing general overview on cryptocurrencies, information about their origin and current situation; discussing the different types of cryptocurrencies, their advantages, and disadvantages; getting to know digital wallets and payment gateways, how to use and invest on them; and translating all this knowledge into real-life examples so it does not seem to be something abstract or ambiguous.

Trainers of this module should be able to make users aware of the enormous advantages of technology and inspire them to learn more about it, so they can implement solutions in their own organizations both ethically and lawfully. In order to achieve so, at the beginning of the Training Programme, trainers will stress the importance of integrating this module's content into their business and life, as well as being able to assess the existing opportunities of such technology.

3.1.2. General overview of Cryptocurrencies

Methodology suggestion / proposed activity: Before introducing any information about Blockchain or Cryptocurrencies, you could begin by asking the audience about their knowledge of Blockchain, their opinion, and experience, and if they think it is useful for their life or/and jobs. Starting with this brainstorming, engaging with the audience, will make the learning experience more interactive and collaborative, which is proved to be more successful than just providing the information in a unilateral way.

Once this brainstorming has been shared, you will explain that Cryptocurrency is a form of digital cash that allows people to transfer value in a digital environment, stressing that it is a new paradigm for money, revolutionizing the payment system across the globe, and commenting on the advantages that these methods offer for your business (stressing the security element), specifying on your own business sector and organization, so they can relate to the topic and acknowledge the importance of this whole training and learning experience.

3.1.3. History of Cryptocurrencies

Learning about the history of Cryptocurrencies constitutes an essential part of this training since it is fundamental to understanding the potential of cryptocurrencies to change the economy, as can already be observed today. However, addressing this topic could become

difficult, since it may seem too theoretical or even little practical. Therefore, when covering this topic, it could be useful to display a video instead of explaining the history yourself.

Here you can access the proposed video to be displayed during this module's section session:
https://www.youtube.com/watch?v=OiDCXdmEe6U&ab_channel=MarkGrabowski.



History of Cryptocurrency

If you feel like some information is missing in this video, or there are any points you want to clarify, don't hesitate to support this information with the 1st Educational Module content, 2.2. History of cryptocurrencies, which analyses how cryptocurrencies have gradually gained the attention of the general public.

Tip: Since playing videos during a lecture don't allow the audience to participate, you can ask the audience to raise their hand while the video is on display if they have any question or want to make any comment. In this case, you will pause the video and let them participate to clarify any doubt that arises.

3.1.4. Different types of Cryptocurrencies

Methodology suggestion / proposed activity: divide your audience into 5 groups, so each group oversees / is in charge of a different type of cryptocurrency that you will assign to them (Bitcoin, Ethereum, Litecoin and Cardano). Each group should do some research about the specific type of currency, its uses, advantages, and disadvantages, and at least 1 practical example of this currency that has been used lately. You will set a specific time for this activity (for instance, 20 minutes), and once the time has finished, each group will present what they have found out and the rest of the groups will listen to them. This learning method that engages with the audience and includes them in the teaching experience is very useful to achieve participation during the learning process.

While each group is presenting the information, they have found about these 5 different types of cryptocurrencies, you will review the content of the Educational Module 1: 2.3. Different types of currencies, to make sure there is no information left to cover, and if there is something important to explain, you will complement every group's information necessary with the module's content.

3.1.5. How to invest safely in Cryptocurrencies

In this section, it is important to have in mind that since cryptocurrencies are not regulated by any government or central entity, their supply is fully controlled by the market and no authority can issue interfere with the price, for instance, by issuing more coins. Considering this, trainers need to understand the importance of properly following the steps and tips explained below when starting to invest in cryptocurrencies:

- 1) Selection of a broker.
- 2) Establishment of investment budget.
- 3) Selection of the best cryptocurrency.
- 4) Making of the purchase of tokens.
- 5) Storage of the token in a wallet.

Trainers of this training programme must assess in advance if this investment will be carried out by trainees, so they have to deeply cover this topic in profundity, these 5 steps, or it is just something that trainees should be informed about, but they will not carry it out this task individually for business purposes. If this last one is the case, the trainer will only overview the steps so trainees can understand the complexity of this task, and the many details that need to be considered when doing so.

Tips: There are several myths when it comes to investing safely in cryptocurrencies. There is the mistaken idea that cryptocurrency investment will make you rich fast and with no effort, or that it is a scam and there is no possibility to make any benefit out of it. These two opposite ideas are far from reality, so it is highly recommended to follow some tips to safely invest in cryptocurrencies:

- Be realistic with your budget and invest in a quantity that you can afford.
- Don't invest in cryptocurrency offerings if you don't find their programming terms convincing.
- Use reliable applications: mainly a good online wallet or, if you prefer offline, a USB stick.
- It is not recommended that you borrow money from trading sites.
- Study cryptocurrency trading flow charts.
- Copy the moves of experienced and important investors.

When covering this section throughout the learning experience, keep in mind these tips in your explanation. You can also use the case of the bitcoin as an example that you will find in the 1st Educational Module, [2.4. How to invest safely in cryptocurrencies?](#)

3.1.6. Types of Digital Wallets

As the majority of concepts regarding Blockchain, digital wallets may seem something too and even hard to explain, as it is not tangible, and may be confusing to understand. Therefore, it is recommended that its explanation is clarified with examples or comparing them with something well-known by the audience. In this case, the comparison statement given by Santander Bank can be very useful in this section:

*Unlike a physical money wallet, what is stored in e-wallets are the **keys** that give us ownership and rights to the cryptocurrencies and allow us to operate with them. Therefore, the loss or theft of the keys can mean the loss of the cryptocurrencies without the possibility of recovering them – **SANTANDER BANK***

It will be very useful for trainers to come back to the example of the “pocket wallet” when they have to explain or clarify other close-related concepts such as electronic transactions and the significance of digital wallets. Regarding this last topic, once the audience has properly understood what Digital Wallets are, make sure they are able to identify that:

- They allow users to transfer funds to people in different nations;
- They securely store all payment information in a compact form;
- They reduce the need to carry physical wallets;
- They get to know the purchasing habits of consumers to increase the effectiveness of the marketing methods;
- They eliminate the need for physical banks and companies to open and maintain a bank account;
- They are required to make transactions and maintain balances of cryptocurrencies.

Tip: In this section, it is fundamental to stress the benefits of digital wallets. Some of these benefits that need to be pointed out are that you can accept payments from anywhere in the world, in any cryptocurrency your provider accepts; the fact that you don't have to worry about or try to understand the cryptocurrency; and the fact that this method reduces the risk of volatility, the risk of losing value while waiting for the cryptocurrency network to verify a transaction, by paying your market rate for tokens at the time of the transaction.

Having discussed the great significance and the benefits of digital wallets, it is also important to cover the difference between Hot and Cold E-Wallets, being the primary difference that a hot wallet will be directly connected to the Internet during its use, while a cold wallet will not.

In this regard, trainers should be able to, in advance, identify what category of E-Wallet will better adapt for their business sector, considering that cold wallets are usually more recommended to store large amounts of cryptocurrency since they offer more security by reducing the attack surface for the hacker. On the other hand, if hot wallets are more convenient for your business, consider exploring their possibilities to explain to your audience the reasons for your choice, and focus on the type of wallet of your choice in your explanation.

The next step to take in this training section is covering the steps to take to open a Cryptocurrency Wallet, so cryptocurrency can be used and stored on the “blockchain”. Trainers should explain that there are many websites and apps to create e-wallets, but that the procedure is the same for all of them, so this explanation can be perfectly applied to any type of Cryptocurrency Wallet.



Tip: In order to make sure your audience is following at all times you during your presentation on the four steps to take when opening a cryptocurrency wallet, it will be interesting to present the graphic image above this tip, so that employees can refer to the image during your explanation and do not get lost with the steps. If you don’t have access to any device to display the image during this session, you can draw a sketch of it in a blackboard, a flipchart board, or a large cardboard where you can write and present it to the audience.

Finally, from the Best Bitcoin Wallets for 2022 list, you can find in the 1st Educational Model, [2.5. How many types of digital wallets exists?](#) you can choose one example of a Bitcoin

Wallet that can work for your business (if you are not already using one) and present it to your employees so they can know how to use it and the specific actions to take to improve your business activity.

3.1.7. Cryptocurrency Payment Gateways

In order to properly present to the audience the content of this section, trainers must make sure they understand and can correctly explain to their employees some key concepts that will appear during the training session:

- *Cryptocurrency Payment Gateways*: a payment processor for digital currencies, similar to payment processors, payment gateways and bank credit card purchases. Cryptocurrency gateways allow you to accept digital payments and receive fiat money in return.
- *Payment gateways*: companies that take on the perceived risk of cryptocurrency payments by using their wallet(s) to facilitate transactions between merchants and their customers.
- *Payment flow*: it refers to the workflow and how it is executed. In terms of steps, your customer chooses to make the cryptocurrency payment at checkout (in-store, on the web, or in the app), you are paid an amount equal to the fair market value of the digital currency at the time of the transaction, the cryptocurrency payment service instantly converts your payment into the currency of your choice and the money is added to your account at the provider; it is deposited into your designated bank account at intervals set out in your service contract.

Once these concepts are clear and some notions on them are provided to the audience, trainers should find the benefits that payment gateways could bring to their business, covering a list of them and presenting them to their employees, relating each of them to their specific sector or industry of interest. Some examples of benefits that trainers can use to connect to their own businesses are the following:

1. Payment gateway removes the anonymity of the person you are dealing with, maintaining the customer's preference for it.

2. You must contact someone if there are any problems with the payment.
3. You can accept payments from anywhere in the world, in any cryptocurrency your provider accepts.
4. You receive the funds in your supplier's account, which transfers them to you.
5. You don't have to worry about or try to understand cryptocurrency.
6. Reduce the risk of volatility, the risk of losing value while waiting for the cryptocurrency network to verify a transaction, by paying your market rate for tokens at the time of the transaction.

On the other hand, in order to transmit the audience the potential risks that payment gateways may entail, trainers should also cover the list of disadvantages that may result to their business if any of the aforementioned steps are missed or poorly executed. In the same manner, here's a list of disadvantages that trainers can use as examples, that they should in advance connect to their own case, to present to their employees:

1. A payment gateway is a third party, which cryptocurrencies were originally designed to bypass.
2. You must rely on your provider's ability to maintain uninterrupted service, as you can receive payments from all over the world and in different time zones.
3. Gateways are companies that provide a service, so they will promote themselves in a way that makes it appear that you need their services when, realistically, you do not.
4. You pay small transaction fees when you use your wallet with cryptocurrencies; you pay more when you use a payment gateway for cryptocurrencies.
5. If the payment gateway is hacked, you will lose all the funds you have in your account with the provider while waiting for them to transfer.

Proposed activity: divide your audience into 4 groups, so each group oversees/is in charge of a different type of payment gateway that you will assign to them (PayRetailers, Coingate, Bitpay,

GoCoin). Each group should do some research about some payment gateways, its uses, advantages, and disadvantages. You will set a specific time for this activity (for instance, 20 minutes), and once the time has finished, each group will present what they have found out and the rest of the groups will listen to them. This learning method that engages with the audience and includes them in the teaching experience is very useful to achieve participation during the learning process.

The trainer's preparation required for properly providing the content of this section during the training session is to review the content on the Educational Module 1: 2.6. What is a Cryptocurrency Payment Gateway? so when each group is presenting the information, they have found about these 4 different types of payment gateways, you will make sure there is no information left to cover, and if there is something important to explain, you will complement every group's information necessary with the module's content.

3.1.8. How to buy, create and invest in Cryptocurrencies

Proposed introduction for this section: The starting point for this training session section can be accessing some of the training resources at the end of this Trainer's Guide (the first two resources are highly recommended), to introduce as well as complement the training. Through the display of these resources, trainees can discuss their observations and comments with the trainer, who can further detail a specific topic or provide guidance in terms of upcoming statements. Combining the training resources with the module's information is a powerful learning investment.

Regarding the creation of cryptocurrencies, it should be noted that anyone with or without knowledge of cryptocurrencies can create their own cryptocurrency and launch it to the market, openly exposing the values and goals she suggests. In this regard, there are three options for trainers to choose from: do it through a web platform, create a token that works on another blockchain already established, or create a coin from scratch or based on an already created one. To any of these options, the distribution of the coin created must enter an exchange app.

To better illustrate their explanations, trainers may also want to refer to the 1st Educational Module: 2.7. How to buy, create and invest in cryptocurrencies, to the Burger King case study, which explains how the fast-food chain has created its own token on the Waves blockchain for the Whooper Burger. This popular case study may be helpful for trainees to easily

relate the topic to a real-life example, so they can understand the logic of buying, creating, and investing in cryptocurrencies in the simplest and most common of ways.

3.1.9. Advantages and threats of using Cryptocurrencies

As has already been covered in this module, there are many important advantages to Blockchain and investing in cryptocurrency. However, there are several threats that should be carefully discussed and considered, since the risks can become dangerous for the financial stability of your business.

Since many advantages and disadvantages have been explained before in the different sections, it would be beneficial for this training experience to engage with your employees in this section and involve them in the presentation of this topic, so they can provide their comments and have their voices heard, as well as it will permit trainers to assess the knowledge and understanding of their audience in this matter.

Methodology suggestion: Use a blackboard, a flipchart board, or a large cardboard where you can write in front of your audience and divide the writing space into two columns: one for advantages and the other for disadvantages. Provide your audience with post-it and writing tools such as pencils, pens, or markers. Then, kindly ask your employees to write in their post-its the advantages and disadvantages of using cryptocurrencies, and one by one they should come to the board to stick them in the right column. They should explain their contribution to the rest of the audience, who will assess and comment on it.



Source: Freepik

Some of the conclusions that should have been achieved (and if they haven’t, should be added by the trainer after employee’s contributions) are the following:

ADVANTAGES	DISADVANTAGES
It brings security to payments	Collapse in the value of money
Easier foreign payments and lower commissions	Scams
Generate brand awareness	Volatility

Proposed final activity: Finally, to conclude the training of this module, you can resort to the Knowledge Assessment section of the 1st Educational Module. This is composed of 9 multiple-choice questions for employees where trainers can assess if the learning objectives have been achieved and if the audience has properly understood what this module has covered so far.

Each Educational Module contains a wide set of references for further knowledge as well as a list of exercises that can be used and adapted by trainers in their own sessions.

3.2. Module 2 – NFTs

3.2.1. Module goals and learning objectives

This second educational module has been developed with the objective of providing general overview on NFTs, information about their origin and current situation; discussing the different types of NFTs, their advantages, and disadvantages; getting to know how to create them, how to sell and/or invest on them; and translating all this knowledge into real-life examples so it does not seem to be something abstract or ambiguous.

Trainers of this module should be able to make users aware of the enormous advantages of NFTs and inspire them to learn more about it, so they can implement solutions in their own organizations both ethically and lawfully. In order to achieve so, at the beginning of the Training Programme, trainers will stress the importance of integrating this module's content into their business and life, as well as being able to assess the existing opportunities of such technology.

3.2.2. General view of NFTs

Methodology suggestion / proposed activity: Before introducing any information about NFTs, you could begin by asking the audience about their knowledge, their opinion, and experience, and if they think it is useful for their life or/and jobs. Starting with this brainstorming, engaging with the audience, will make the learning experience more interactive and collaborative, which is proved to be more successful than just providing the information in a unilateral way.

Once this brainstorming has been shared, you will explain that NFT (non-fungible tokens) is a digital asset that represents real-world objects like art, music, in-game items and videos, and comment on the advantages that these tokens offer for your business (stressing the security element), specifying on your own business sector and organization, so they can relate to the topic and acknowledge the importance of this whole training and learning experience. To make the topic more relatable you can list the 10 best examples for NFTs via this link: <https://bernardmarr.com/the-10-best-examples-of-nfts/>

It is also key to refresh the previously known terms related to NFTs (Blockchain, Blockchain Address, Smart Contracts and Cryptocurrency wallet) to make sure all students can understand the upcoming topics.

To make the NFT process visual, it is worth watching this 5-minute video about the basics:



<https://www.youtube.com/watch?v=NNQLJcJEzv0>

Tip: Since playing videos during a lecture don't allow the audience to participate, you can ask the audience to raise their hand while the video is on display if they have any question or want to make any comment. In this case, you will pause the video and let them participate to clarify any doubt that arises.

3.2.3. State of Art: Current situation and existing problems

Many have debated the merits of the digital collectibles. Enthusiasts have said they're the key to unlocking the next phase of the internet, often called the metaverse or Web3. Naysayers say there's little to no value in the digital tokens.

You can discover the current market trends and shares of NFT's via this website:
<https://www.statista.com/outlook/dmo/fintech/digital-assets/nft/worldwide>

Methodology suggestion / proposed activity: You can divide your group into two: the believers and the non-believers of NFTs. They will get limited amount of time to do a quick desktop research on the future of NFTs and confirm their theories whether NFT is going to be a new trendsetter, or it is just a trend to be ceased soon. After the research has been done, make two groups share their findings and opinion with each other.

The second part of the material is about getting to know more about the challenges and opportunities of the NFTs.

Methodology suggestion / proposed activity: Before reading the actual text, it is important to have a short brainstorming session about the opportunities and challenges of NFTs.

Methodology suggestion / proposed activity: After discussing the results and checking out the material, your students can further think together and come up with different views and ideas on the following topics:

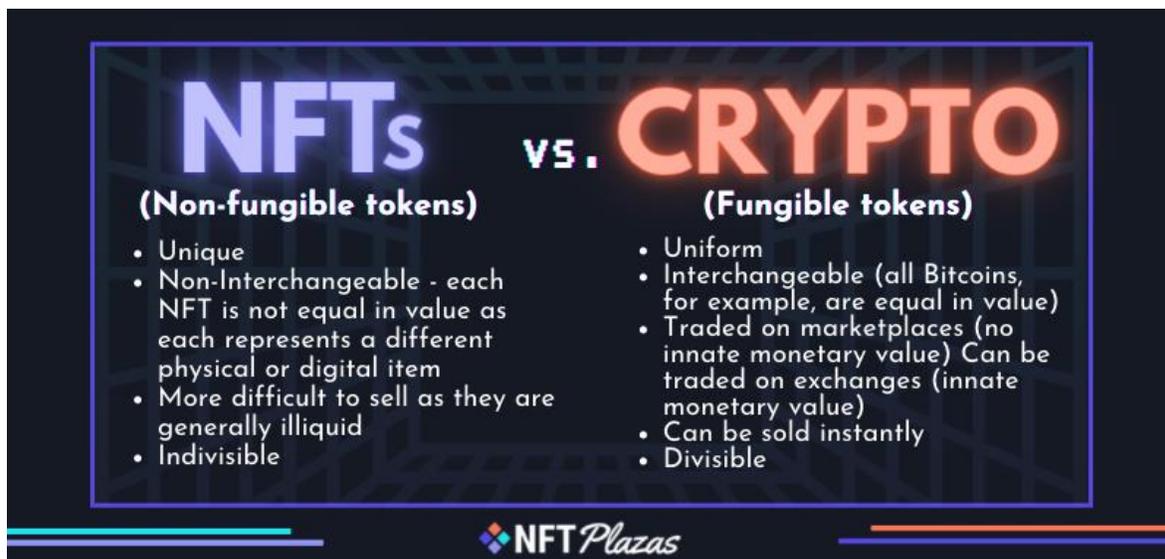
- Environmental impact – **Does NFTs have carbon footprint? And if so, how can it be reduced?**
- Gaming and Augmented Reality – **What does NFT has to do with gaming and AR?**
- Curation and education – **Can NFTs contribute to education? And if so, how?**
- Ownership – **When you own a NFT, what is that you really own?**
- Centralization in a Decentralized Ecosystem – **Is centralized market for NFTs are good or not? Find pros and cons!**
- Security challenges – **Can someone steal my NFT?**
- Scams and Copyright issues – **How do you know if an NFT is fake? What about the copyrights?**
- Tech Issues – **Would it be better to just visit a gallery of a local artist? Discuss it with pros and cons!**

3.2.4. Blockchain and NFTs

Blockchain and NFTs are on opposite sides of the spectrum. At one end of the spectrum of digital assets are cryptocurrencies like bitcoin used in payment networks such as the Bitcoin blockchain. Bitcoins are fungible: that is, one bitcoin is equal in value and function to every other bitcoin. Therefore, if you have a contract involving bitcoin, you could replace one bitcoin with

another. At the other end of the spectrum are NFTs: each token represents a thing of singular value. In a contract, you couldn’t replace an Andrew Wyeth painting with Mike Winkelmann art and expect no one to notice. NFTs span a range of unique assets—not just collectibles but birth and death certificates, deeds to property, and the identities of objects on the Internet of Things.

Methodology suggestion / proposed activity: The trainees should try to assess in working groups what do they know about Blockchain and NFTs and what does one have to do with the other one? The goal is to make sure they know what the difference is between these two. Use a blackboard, a flipchart board, or large cardboard where you can write in front of your audience and divide the writing space into two columns: one for advantages and the other for disadvantages. Provide your audience with post-it and writing tools such as pencils, pens, or markers. Then, kindly ask students to write the characteristics of NFTs or crypto. The activity ends when there is no more line to add.



Source: nftplazas.com

3.2.5. Benefits of NFTs for your business

Methodology suggestion / proposed activity: Before jumping right into the topic, let’s discover the reasons why most of the companies don’t sell NFTs? If it is in fashion now, than why is not that common? Find reasons together.

Wrapping up the discussion: Right now, the biggest problem with NFTs is that they're not compatible with the current financial system. If consumers want to buy an NFT, they most likely have to use a cryptocurrency. This means that many businesses are going to have to start adjusting their financial processes before they can sell their NFTs for cash. However, this is only temporary. In time, as it is expected there will be more and more companies that accept a variety of payment options. This also means that NFTs could be useful in developing countries where people don't trust traditional banks or financial institutions.

But to cover the following section in the core content (Benefits of NFTs) for the sake of situation, let's imagine there is not really a boundary to buying/selling NFTs. After completing this section students should put their knowledge into practice.

Methodology suggestion / proposed activity: Play a short contest about the benefits. 2-3 of the students should imagine that tomorrow they have a short meeting with the executive board of their company and they have 3 minutes to convince them why selling NFT can lead their business into success. What would be the main reasoning? What do you think what is the most important for executives and/or investors in NFTs?

For building up this 5-minute “pitch”, use the following points from the core content, but student also should tailor their speech according to type of business they work for. They can use a whiteboard, PowerPoint Presentations, or whatever comes in handy to them. Also, they shouldn't forget to include best practices – to be more convincing. (Best practices can be searched on the internet).

- Drive attention to your brand
- Bring transparency to your product lifecycle
- Gain additional revenue
- Secure data and transactions
- Attract investments
- Building a strong community
- Raising funds

While one is making the pitch, the others pretend to be a member of the executive board. After the time is up, the observing members tell their opinion whether they were convinced or not. They can rate from 1-5 and the one who has the highest average is obviously the winner.

If it all sounds good to the students, they may launch their first NFT project. But also, there is a list what they should consider before jumping right in. Once they come up with an NFT business ideas, it's essential to research all possible pitfalls. The use of NFTs is still in its infancy in many industries. Therefore, be aware of possible challenges and the peculiarities of developing solutions that use non-fungible tokens. In particular, as a blockchain-based technology, NFTs inherit some security and scalability concerns.

Methodology suggestion / proposed activity: finishing up the “considerations before starting an NFT project” part of the educational content, every student should list concerns and challenges that may come up when starting the NFT business. The students after should work in 3 different working groups and have cca. 20 minutes to investigate the following topics then discuss their finding with all classmates.

Legal and copyright issues: What does your country's regulation on this topic? Are there any best practices?

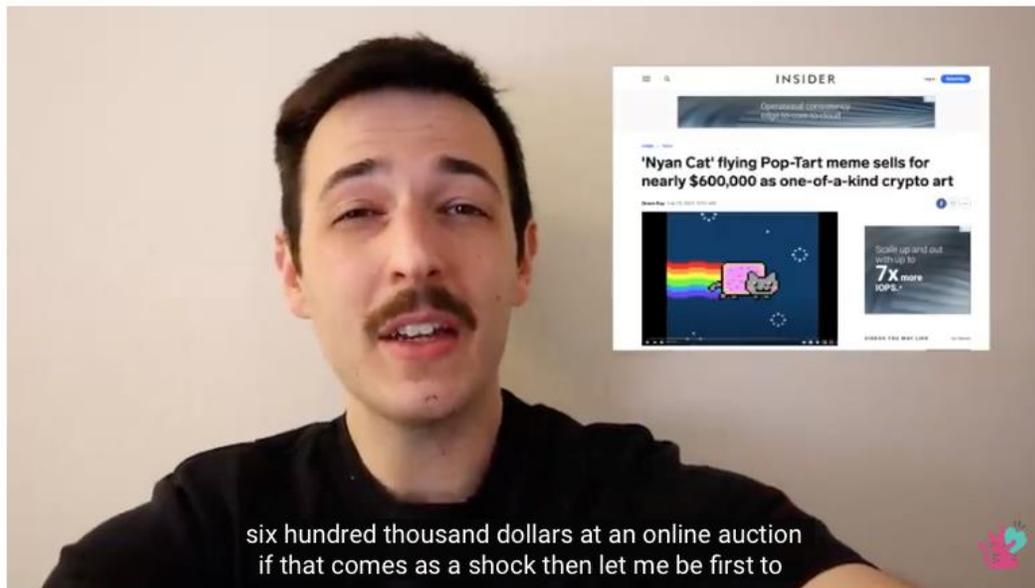
Blockchain platforms – What platform would you choose and why? How do you register to that platform, and how is its user experience?

Security – How would you protect your NFTs? What are the best practices? What are the financial means for this type of protection?

3.2.6. NFT in practice

Methodology suggestion / proposed activity: the core content includes all necessary steps and information about selling and buying an NFT, so it is pretty straightforward. If the students are up to it, they can start the registration process or better, if any of them has already an account he/she can show it to the others if they will.

For the whole process, the trainees can check out this video:



<https://www.youtube.com/watch?v=Gjo1hlley9g>

After checking out a marketplace, every student should make a list of up to 3 inspiration NFTs that can also work for their business as well. All student should introduce one NFT and introduce the reason for the other why that NFT can be a beneficial to their company?

3.2.7. NFT: Use cases

This chapter also builds on practical knowledge, as it lists use cases of NFTs, so additional activities are optional.

Methodology suggestion / proposed activity: Students in working pairs should conduct a research on their digital means: beyond these use cases, they should be looking up the following topics as well:

- What other industries (apart from the one that the material mentioned) can benefit from NFTs?
- Until the end of 2022 list some of the most expensive NFTs in the world! What are the common characteristics of these NFTs?
- Who is the most trending NFT seller from your country? Check and find out!

After finishing the research, the trainer asks the questions to all working pairs and make notes of the answers.

Proposed final activity: Finally, to conclude the training of this module, you can resort to the Knowledge Assessment section of the 2nd Educational Module. This is composed of 5 multiple-choice questions for employees where trainers can assess if the learning objectives have been achieved and if the audience has properly understood what this module has covered so far.

Each Educational Module contains a wide set of references for further knowledge as well as a list of exercises that can be used and adapted by trainers in their own sessions.

3.3. Module 3 – Smart Contracts

3.3.1 Module goals and leaning objectives

This module's purpose is to provide a comprehensive overview of what smart contracts are, how they work, and their many applications. In particular, this module will explain how smart contracts serve as a way to facilitate transactions on the blockchain and will provide real-life examples of how smart contracts are used to achieve maximum results in various circumstances. Additionally, this module will explore common use cases for smart contracts, discuss the potential benefits and drawbacks of using them, and provide suggestions for best practices when implementing them. Finally, this module will provide resources for further exploring smart contract technology.

Methodology suggestion / proposed activity: Request trainees to share their understanding when they hear about smart contracts. Use questions such as: what do you believe they are? What purposes do you think they can serve? Where have you heard them before and if so in what context? Write on a white board their answers.

Then, break the group into smaller discussion circles and ask them to discuss the answers given and provide more in-depth examples of the potential applications of smart contracts. Once the discussion circles have finished, bring the group back together and ask them to present their findings and conclusions from their discussions. Write down the most important points on the whiteboard or flip chart.

Assessment: After letting everyone to share their thoughts use their answers to create the terminology of smart contracts which will be a milestone to proceed to the 1st session. Then, assess the understanding of the group by asking questions about the terminology created during the discussion circles and the conclusions from the presentations. This will help determine the level of understanding and provide feedback on the effectiveness of the activity.

Duration: 30 min

3.3.2 State of the Art: Current situation and existing Problems

After the terminology of smart contracts has been explained and has been understood by everyone during the previous activity the induction of the trainees to the learning content can start.

It is crucial for the participants to have a comprehensive understanding of the importance of data transparency, the problems associated with limited transparency, and how blockchain technology can mitigate these issues.

Methodology suggestion / proposed activity: Rock Paper Scissors Blockchain is a game that can be used to illustrate the importance of transparency within a blockchain. In this game, players take turns selecting either rock, paper, or scissors. However, the crucial aspect is that at the end of each round, players must reveal their choices to prove that they were truthful. Failure to reveal their choice will result in losing the game.

The purpose of this game is to help trainees understand the concept of immutability within a blockchain. Any attempts to dishonestly edit or delete a choice will be immediately apparent, as players need to reveal their choices openly. This demonstration highlights the fundamental principle of blockchain, which ensures that transactions and data cannot be altered or tampered with without detection.

Furthermore, Rock Paper Scissors Blockchain also emphasizes the importance of trust within a blockchain system. Players must trust that other participants are being honest about their choices in order for the game to be fair. By building this trust, the game emphasizes the role of transparency in maintaining integrity and fairness within a blockchain.

To further enhance the activity and reinforce the concepts learned, trainers can introduce a modified version of the game that incorporates smart contracts. After completing the initial rounds, trainers can "add" smart contracts to the game to ensure fair play and game security.

In this modified version, players would submit their choices to a smart contract, which would lock in their selections and make them immutable. The smart contract would then automatically detect which player won the round and award the victory accordingly. By utilizing smart contracts, the game ensures that all players are playing fairly, as no one can change their choice after it has been submitted. Moreover, the smart contract can securely store all the game data, making it transparent and accessible to all players, thus demonstrating the benefits of transparency within a blockchain system.

Assessment: After the completion of the game, a group discussion to assess the trainees' understanding of the concepts presented will be conducted.

4. Open-ended questions could be asked to gauge their comprehension. Some sample questions include:
 - How does the game illustrate the importance of transparency within a blockchain?
 - What are the benefits of using a smart contract in the modified version of the game?

- How does the smart contract ensure fairness and security in the game?
- Can you explain how the concept of immutability is demonstrated in the modified game?
- What are the advantages of having transparent and accessible game data for all players?

Tips: Encourage the trainees to share their insights and observations from playing the game and discuss any challenges they encountered.

Provide clarification and additional explanations as necessary to address any misconceptions or gaps in understanding.

Summarize the key learnings from the game and the discussion, reinforcing the importance of transparency and trust within a blockchain system.

Conclude the assessment by allowing trainees to ask any remaining questions related to the game or blockchain concepts.

Duration: 20 min

3.3.3 Blockchain and Smart Contracts

When explaining the relation between smart contracts and the blockchain, it is important to follow the flow of the course as presented. After providing a historical representation, the value of smart contracts in the blockchain should be emphasized. The main points to cover are as follows:

- Blockchain technology can be utilized in various ways, and one such application is through the use of smart contracts.
- Smart contracts are digital protocols that enable users to securely and efficiently work with high-value digital assets.

- By eliminating the need for intermediary parties, smart contracts save both time and money.
- The use of smart contracts ensures that all parties involved can immediately ascertain the outcome, providing certainty.
- These contracts automate workflows by triggering the next step once specified conditions are met.
- There are various advantages to using blockchain-based smart contracts, including enhanced security, reliability, efficiency, and cost savings.

3.3.4 How Smart Contracts Work

The aim of this phase of the content is to provide a more in-depth explanation of smart contracts. Trainees will delve into the logic behind creating smart contracts and gain an understanding of how they are written within the blockchain.

To facilitate comprehension, an example of a smart contract code is introduced: "if { ; } else { ; }". This code can be explained as a conditional statement, commonly known as "if/when...then...". This example serves as a foundation for trainees to practice and fully comprehend the underlying concept of the code.

By breaking down the code and exploring its components, trainees can grasp the logic behind smart contracts. The "if" part represents a condition or trigger that must be met, while the statements within the curly brackets "{" outline the actions or instructions to be executed if the condition is fulfilled. Conversely, the "else" part signifies an alternative set of actions or instructions that will be executed if the condition is not met.

Through this example, trainees can begin to see how smart contracts utilize conditional statements to automate processes within the blockchain. They will gain a deeper understanding

of how smart contracts can enable the execution of predefined actions based on specific conditions, bringing efficiency, reliability, and transparency to various business operations.

Throughout this phase, trainees will have the opportunity to practice and engage with similar smart contract codes, further solidifying their understanding of how these contracts are written and their practical applications within the blockchain ecosystem.

Methodology suggestion / proposed activity: Smart Contract Logic Exploration

Objective: To help trainees understand the logic behind smart contracts and how they are written within the blockchain by practicing with conditional statements.

Instructions:

5. Divide trainees into small groups of 3-4 members.
6. Explain to the groups that they will be engaging in an activity to explore the logic behind smart contracts using conditional statements.
7. Provide each group with a set of hypothetical scenarios that can be represented using smart contract logic. For example:
 - Scenario 1: If a customer purchases a certain product, then deduct the corresponding amount from their account balance; otherwise, display an error message.
 - Scenario 2: If a student achieves a passing grade in all subjects, then grant them access to the next level; otherwise, notify them of the need for improvement.
 - Scenario 3: If a user submits a valid ID and meets the eligibility criteria, then approve their application; otherwise, reject it.
8. Instruct each group to discuss and write the corresponding smart contract logic for each scenario using the "if { ; } else { ; }" structure. Encourage them to think about the conditions, actions, and alternative actions in each scenario.
9. Allow sufficient time for the groups to work on their smart contract logic, providing assistance and guidance as needed.

10. Once the groups have completed their smart contract logic, reconvene and allow each group to present their scenarios and explain their written logic.
11. Facilitate a discussion among all trainees by asking questions such as:
 - How did you approach the task of writing smart contract logic for each scenario?
 - What conditions did you consider in your smart contract logic?
 - Did you include any alternative actions in the "else" part of the code? Why or why not?
 - How do you see the practical application of these smart contract logics in real-world scenarios?
12. Encourage trainees to engage in dialogue, share their insights, and ask questions to deepen their understanding of smart contract logic.
13. Conclude the activity by summarizing the key learnings and highlighting the importance of understanding the logic behind smart contracts for effective blockchain implementation.

Assessment: This activity allows trainees to actively engage with the concept of smart contract logic. By working on hypothetical scenarios and writing corresponding smart contract logic, trainees gain hands-on experience and a practical understanding of how conditional statements are used in smart contracts within the blockchain. It encourages collaboration, critical thinking, and application of knowledge in a real-world context.

Duration: 20 min

3.3.5 Smart Contracts in untrusted and semi-trusted environments

As previously mentioned, smart contracts are designed to secure transactions between parties who may not trust each other. However, it is crucial for participants to understand how these transactions are fulfilled. Explaining the technical components involved can be challenging

for all participants, so the following terminology is provided as supporting material to aid in comprehension.

Terminology:

14. Source code: The original human-readable code that defines the behavior and logic of a smart contract or application.
15. Bytecode: The compiled form of the source code that can be executed by the blockchain virtual machine. It is a low-level representation of the smart contract.
16. Nodes: Individual computers or devices participating in a blockchain network. They maintain a copy of the blockchain and validate transactions.
17. Blockchain: A decentralized and distributed digital ledger that records transactions across multiple nodes, providing transparency and security.
18. DApp: An abbreviation for Decentralized Application. It refers to an application that runs on a blockchain network, utilizing smart contracts and decentralized infrastructure.
19. ABI (Application Binary Interface): A specification that defines how a DApp can interact with a smart contract. It provides the necessary information to format messages and invoke functions correctly.
20. Digital signature: The process of using a private key to create a cryptographic signature that verifies the authenticity and integrity of a message or transaction.
21. Replication: The process of copying and distributing data or transactions across multiple nodes in a blockchain network to achieve consensus and ensure redundancy.
22. Authenticity: The property of being genuine and unaltered, ensuring that the data or transactions on the blockchain are valid and trustworthy.
23. Agreement: Consensus among nodes in a blockchain network on the validity and ordering of transactions, achieved through consensus algorithms like Proof of Work or Proof of Stake.
24. Public networks: Blockchain networks accessible and open to the public, where participants are untrusted and may have conflicting interests.

25. Execution speed: The rate at which smart contracts and transactions are processed and executed by the blockchain network.
26. Logic: The set of rules and instructions that govern the behavior and operations of a smart contract or application.
27. Business-to-business scenarios: Interactions and transactions that occur between different businesses or organizations.
28. Trusted or semi-trusted environments: Environments where participants are known and have established trust relationships, such as private consortium blockchains.
29. Cryptlets: A concept that enables the integration of traditional business application development models with smart contracts. Cryptlets are off-chain components that provide specific functionalities and can be invoked by smart contracts.

By understanding these terms, participants can gain a better grasp of how smart contracts operate, ensuring a clearer comprehension of the content covered in the training sessions or as supplementary material for trainers to assist participants in their understanding.

Methodology suggestion / proposed activity: Present the following case study to ensure that the trainees understand the use of Cryptlets. After presenting the case study, trainees should be given time to discuss the case study and express any questions.

Use Case: Temperature Conversion Cryptlet

Let's consider a scenario where a decentralized application (DApp) needs to convert temperatures between Fahrenheit and Celsius. To achieve this, a Cryptlet can be utilized.

30. Problem Statement: The DApp receives temperature values from users in Fahrenheit but needs to convert them to Celsius for internal processing.
31. Cryptlet Creation: A Cryptlet is developed specifically for temperature conversion. It includes the necessary logic and algorithms to perform the conversion accurately.

32. **Cryptlet Deployment:** The Cryptlet is deployed on a separate computer or in the cloud, outside the blockchain network. This allows it to run independently of the nodes on the network.
33. **Integration with DApp:** The DApp interacts with the Cryptlet by sending a request with the Fahrenheit temperature value that needs to be converted.
34. **Cryptlet Execution:** The Cryptlet receives the request and executes the temperature conversion algorithm. It performs the necessary calculations to convert the Fahrenheit temperature to Celsius.
35. **Response to DApp:** Once the conversion is completed, the Cryptlet sends the converted temperature value back to the DApp as a response.
36. **DApp Integration:** The DApp receives the converted temperature value from the Cryptlet and can continue its internal processing using the Celsius temperature.

In this example, the Cryptlet acts as an off-chain component that provides a specific functionality (temperature conversion) to the DApp. By running the Cryptlet outside the blockchain network, it eliminates the need for every node on the network to execute the conversion algorithm. This improves efficiency and reduces the computational burden on the blockchain network.

Cryptlets enable the integration of traditional business application development models with smart contracts by extending their functionality outside of the blockchain. They operate in a safe computing environment, ensuring the same level of security while optimizing performance and scalability.

Duration: 15'

Top of Form

3.3.6 Problems that will be addressed

The objective of the given unit is to highlight the key elements and advantages of smart contracts. It emphasizes their immutability, speed, efficiency, and accuracy, as well as the elimination of paperwork and errors associated with manual processes. Also, emphasizes the security of smart contracts due to their distribution without third-party involvement and the encryption of transaction records in the blockchain. Furthermore, it mentions the time and cost savings achieved by using smart contracts instead of traditional contracts, by eliminating intermediaries and reducing delays and fees. Overall, the objective is to provide a comprehensive understanding of smart contracts, their benefits, and their application in various contexts.

Methodology suggestion / proposed activity: One possible activity to help trainees understand this subject is an online presentation/debate. First, the trainer can divide the trainees into two teams. Each team will be assigned a different form of smart contracts (e.g., legal contract, DAO, or ALC). Each team must then research and prepare a presentation explaining their assigned type of smart contract, highlighting its advantages and disadvantages. The teams should then present their findings to the rest of the trainees and participate in a debate about the various forms of smart contracts. This would help the trainees to understand the concept of smart contracts in greater depth and gain a better appreciation of its uses in different contexts.

Duration:45 min

3.3.7 Real life implementations with details

The scenarios provided in this Smart Contracts unit serve as powerful illustrations and applications of the topics covered, equipping learners with the skills and understanding necessary to confidently employ smart contracts in a variety of contexts. Upon completion of this unit,

learners will become well-versed in smart contract technology and be ready to effectively use and promote its utilization.

Methodology suggestion / proposed activity: After concluding the theoretical part present the following examples to trainees to enhance their perception of smart contracts applications:

- IBM has been actively exploring the use of smart contracts in various industries. They have developed the Hyperledger Fabric framework, which is an open-source blockchain platform that enables the implementation of smart contracts for enterprise applications.
- AXA is using blockchain technology to offer flight insurance, it enables customers to receive automatic compensation if their flights are delayed and is based on smart contracts on Ethereum blockchain. This system is beneficial to customers and the airline alike, as it removes the possibility of fraudulent claims, makes the process faster, and more secure.

<https://www.axa.com/en/news/axa-goes-blockchain-with-fizzy>

- Walmart has been actively exploring the use of smart contracts in their supply chain operations. They have partnered with IBM and other companies to develop blockchain-based systems that enable the tracking and authentication of products, ensuring their quality and authenticity.

<https://www.hyperledger.org/learn/publications/walmart-case-study>

- Medicalchain is a blockchain platform that focuses on securely storing and sharing medical records and facilitating telemedicine services. Through the use of smart contracts, Medicalchain enables patients to have full control over their medical records and determine who can access them. Smart contracts are used to define the permissions and access levels for healthcare providers, ensuring privacy and data security.

<https://medicalchain.com/en/>

- Pawtocol is a blockchain-based platform that utilizes smart contracts to enhance pet ownership and pet-related services. By leveraging smart contracts, Pawtocol aims to provide a decentralized and efficient system for pet owners to find their missing pets. It enhances collaboration within the pet owner community and incentivizes participation in the search process while ensuring the security and integrity of the pet's information.

<https://pawtocol.com/>

These are just a few examples of companies actively applying smart contracts. The adoption and implementation of smart contracts are growing rapidly across industries as organizations recognize the potential benefits of automation, transparency, and efficiency that they offer.

3.3.8 Conclusions

During the concluding session of the module, it is important to facilitate an open conversation between the trainer and trainees. This allows for any missing points to be addressed and provides an opportunity for trainees to ask questions and share their own conclusions.

The open conversation serves as a platform for trainees to express their thoughts, clarify any uncertainties, and discuss their overall understanding of the module content. The trainer can encourage trainees to share their key takeaways, insights, and any additional applications of smart contracts they may have identified within their respective sectors.

This open conversation provides a valuable opportunity for trainees to engage in a collaborative discussion, where they can learn from each other's perspectives and experiences. The trainer can actively listen to the trainees' input, provide further explanations if needed, and address any lingering doubts or questions.

By conducting this open conversation, the trainer ensures that all trainees have had the opportunity to fully grasp the concepts and potential applications of smart contracts. It promotes a comprehensive understanding of the topic and allows trainees to reflect on the module as a whole.

Ultimately, this concluding session fosters a collaborative and inclusive learning environment, leaving trainees with a clear understanding of smart contracts and their potential impact within their specific sectors.

Methodology suggestion / proposed activity: Request each trainee to come up with their own idea of how smart contracts can be applied within the sector they are working in and identify the problems that can be addressed through the implementation of smart contracts.

For example, let's say the trainees are working in the insurance sector. Each trainee would be asked to think about how smart contracts can be utilized within insurance processes and what specific challenges or inefficiencies can be resolved by implementing smart contracts.

They might identify problems such as lengthy and manual claims processing, the need for trust between insurers and policyholders, or difficulties in verifying and validating insurance policies. By applying smart contracts in this context, trainees could propose solutions like automating claims processing and settlement, creating transparent and tamper-proof policies, or establishing trustless interactions between insurers and policyholders.

Evaluation: This exercise encourages trainees to think critically about their own industry and how smart contracts can bring about improvements. It promotes innovative thinking and problem-solving by exploring the potential applications of smart contracts in their specific sector, ultimately leading to a deeper understanding of the technology and its practical implications.

3.4. Module 4 – Supply Chain & Logistics

3.4.1. Introduction

A blockchain supply chain can help participant's record price, date, location, quality, certification, and other relevant information to manage the supply chain more effectively. The availability of this information within blockchain can increase traceability of material supply chain, lower losses from counterfeit and gray market, improve visibility and compliance over outsourced contract manufacturing, and potentially enhance an organization's position as a leader in responsible manufacturing.

Blockchain driven innovations in the supply chain will have the potential to deliver tremendous business value by increasing supply chain transparency, reducing risk, and improving efficiency and overall supply chain management.

Blockchain can enable more transparent and accurate end-to-end tracking in the supply chain: Organizations can digitize physical assets and create a decentralized immutable record of all transactions, making it possible to track assets from production to delivery or use by end user. This increased supply chain transparency provides more visibility to both businesses and consumers.

Blockchain can drive increased supply chain transparency to help reduce fraud for high value goods such as diamonds and pharmaceutical drugs. Blockchain could help companies understand how ingredients and finished goods are passed through each subcontractor and reduce profit losses from counterfeit and gray market trading, as well as increase confidence in end-market users by reducing or eliminating the impact of counterfeit products.

Furthermore, businesses can maintain more control over outsourced contract manufacturing. Blockchain provides all parties within a respective supply chain with access to the same information, potentially reducing communication or transfer data errors. Less time can be

spent validating data and more can be spent on delivering goods and services—either improving quality, reducing cost, or both.

3.4.2. Module Goals

In this module you will learn about how blockchain technology can be applied to Supply Chain and Logistics, and is formatted as follows:

- What is the current situation in the field and what problems do exist?
- How can blockchain be utilized in the field? What problems would it address?
- Real-life implementations with details that the user can get inspiration from,
- Proposed resources (where do I go from here).

3.4.3. Learning Objectives and Competencies

Learning objectives

The learning objective for Module 4 is to create awareness of the huge benefits using the technology and motivate learners to dig more, understand, design and apply such solutions, that will give them ways, first to survive, and then to beat unethical/illegal competition.

1. Create awareness of the benefits,
2. Highlight learnings from previous case studies,
3. Share information on the direction of the technology
4. Understand where these solutions fit in their business and what advantages they carry.
5. To be able to analyze and design a roadmap for implementing a solution in their environment.
6. To be able to understand the real-life scenarios vs over-promising proposals when implementing a solution with external experts.

To be able to evaluate the potential of emerging trends in this space.

Competencies

After completing Module 4, the learner will understand where these solutions fit in their business and what advantages they carry. To be able to analyze and design a roadmap for implementing a solution in their environment. To be able to understand the real-life scenarios vs over-promising proposals when implementing a solution with external experts.

To be able to evaluate the potential of emerging trends in this space.

On completion of this training experience, participants should develop the following competencies:

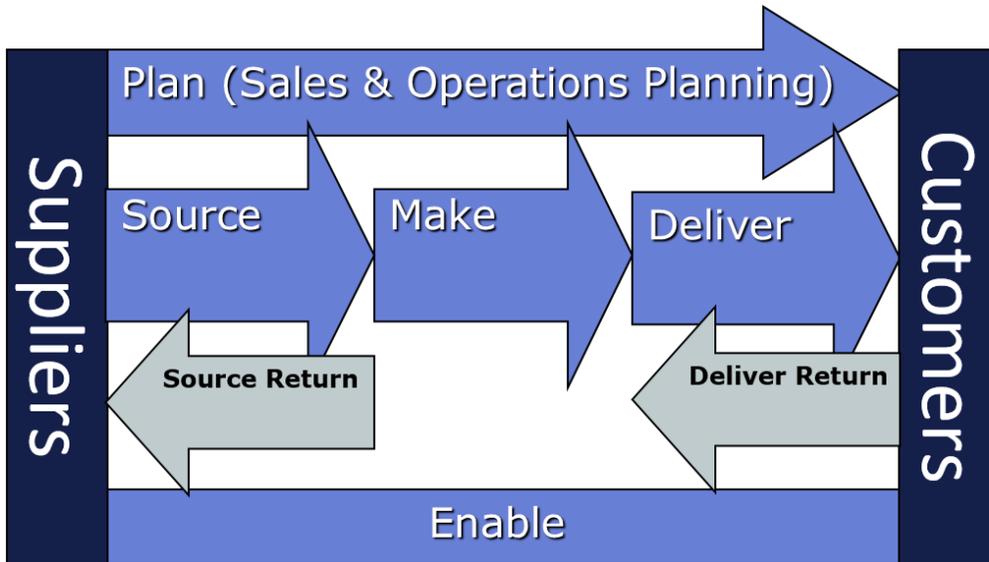
1. Know the type of information blockchain can store and understand how this can improve Supply Chain & Logistics,
2. Understand the current obstacles to adoption,
3. Review current deployments and case studies,
4. Identify the next stages of development and roadmap for the technology,
5. Highlight emerging opportunities,
6. Refer the reader to further sources of information,
7. Estimate the time horizon for useful developments,
8. Identify the key players in the eco system,
9. Identify variations by sector, industry or geography.

3.4.4. Supply Chain

In this section we explain supply chain through the use of one of the key reference models for supply chain is the Supply Chain Operations Reference (SCOR) model developed by the Association for Supply Chain Management (APICS). This model identifies the six primary supply chain processes;

Plan...Source...Make...Deliver...Return...Enable

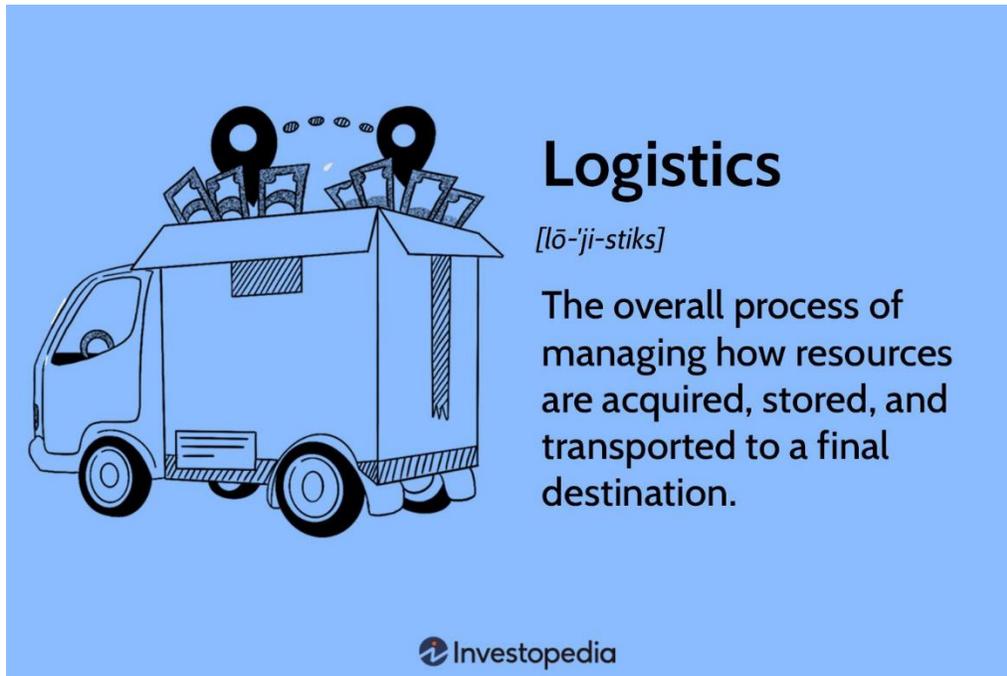
(See figure overleaf)



3.4.5. Logistics introduction

Logistics is the process of planning and executing the efficient transportation and storage of goods from the point of origin to the point of consumption. The goal of logistics is to meet customer requirements in a timely, cost-effective manner.

Logistics is a fundamental part of supply chain management.



3.4.6. BlokChain Introduction

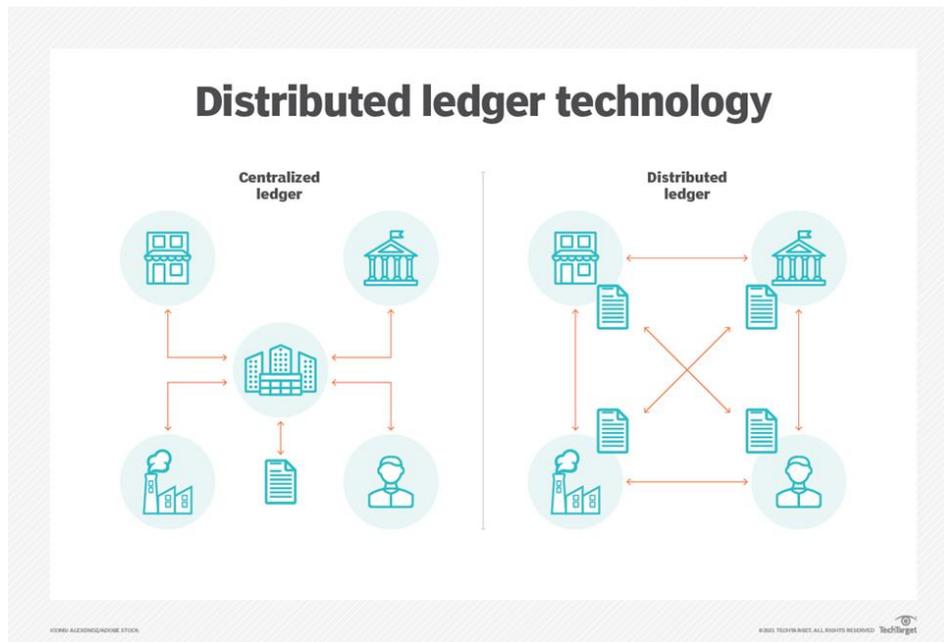
We explain blockchain in terms of distributed ledger technology - Distributed ledger technology is a platform that uses ledgers stored on separate, connected devices in a network to ensure data accuracy and security. Blockchains evolved from distributed ledgers to address growing concerns that too many third parties are involved in too many transactions.

DIFFERENCES BETWEEN CENTRALIZED AND DECENTRALIZED LEDGERS

Centralized ledgers are maintained by a single entity acting as a trusted intermediary while decentralized ledgers are maintained by multiple entities which are simply nodes or computing devices that eliminate the need for trust in any single entity.

Distributed ledgers also reduce operational inefficiencies, speed up the amount of time a transaction takes to complete, and are automated, and therefore function 24/7, all of which reduce overall costs for the entities that use them.

(See figure overleaf)



3.4.6. Emerging Trends in Blockchain

Proof of Stake

Proof of Stake (PoS) is a consensus mechanism that involves network participants staking the network's token to validate transactions and secure the network. As a reward for helping to secure the integrity of the network, validators receive newly minted tokens.

Proof of Stake was introduced in a research paper titled "PPCoin: Peer-to-Peer Cryptocurrency with Proof-of-Stake", by developers Scott Nadal and Sunny King in 2012. Their goal: to develop an alternative to the energy-intensive and less scalable Proof of Work method. Since then, different cryptocurrencies have implemented a range of Proof of Stake-based algorithms in their networks to achieve scalability and consume less energy. Proof of Stake is a less costly way of reaching consensus and provides even small investors with the ability to earn rewards on the network. However, there are certain risks you must be aware of before staking your funds.

Layers

Layer 1 refers to the underlying blockchain architecture, i.e., the actual blockchain itself. In the case of Bitcoin, it is the BTC network launched in 2009.

Layer 2 refers to various protocols that are built on top of layer 1 to improve the original blockchain's functionality. Layer 2 protocols often use off-chain processing elements to solve the speed and cost inefficiencies of the layer 1 network. Examples of layer 2 platforms for Bitcoin include Lightning Network and Liquid Network.

Layer 3 is represented by blockchain-based applications, such as decentralized finance (DeFi) apps, games, or distributed storage apps. Many of these applications also have cross-chain functionality, helping users access various blockchain platforms via a single app.

3.4.7. Barriers to development of Blockchain in Supply Chain

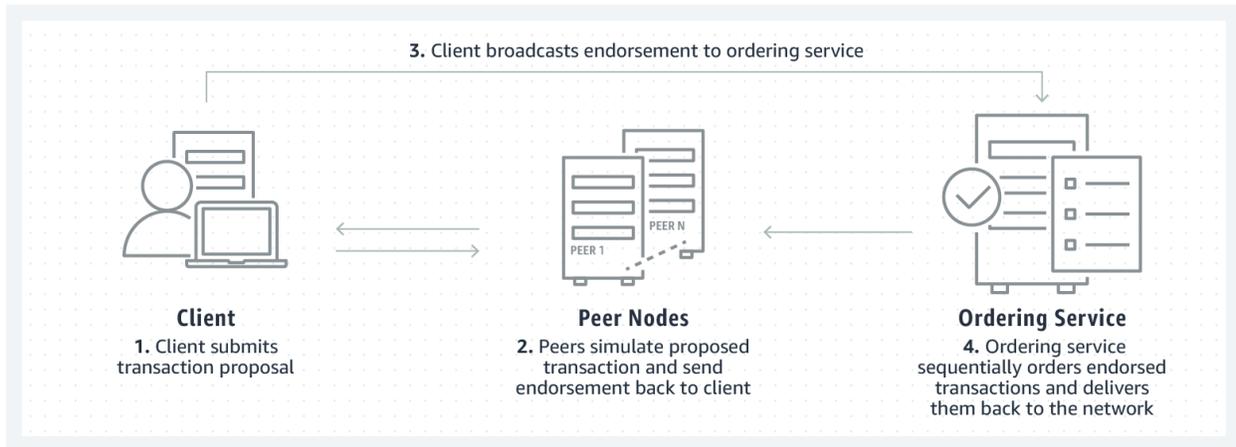
The Barriers to deployment are discussed under the following headings;

1. Environmental and Climate Impact.
2. Lack of standardization
3. Reputation of technology
4. Stability of the technology
5. Legal certainty

3.4.8. Players

Hyperledger

Hyperledger Fabric platform is an open source blockchain framework hosted by The Linux Foundation. It has an active and growing community of developers. Permissioned. Fabric networks are permissioned, meaning all participating member's identities are known and authenticated.



Ethereum

Ethereum is a decentralized blockchain with smart contract functionality. Ether is the native cryptocurrency of the platform. Among cryptocurrencies, ether is second only to bitcoin in market capitalization. It is open-source software. Ethereum was conceived in 2013 by programmer Vitalik Buterin.

Ethereum is a worldwide system, an open-source platform to write computer code that stores and automates digital databases using smart contracts, without relying upon a central intermediary, solving trust with cryptographic techniques.

Since Ethereum has its own ether, it can be advantageous over Hyperledger in the use cases which require a cryptocurrency. Since Hyperledger is also programmable, it can leverage the embedded logic in chain code to automate business processes across your network.

3.4.9. How can Blockchain be utilized in Supply Chain

In this section we will examine the characteristics of blockchain that make it useful in Supply Chain and Logistic use cases. We will then explore how those characteristics enable functionality that is useful to supply chain and logistics processes. To facilitate the discussion, we address utilization under the following headings;

- Information Sharing
- Traceability
- Transparency

- Efficiency
- Quick Updates
- Disintermediation
- Trust
- Security and Privacy
- Immutability
- Verified Transactions
- Scalability
- Smart Contracts

3.4.10. What opportunities does Blockchain provide in Supply Chain and Logistics?

Blockchain makes global supply chains more efficient by allowing companies to complete transactions directly and without third parties. It also facilitates increased integration of financial and logistics services, enabling greater data collaboration between stakeholders.

The following examples demonstrate where the capabilities of blockchain technologies can be applied to supply chain and logistics to create opportunities to add value or overcome existing challenges:

- Opportunities for Compliance and Traceability Improvements:
- Opportunities for Reduced Transaction Costs:
- Opportunities for Collaboration, Transparency and Disintermediation
- Opportunities for Digitalisation and Automation of Processes

3.4.11. Real-life implementations with details

This section is delivered through a series of real-life case studies highlighting industries or sectors that are at varying stages of adoption.

1.1. Module 5 – Smart Contracts hands on programming tutorial

This module is a 'cookbook' to help learners write and deploy their first smart contract.

The module's main goals are for the learner to gain familiarity with working with dev tools. The crypto space is a tech heavy space and even business focused individuals need to have an elementary understanding of what goes into creating blockchain solutions. Learners that will apply themselves through this module will take a look under the hood of very complex technologies and demystify the difficulty of interacting with the exciting crypto space.

Through the module our target group will learn the 101 basics of Solidity and Remix (the programming language and the main tool used to create smart contracts); the need for fees, the faucet they will receive them from and the digital wallet they will store them to; They will also learn about the test network they are going to use to deploy their first smart contract.

After knowing and understanding the 'ingredients' learners will start with setting up their Metamask wallet. Then they will setup and use the RSK testnet to get some test digital money (the needed currency to fulfill the designed activity). They will setup then their development environment and will move on to write their first simple smart contract. They will compile and deploy their contract and, finally, they will run their contract and access the actions of their contract on the blockchain.

Proposed methodology: In order to have solid results, Module 5 requires the proper setup of a computer lab:

- A computer or laptop with internet access for each participant
- A projector or large screen to display instructions and demonstrations
- A whiteboard or flipchart for notes and explanations
- Handouts or slides outlining the key concepts

3.5.1 Overview

Since the hands-on lab can be scheduled at a different day than the rest of the modules, and/or participants may choose to attend it without accessing Module 4 an introductory session for smart contracts will be prepared so the trainer may use to his discretion.

The contents of this introductory session and its delivery will be as follows:

- Introduction to smart contracts (Optional)

Duration: 75 minutes

Welcome and Introduction (10 minutes)

Welcome the participants and introduce the objectives of the learning activity.

Explain that the session will focus on providing an overview of smart contracts, their benefits, and potential use cases for startups and SMEs.

Blockchain and Ethereum Basics (20 minutes)

Provide a brief introduction to blockchain technology, its key features, and benefits (e.g., decentralization, security, transparency, and immutability).

Introduce Ethereum as a blockchain platform that allows for the creation of decentralized applications (dApps) and smart contracts.

Explain the concept of Ether as the native cryptocurrency of the Ethereum network, used for transactions and paying gas fees.

What are Smart Contracts? (20 minutes)

Define smart contracts as self-executing contracts with the terms of the agreement directly written into code.

Explain how smart contracts are stored on the blockchain and automatically execute when predefined conditions are met.

Discuss the security, trust, and efficiency advantages of smart contracts compared to traditional contracts.

Smart Contract Use Cases (25 minutes)

Present a range of use cases for smart contracts in various industries, focusing on potential applications relevant to startups and SMEs.

Examples may include supply chain management, decentralized finance (DeFi), tokenization of assets, digital identity, and voting systems.

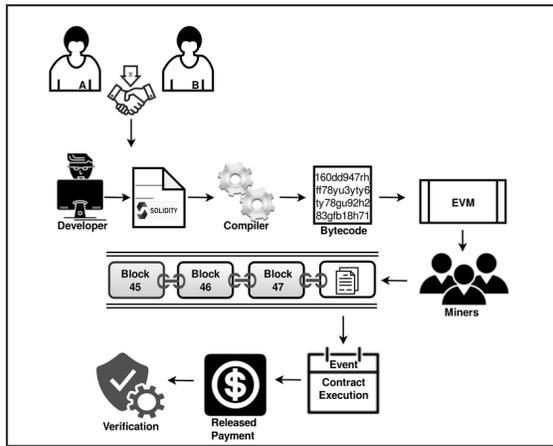
Encourage participants to discuss potential use cases for smart contracts within their own businesses or industries.

Proposed methodology: The following subjects provide the base of understanding for building a computer program in general and especially a smart contract. It will be provided by the trainer through a projector.

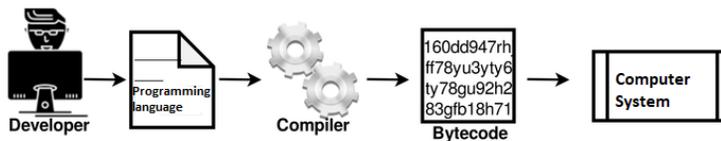
Activity: At the end of this chapter an interactivity will be planned with a set of questions related to the topics. It will run on trainers' computers/laptops anonymously and the trainer will provide feedback for both the correct and incorrect answers.

➤ The lifecycle of a smart contract (15 minutes)

The whole picture will be provided and explained followed below by the break down of its main components.



➤ Basic programming components (15 minutes)

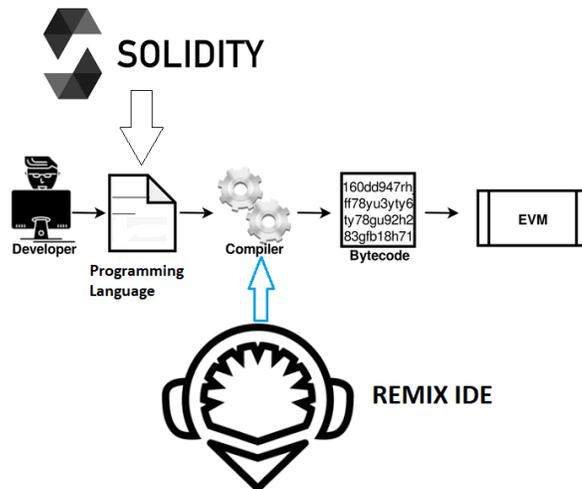


Startup founders, small and medium enterprise (SME) owners, and young workers with limited or no programming experience, may feel getting started as a daunting experience, but with the use of this introduction and the proposed tools, their first steps on their programming journey with smart contracts will be simple and satisfactory.

The first thing to realize is that computer programming involves creating a set of instructions for a computer to execute. These instructions are written using a ‘high-level’ programming languages such as Python, JavaScript, Java and for smart contracts, Solidity. The term ‘high-level’ means the programming language resembles human language (it has structure, syntax, arguments, variables, data types, loops, conditional statements, functions

etc) so it is easier for us to write programs. Still computers cannot understand directly the programs we make and another program is used in the middle (compiler) to translate it to instructions the computer can understand (bytecode). For Solidity the compiler is included in the Remix Integrated Development Environment (IDE).

- The Solidity programming language and the REMIX Integrated Development Environment (30 minutes)



Solidity and Remix are essential tools for non-programmers looking to build their first smart contract because they simplify the process and provide an accessible environment for creating and deploying smart contracts on the Ethereum blockchain.

1. Solidity: Solidity is a high-level, statically-typed programming language designed specifically for writing smart contracts on the Ethereum blockchain. It was created to be easy to learn and understand, especially for those with limited programming experience. Here are some reasons why non-programmers need Solidity:
 - a. Purpose-built for smart contracts: Solidity is tailored for developing smart contracts, which means it has features and constructs specifically designed for this purpose. This makes it easier for non-programmers to grasp the essential concepts and write secure, efficient smart contracts.
 - b. Familiar syntax: Solidity's syntax is similar to popular programming languages like JavaScript, making it easier for non-programmers to learn and understand.

c. Extensive documentation and community: Solidity has a wealth of resources, including comprehensive documentation and a large, supportive community. This makes it easier for non-programmers to find help and learn from others as they develop their smart contracts.

2. Remix: Remix is an open-source, web-based integrated development environment (IDE) designed specifically for developing, testing, and deploying smart contracts written in Solidity. Here are some reasons why non-programmers need Remix:

a. User-friendly interface: Remix provides an intuitive, easy-to-use interface that simplifies the process of writing, testing, and deploying smart contracts. This makes it more accessible for non-programmers and helps them get started quickly.

b. Built-in compiler: Remix includes a built-in Solidity compiler that automatically compiles your code as you write it. This feature helps non-programmers quickly identify and fix errors in their code, streamlining the development process.

c. Testing and debugging tools: Remix provides powerful tools for testing and debugging smart contracts, which are essential for ensuring the security and reliability of your contract. Non-programmers can use these tools to validate their smart contract's functionality and identify potential issues.

d. Easy deployment: Remix allows you to deploy your smart contract directly to the Ethereum blockchain with just a few clicks. This simplifies the deployment process and enables non-programmers to get their smart contracts up and running quickly.

The following are some advantages of using an IDE like Remix vs a simple compiler:

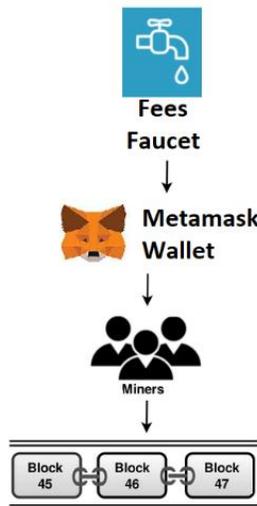
IDEs often have advanced code editors with features like syntax highlighting, auto-completion, code folding, and automatic indentation, which make writing and organizing code easier and more efficient.

IDEs provide integrated debugging tools that help programmers identify, diagnose, and fix errors in their code. These tools often allow you to set breakpoints, step through code, and inspect variables at runtime.

IDEs often include built-in compilers or interpreters for one or more programming languages, allowing you to build and run your code without leaving the IDE.

IDEs often include tools and shortcuts for automating repetitive tasks, such as code generation, refactoring, and code formatting, which can save you time and effort during development.

- The needs for fees and a digital wallet. (30 minutes)



When creating your first smart contract, you'll need a fee faucet and a MetaMask wallet for several reasons, mainly related to testing and deploying your smart contract on a blockchain network. Let's break down the purpose of each tool and why they are necessary.

Fee Faucet: A fee faucet is a service that provides a small amount of cryptocurrency for free, typically used for testing purposes on test networks. These test networks function similarly to the main Ethereum network but do not involve real monetary value. The reasons you need a fee faucet are:

- Testing transactions:** When developing and testing your smart contract, you need to ensure it functions correctly and securely before deploying it to the main Ethereum network. By using a fee faucet to acquire test Ether, you can simulate transactions on a test network without risking real funds.
- Paying gas fees:** All transactions on the Ethereum network, including deploying and interacting with smart contracts, require gas fees. Gas fees are paid in Ether and are necessary to compensate miners for validating and processing transactions. A fee faucet provides test Ether for paying these gas fees on test networks.

MetaMask Wallet: MetaMask is a browser-based cryptocurrency wallet and gateway to blockchain applications. It allows you to manage and store Ether and other Ethereum-based tokens, as well as interact with smart contracts:

MetaMask helps programmers manage their Ethereum account's private keys securely, which are essential for signing transactions, deploying smart contracts, and managing your funds.

It supports multiple Ethereum test networks, making it easy to switch between them and the main Ethereum network. This feature simplifies the process of testing and deploying smart contract across different environments.

Finally, MetaMask can be easily integrated with development tools like Remix, allowing us to deploy and interact with our smart contract directly from the IDE. As we will see this seamless connection streamlines the development process and improves the overall user experience.

In summary, a fee faucet and a MetaMask wallet are essential tools when creating our first smart contract. A fee faucet provides test Ether for simulating transactions and paying gas fees on test networks, while a MetaMask wallet securely manages our private keys and simplifies the process of interacting with smart contracts and blockchain applications. By using these tools, we can ensure that our smart contract is secure, reliable, and ready for deployment on the main Ethereum network.

- Wrap up and Interactivity. (30 minutes)

3.5.2 Environment setup Introduce Remix IDE REMIX IDE

Introduce Remix IDE (15 minutes)

Trainer explains the purpose and features of Remix IDE as a web-based integrated development environment for creating, testing, and deploying Solidity smart contracts. He emphasizes the user-friendly interface and built-in tools that make Remix IDE accessible for beginners.

Hands-on activity: Exploring Remix IDE (30 minutes)

Trainer guides participants through the process of accessing Remix IDE and demonstrates how to navigate Remix IDE's interface, explaining the various panels and tools available (e.g., file explorer, code editor, compiler, and deploy & run panel). He asks also participants experiment with Remix IDE features like auto-completion, syntax highlighting, and automatic compilation.

3.5.3 Writing our first Smart Contract

Introduction of Solidity (15 minutes)

Trainer explains the purpose and features of Solidity as a programming language designed for Ethereum smart contracts. He may discuss the similarities between Solidity's syntax and popular programming languages like JavaScript (if the specific audience has some basic experience).

Hands-on activity: Writing a simple smart contract (30 minutes)

The trainer provides participants with a basic template for a smart contract (e.g., a simple storage contract) and explains its structure and components. He then guides participants through modifying the template to create their own simple smart contract and encourage participants to experiment with different variables, functions, and basic Solidity constructs.

3.5.4 Metamask Configuration

Hands-on activity: Obtaining test fees -RBTCs and setting up Metamask (30 minutes)

Trainer guides participants through the process of obtaining RBTCs from a faucet and setting up a MetaMask wallet by installing the MetaMask browser extension and setting up a new wallet. Demonstrates also how to switch between Ethereum networks in MetaMask how to import an Ethereum account using a private key or seed phrase (optional) and have participants add the test Ether they obtained earlier to their MetaMask wallet.

3.5.6 Connect Remix to the RISK TESNET

In this and the following steps trainer guides participants through testing and deploying a smart contract to the test blockchain network using Remix IDE (30 minutes)

Hands-on activity: (30 minutes)

At first trainer guide participants through the process of compiling their smart contract in Remix IDE, explains the importance of testing smart contracts and introduce Remix IDE's built-in tools for testing and debugging and show participants how to use Remix IDE to test their smart contract's functions and identify potential issues.

Hands-on activity: Deploying the smart contract (30 minutes)

Trainer ensures participants have their MetaMask wallet set up and connected to a test network with RBTCs (refers to a previous learning activity if necessary) and guides participants through the process of deploying their smart contract to the test network using Remix IDE and MetaMask.

3.5.7 RSK Explorer

3.5.8. Interact with your first Smart Contract

Trainer demonstrates how to interact with the deployed smart contract using Remix IDE and MetaMask, including executing transactions and reading data.

3.5.9 Wrap up

At the end of the session trainer summarizes the key concepts covered in the learning activity, highlighting the importance of Solidity, Remix IDE and Metamask for building and deploying smart contracts. He encourages participants to continue exploring these three tools Solidity and Remix IDE on their own to develop more complex smart contracts and opens the floor for questions and provide additional explanations or demonstrations as needed.

2. Further Resources on Blockchain

This is a collection of resources that could be used by trainers to support both their knowledge and their lectures on Blockchain. They are organized following the modules outline, so it is reasonable and easy to find the information, from general to more specific.

- A brief but very visual **YouTube Video** that covers an **overview about Cryptocurrencies**, like what Cryptocurrency is, how Cryptocurrency originated, how Cryptocurrency works, how Cryptocurrency benefits us, and how it works on Blockchain:
https://www.youtube.com/watch?v=1YyAzVmP9xQ&ab_channel=Simplilearn
- **A Cryptocurrency Timeline:** An interesting article with a graphic explanation of the history of cryptocurrencies divided into time periods:
<https://www.withvincent.com/research/cryptocurrency-timeline>
- This **YouTube video on "What is NFT"** covers all the important concepts of NFTs like What are NFTs?, What are Non-Fungible Tokens, What is NFT and how it works, how are NFTs different from other cryptocurrencies working in the same Blockchain Technology, how NFT became so popular and what future NFTs hold for the world's economic system: <https://www.youtube.com/watch?v=NNQLJcJEzv0>
- A well-summarised **article about the basics of NFTs** and also contains the biggest milestones of the NFT history, fully explained with pictures and videos:
<https://nftnow.com/guides/what-is-nft-meaning/>
- A short article from Western Union Bank discussing the **security of credit cards and digital wallets**. <https://www.westernunion.com/blog/en/us/are-digital-wallets-safer-than-credit-cards/>
- The interesting and curious origin of Dogecoin. From a meme to a cryptocurrency endorsed by Tesla CEO Elon Musk and investor Mark Cuban: The rise of **Dogecoin**.
<https://www.theblock.co/learn/245715/a-brief-history-of-dogecoin>

- Article in which **the collapse of the NFT**, the origin of this, the procedure of the collapse and the current situation of these tokens are detailed.
<https://markets.businessinsider.com/news/currencies/nft-market-crypto-digital-assets-investors-messari-mainnet-currency-tokens-2023-9>
- PoS (Proof Of Stake) [https://www.axi.com/int/blog/education/blockchain/proof-of-stake#:~:text=Proof%20of%20Stake%20\(PoS\)%20is,validators%20receive%20newly%20minted%20tokens](https://www.axi.com/int/blog/education/blockchain/proof-of-stake#:~:text=Proof%20of%20Stake%20(PoS)%20is,validators%20receive%20newly%20minted%20tokens)
- <https://phemex.com/academy/bitcoin-layer-1-vs-2-vs-3#:~:text=Layer%20%20blockchain%20refers%20to,games%2C%20or%20distributed%20storage%20apps>
- Ethereum <https://ethereum.foundation/>
- hyperledger-vs-ethereum <https://www.edureka.co/blog/hyperledger-vs-ethereum/#:~:text=since%20Ethereum%20has%20its%20own,business%20processes%20across%20your%20network>
- Using blockchain to drive supply chain transparency
<https://www2.deloitte.com/us/en/pages/operations/articles/blockchain-supply-chain-innovation.html>
- Building a transparent supply chain <https://hbr.org/2020/05/building-a-transparent-supply-chain>
- Can Blockchain reduce supply chain complexity and costs?
<https://www.sccgltd.com/featured-articles/can-blockchain-reduce-supply-chain-complexity-and-costs/>
- Blockchain: A new tool to cut costs <https://www.pwc.com/m1/en/media-centre/articles/blockchain-new-tool-to-cut-costs.html>

- Meaningful Blockchain Use in Digital Process Automation
<https://blog.seeburger.com/the-future-of-automation-meaningful-blockchain-use-in-digital-process-automation/>
- Blockchain Workflow Automation <https://www.processmaker.com/blog/blockchain-workflow-automation-why-you-should-embrace-it/>

3. References

Blockchain Facts: What Is It, How It Works, and How It Can Be Used. (n.d.). Investopedia. Retrieved 14 September 2022, from <https://www.investopedia.com/terms/b/blockchain.asp>

Cryptocurrency Explained With Pros and Cons for Investment. (n.d.). Investopedia. Retrieved 14 September 2022, from <https://www.investopedia.com/terms/c/cryptocurrency.asp>

What is Bitcoin? (n.d.). Retrieved 14 September 2022, from <https://www.coinbase.com/es/learn/crypto-basics/what-is-bitcoin>

Bitcoin price history 2013-2022. (n.d.). Statista. Retrieved 28 October 2022, from <https://www.statista.com/statistics/326707/bitcoin-price-index/>

Digital Finance Package. (n.d.). [Text]. European Commission - European Commission. Retrieved 28 October 2022, from https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1684

ElBahrawy, A., Alessandretti, L., Kandler, A., Pastor-Satorras, R., & Baronchelli, A. (n.d.). Evolutionary dynamics of the cryptocurrency market. *Royal Society Open Science*, 4(11), 170623.
<https://doi.org/10.1098/rsos.170623>

Eu search for regulatory answers to crypto assets and their place in the financial markets • infrastructure | Elsevier Enhanced Reader. (n.d.). <https://doi.org/10.1016/j.clsr.2021.105632>

Luther, W. J., & Sridhar, N. (2021). *On the Origin of Cryptocurrencies* (SSRN Scholarly Paper No. 3976424). <https://doi.org/10.2139/ssrn.3976424>

Procedure File: 2020/0265(COD) | Legislative Observatory | European Parliament. (n.d.). Retrieved 28 October 2022, from

[https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2020/0265\(COD\)&I=en](https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2020/0265(COD)&I=en)

Glen, Stephanie (2021). NFTs explained in two pictures. The good, the Bad... and the Ugly.

<https://www.datasciencecentral.com/nfts-explained-in-two-pictures/>

Lazoryak, Julia (2022). NFTs and How they can be beneficial for your business?.

<https://flyaps.com/blog/nfts-benefits-for-businesses/>

Dev Blog (2022). Does your business need NFTS? Use cases, benefits and nuances to consider.

<https://www.apriorit.com/dev-blog/770-blockchain-nft-for-businesses>

Pitts dr., Casuel (2022). Why should business leaders pay attention to NFTs?

<https://www.forbes.com/sites/forbesbusinesscouncil/2022/07/20/why-should-business-leaders-pay-attention-to-nfts/?sh=7023a624545b>

Sharma, Rakesh (2022). Non Fungible NFT – What it means and how it works?

<https://www.investopedia.com/non-fungible-tokens-nft-5115211>

Macnamara, Ryan (2022). How to buy Non Fungible Tokens (NFTs). <https://www.benzinga.com/how-to-buy-nfts>