MODULE:

1.2

Use Cases

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OUTLINE

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CHAPTER:

1.

Introduction: Blockchains & DLT

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SUMMARISING BLOCKCHAIN

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KEY POINTS

1) **Decentralised Trust**: Blockchain technology enables the transfer of trust from a central authority managing shared data to the underlying protocol that coordinates consensus among participants.
2) **Validation and Security**: Through blockchain technology, data can be chronologically ordered, allowing all parties to verify the complete history of shared information without the concern of data having been altered.
3) **Privacy and Anonymity**: Blockchains are often built with pseudonymity in mind. Knowing proper procedure allows users to maintain anonymity when needed.
4) **Automation**: The power of blockchain is harnessed by smart contracts, which automate the execution of transactions verified by cryptographic signatures based on predefined conditions being fulfilled (e.g. if specific criteria are met).

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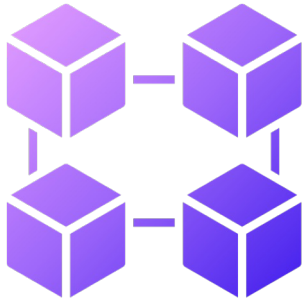
DLT TECHNOLOGY

To sum it up: blockchain is a revolutionary **technology** for **distributed ledgers** (DLT) that establishes decentralised trust, ensures validation and security through chronological data sharing, enables privacy and anonymity with cryptographic control over information, and drives automation through smart contracts.



IDENTIFICATION

It is essential for companies to identify the **right use cases**, because blockchain has many potential applications in areas as diverse as supply chain management, insurance or cybersecurity.

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CHAPTER:

2.

Why Implement a Blockchain?

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WHY IMPLEMENT A BLOCKCHAIN?

The use of a blockchain solution does not always make sense when applied to any problem. In fact, there are situations where it might be better to use a centralised database or a different technology.

So, when can the utilisation of blockchain **enhance the value of my operations**?

In the next slide, we will explore some important factors to consider when deciding whether to use blockchain technology. If **at least four out of the six factors**, which will be presented on the following slide, come into play, it makes sense to opt for Distributed Ledger Technology (DLT).

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KEY POINTS: USE CASES

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1. **Data sharing among multiple parties**: when several entities collaborate by sharing data and require a unified perspective on this shared data.

2. **Updating data across multiple parties**: in scenarios where multiple participants contribute updates to data, and these actions necessitate an immutable record.

3. **Ensuring trustworthy recorded actions**: when participants seek assurance that the actions documented in the record are authentic and valid.

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KEY POINTS: USE CASES

4. **Minimising cost and complexity of intermediaries**: in situations where intermediaries introduce unnecessary expenses and intricacies.

5. **Urgent interactions with costly delays**: for interactions where time sensitivity is crucial, and any delays in the process escalate expenses.

6. **Interdependent participant transactions**: when the transactions initiated by participants are interconnected, and the success of one depends on the execution of others.

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OTHER EXAMPLES

TECHNOLOGY

Additional pertinent criteria for assessing the applicability of blockchain include:

From a **technical** standpoint:

- Framework assessment and determination;
- Examination of IT architecture, encompassing business logic, transaction sequences, and more.

BUSINESS

From a **business** viewpoint:

- Facilitation of digital asset transfers;
- Exploration of identity-related matters;
- Integration of payment systems within a blockchain framework.

These elements have the potential to be integrated into a blockchain ecosystem.

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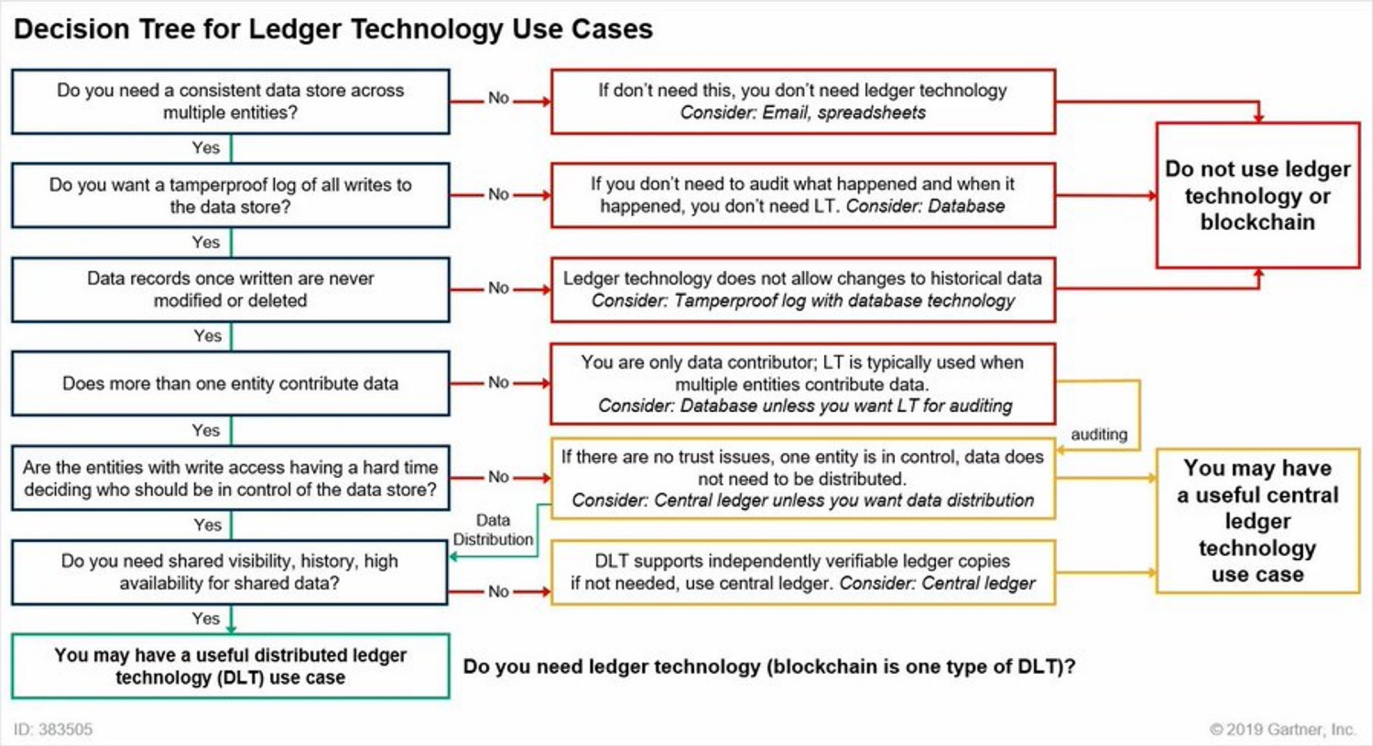
DECISION TREE



Source: https://blogs.gartner.com/avivah-litan/2019/03/05/enterprise-permissioned-blockchain-hardly-revolution-yet/

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DLT VS DATABASE

DISTRIBUTED LEDGER TECHNOLOGY

- Decentralised model
- Faster processing and scalability
- New technologies - risks
- Resilience increase with nodes

DATABASE

- Centralised model
- Low costs
- Easy to implement
- Backups required

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DLT Approach

- **Decentralised Transactions**: in a DLT-based approach, transactions involving collateral are conducted in a decentralised manner, directly between peers.
- **Predefined Conditions**: transactions embed predefined conditions, such as release dates and rules for handling loan repayment failures
- **No Centralised System**: there is no need to establish a centralised system or platform for managing collateral.
- **Customisable Business Rules**: Business rules regarding collateral can be customised and tailored to match the specific agreements between counterparties.
- **Permissioned DLT**: in some cases, a permissioned Distributed Ledger may have an administrator who sets participation criteria and onboards new participants.
- **Minimal Administrator Role**: the role of the administrator in a DLT-based system is minimal compared to the centralised entity in traditional approaches.
- **Event-Driven Operations**: business actions can be triggered automatically based on events, eliminating the need for external interventions.
- **Efficiency and Scalability**: DLT-based structures can potentially be set up more quickly and scaled efficiently due to minimal administrative requirements and distributed processing.

DATABASE (centralised approach)

- **Central Entity:** in the centralised approach, a central entity is required to oversee and manage data.
- **Dedicated Platform:** the central entity sets up a dedicated platform specifically designed for managing collateral transactions
- **Membership Criteria:** the central entity establishes membership criteria that entities or individuals must meet to participate in the registry.
- **Rules and Procedures:** comprehensive rules and procedures are defined and enforced by the central entity for all transactions involving assets or data.
- **Transaction Processing:** all transactions related to collateral are processed exclusively on the centralised platform.
- **Business Actions Control:** the central platform has full control over all business actions related to collateral transactions.
- **Software Applications:** typically, standardised software applications are used, or custom software is developed to meet the specific needs of the collateral management

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CHAPTER:

3.

Practical Implications

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EXAMPLES OF USE IN DIFFERENT SECTORS

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Insurance payouts

Blockchain-based applications can **eliminate the risk of fraud** while **accelerating claim payouts** in the insurance industry. Immutable records of an asset's value, claims and reimbursements provide the insurance industry with easy access to all necessary information. In addition, **smart contracts** can reduce much of the bureaucracy involved in processing insurance claims.

Blockchain voting

What is blockchain voting? It is an **application of blockchain technology to an existing need**. With blockchain voting, **verification of the voter's identity is guaranteed** by cryptographic protection. The blockchain network can monitor votes, count votes and guarantee the **integrity** of the result.

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EXAMPLES OF USE IN DIFFERENT SECTORS

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Supply chain management

Manufacturers, retailers and consumers all have an interest in **tracking the supply chain** from raw material sources to the consumer's shopping cart.
Whether it's verifying that food is free of inorganic contaminants or ensuring that import taxes are correctly paid in international passages, blockchains can play a vital role in **tracking goods along their journey from production to consumption**.

Healthcare

Blockchain database architecture is perfect for **storing personal health documents**. Users have a permanent repository of their health records, accessible wherever there is an internet connection. They can allow **doctors and insurance companies to access** it with simple online transactions, and doctors with the appropriate authorisations can add new data to the records.

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PROS AND CONS OF DLTs

PROS (1/2)

- **Chain Accuracy:** The blockchain network involves numerous computers and devices to validate transactions. This diminishes human involvement in verification, resulting in fewer errors and a precise information record.
- **Cost Efficiency:** Blockchain eliminates the necessity for third-party verification and its accompanying expenses. For instance, individuals no longer need to pay banks for transaction verification or notaries for document authentication.
- **decentralisation:** The blockchain is replicated and distributed across a computer network. This dispersion enhances security, as the information is not stored within a single central database, making tampering significantly more challenging.

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PROS AND CONS OF DLTs

PROS (2/2)

- **Efficient, Private, and Secure Transactions**: operating around the clock, 24/7, 365 days a year, blockchains facilitate transactions. Some blockchains enable transactions to be finalised within seconds. Recorded transactions necessitate authentication by the blockchain network before being appended to a block. Each block includes **a unique hash** (digital signature) and the hash of the preceding block, rendering **blocks immutable post-verification**.
- **Transparency**: The majority of blockchains are constructed as open-source software, permitting the code to be accessible to everyone. This openness enables auditors to scrutinise cryptocurrencies for security purposes. Moreover, the decentralisation of ledgers allows anyone to propose changes or enhancements to the system. In this sense, there is a democratisation of the process of maintaining the database.

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PROS AND CONS OF DLTs

CONS

- **Technology Costs**: Despite the potential to reduce transaction fees, blockchain technology isn't without expenses. Notably, Bitcoin's proof-of-work mechanism, which validates transactions, demands extensive computational power, contributing to substantial energy consumption.
- **Speed and Data Inefficiency**: Bitcoin's proof-of-work system takes around 10 minutes to append a new block to the blockchain. Consequently, the network's capacity is limited, estimated at approximately three transactions per second (TPS).
- **Illegal Activities**: A prominent instance of blockchain misuse involves the *Silk Road*, an illicit online marketplace on the dark web. Operating via the Tor Browser, users could anonymously buy and sell illegal goods, utilising Bitcoin and other cryptocurrencies for covert transactions.
- **Regulation**: Governments possess the theoretical ability to outlaw cryptocurrency ownership or participation in their networks, but such efforts could prove difficult given the decentralised nature of these systems.

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PROS AND CONS OF DLTs

PROS

- Chain Accuracy
- Cost Efficiency
- Optimal decentralisation
- Efficient, Private and Secure Transactions
- Transparency

CONS

- Technology Cost
- Speed & Data Inefficiency
- Illegal Activities
- Regulation

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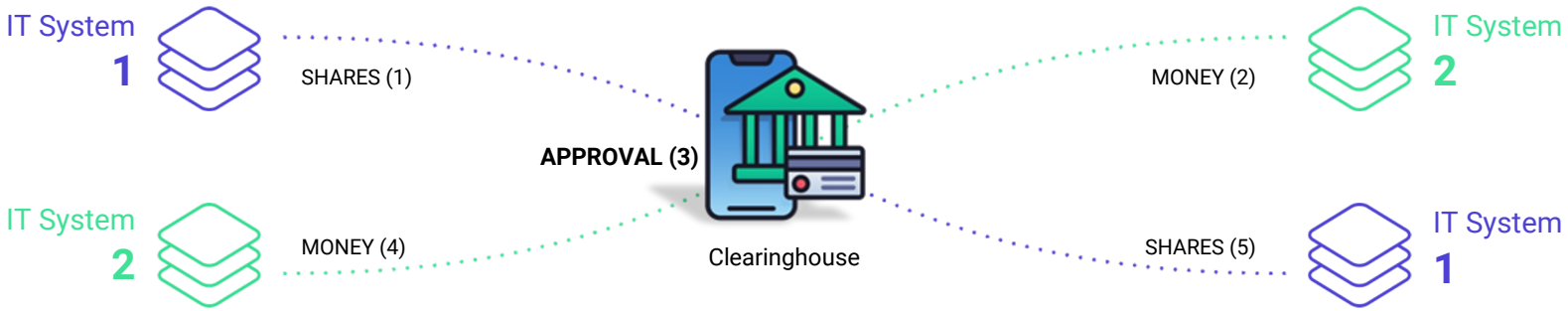
APPLICATION OF A DLT

How does a transaction currently work (2-3 days; fees; multiple steps)



How does a transaction work on a DLT system (seconds; no fees; simple step)

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EXAMPLES OF DLTs USE CASES

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Digital Identity

Tokens on blockchains may allow privacy preserving digital identity systems to be built. Self Sovereign Identity (SSI) may be very interesting.

Payment Tokens

Payment tokens are built as an efficient standardised means of exchange. Examples include stablecoins and algorithmic stablecoins.

Tokenized Art

Art, oldtimers, wine, and similar types of investment may now be tokenized for more efficient markets while allowing fractional ownership.

Voting

Decentralised processing combined with cryptography may allow for accountability without compromising on anonymity with regards to voting.

Decentralised Finance

Decentralised applications have already found some level of success with DeFi - applications for peer-to-peer lending, exchanging, etc.

Tokenized Securities

The integration of real-world assets in blockchain systems remains a very promising building block for future use cases.

DAOs

Smart contracts may also be used to build decentralised organisations governed by tokens.

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BITCOIN

Bitcoin is a **decentralised digital currency** and a form of electronic cash. It operates on a **peer-to-peer network**, utilising **blockchain technology** to enable secure and transparent transactions without the need for intermediaries like banks.

Bitcoin transactions are **verified by network participants through cryptography and recorded on a public ledger**. It was created in 2009 by an unknown person or group using the pseudonym Satoshi Nakamoto and has since gained attention as a store of value and potential alternative to traditional currencies.

To learn more about it: https://www.youtube.com/watch?v=I1si5ZWLgy0

Bitcoin is a **peer to peer electronic cash system.**

People can send and receive Bitcoins directly, secured by cryptography and the consensus protocol.

- Transactions are verified by miners and added to the blockchain.
- New Bitcoins are **created through mining**
- Bitcoin's value can be volatile, and it's often seen as a potential investment or store of value. It's accessible globally and offers a new way to handle transactions without relying on traditional financial systems.

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ETHER

Ether, or **ETH**, is the native currency of Ethereum. It is a '**digital currency**' that can be sent over the Internet instantly, and can also be used to pay for transactions in many **Ethereum-based applications**.

There are many exchange platforms for cryptocurrencies on which you can buy ETH, but the best one to use depends on specific factors, such as where you live.

Ethereum introduced the concept of **programmable contracts**, which can be used to create tokens, and the native cryptocurrency called Ether (ETH), which is used for transactions and network participation.

To learn more about it: https://ethereum.org/en/

Ethereum is the **community-run technology** powering the cryptocurrency ether (ETH) and thousands of decentralised applications.

Ethereum is an **open-source blockchain** platform that enables developers **to create and deploy smart contracts and decentralised applications (DApps)**.

Ethereum has revolutionised the blockchain space by allowing for self-executing contracts and a wide range of decentralised applications across various industries.

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NFTs

A **Non-Fungible Token** (NFT) is a **unique digital asset** that represents **ownership or proof of authenticity** of a specific item or piece of content, using a blockchain token.

Unlike cryptocurrencies like Bitcoin or Ethereum, which are interchangeable and hold equal value, **NFTs are distinct and cannot be exchanged on a one-to-one basis** due to their individual characteristics.

Each NFT is verifiably unique and is typically bought, sold, and stored on specialised NFT platforms, providing a **new way to establish ownership** and value in the digital realm.

To learn more about it:
https://www.forbes.com/advisor/investing/cryptocurrency/nft-non-fungible-token/

NFTs are created or "minted" to represent various objects, **encompassing both tangible and intangible assets**, such as graphic art, GIFs, videos (including sports highlights), collectibles, virtual avatars, video game skins, designer sneakers, music, and even tweets.

Think of NFTs as the **digital equivalent of physical collector's items**. Rather than receiving a physical object like an oil painting, the buyer obtains a **digital file**. Moreover, NFT owners theoretically enjoy **exclusive ownership rights**.

Each NFT can have only one owner at any given time, and blockchain technology simplifies the verification and transfer of tokens among owners. Creators can also embed specific information within an NFT's metadata, **allowing artists**, for instance, **to sign** their work by including their signature in the file. Moreover, when the NFT work is resold, the artist may receive a percentage of the transaction at each transfer.

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WEB3

For cryptocurrency developers and enthusiasts, **Web3** incorporates the technologies and concepts that are at the heart of cryptocurrencies: **decentralisation**, **token-based economies, smart contracts** and **the blockchain**.

It focuses on the **idea of ownership**, taking control away from the dominant big data companies and other central authorities and handing it over to the users. This is what decentralisation means:

> Users can conduct peer-to-peer business transactions, eliminating middlemen and reducing controlling entities. The **focus is more on privacy**, **transparency** and **user ownership**.

This is where blockchain technology and cryptocurrencies come in. Cryptocurrencies and the token economy facilitate this decentralisation model, allowing **information to be stored on a distributed ledger outside of any controlling entity**.

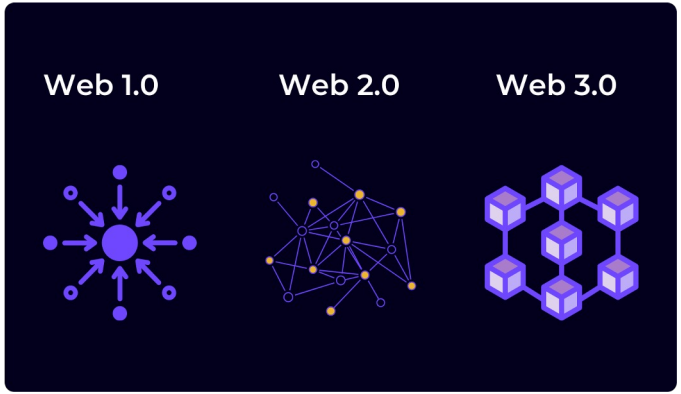

Image source: https://www.weforum.org/agenda/2022/02/web3-transform-the-internet/

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SMART CONTRACTS

A Smart Contract is a computer program that **directly and automatically controls** the transfer of digital assets between parties under specified conditions, operating much like traditional contracts but **with automatic enforcement through code**. These programs execute precisely as coded by their creators and, similar to traditional contracts upheld by legal means, smart contracts rely on code for their enforcement.

Smart contracts are essentially **programs stored on a blockchain and executed** when specific conditions are met. They are commonly utilised to automate contract execution, ensuring all parties have immediate certainty of the outcome, thus **eliminating the need for intermediaries and** streamlining **bureaucratic processes**. One notable application of smart contracts is in the creation of tokens, which are cryptocurrencies built on the Ethereum platform.

Advantages of Smart Contracts:

- Speed efficiency and accuracy
- Trust and transparency
- Security against hacking
- Saving time and money

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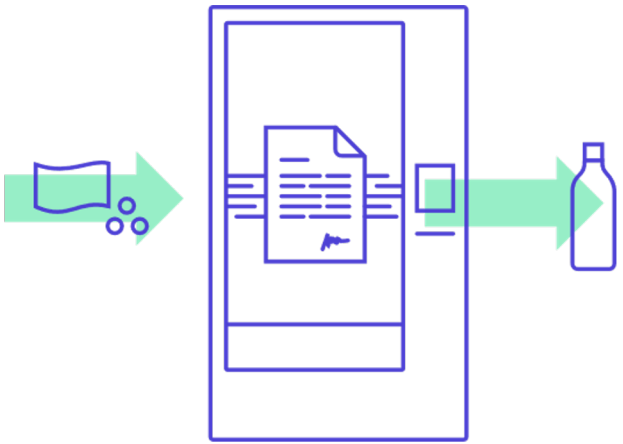
HOW DOES A SMART CONTRACT WORK?

This type of contract is designed to automatically execute and manage activities according to the rules defined in the code. It works similarly to a standard programme that implements business rules, except that the execution environment is a blockchain.

We can compare it to how a vending machine works: with the right inputs, a certain output is **guaranteed**.

Simply put, we can think of smart contracts as a digitised form of contract execution on the blockchain. Smart contracts involve two or more contracting parties and are technically legally binding, just like conventional digital contracts. While there are some similarities between traditional and smart contracts, they are not the same. While they are not intended to replace traditional agreements, smart contracts can be used to move us closer to a more decentralised society.



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DECENTRALISED EXECUTION

Smart contracts play a pivotal role in **decentralised execution** within Distributed Ledger Technologies (DLTs). They automate and enforce agreements, **eliminating the need for intermediaries**, enhancing security, and enabling a wide array of decentralised applications and use cases. Their **transparency and the assurance provided by nodes** establish them as an important use case of blockchain technology, granting users greater control and autonomy over their digital transactions and contracts.

Traditionally, **execution** of payments typically relied on a **centralised entity** to process transactions efficiently, requiring users to place trust in this central authority. Conversely, decentralised execution relies on a distributed network of nodes to independently validate and achieve consensus on transactions, offering enhanced security and trust without the necessity of a central authority.

	Decentralised Execution	**Legacy Execution**
Authority	Decentralised / Nodes	Central Authority
Consensus	Proof of Work / Proof of Stake	
Efficiency	Scalability challenges as every node needs to process and store the entire transaction history	More efficient and faster as they do not require consensus
Trust	High level of security and trust (each node)	In the centralised authority
Examples	EVM Compatible Smart Contract Platforms, e.g. Ethereum	Traditional financial systems / permissioned blockchains or DLTs

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DECENTRALISED APPLICATIONS (dApps)

A decentralised application (dApp) is an application **built on a decentralised network** that combines a **smart contract** and a **frontend user interface**, with the **backend code running on a decentralised peer-to-peer network**. On Ethereum, smart contracts are accessible and transparent, like open APIs, allowing dapps to also include a smart contract written by others.

Unlike traditional apps with backend code running on centralised servers, **a dapp can have frontend code and user interfaces written in any language**, similar to an app, making calls to its backend. Furthermore, its frontend can be hosted on decentralised storage, such as IPFS (InterPlanetary File System).

The dapps on Ethereum are characterised by their decentralised operation, deterministic functionality in all environments, Turing completeness and execution within a virtual environment known as the Ethereum Virtual Machine.

PROS	CONS
Zero downtime	Maintenance
Privacy	Performance overhead
Censorship resistance	Network congestion
Complete data integrity	User experience
Trustless computation	Potential centralisation

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CHAPTER:

4.

Public vs Private Blockchains

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PUBLIC vs PRIVATE BLOCKCHAINS

	Public blockchain	Private blockchain
Identity	Anonymous/Pseudonymous	Known identities
Transaction speed	Low	High
Security	Guaranteed by the network	Guaranteed by the owners
Asset	Native Assets	None
Access	Open read/write	Permissioned read/write
Trust	Require no trust between members	Nodes need to trust each other or the owner

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PUBLIC & PRIVATE BLOCKCHAINS

Blockchain technology has revolutionised various industries by providing secure, transparent, and decentralised solutions. There are two primary types of blockchains: **public** and **private**.

- Public blockchains are open, permissionless, and trustless, while private Blockchains are restricted, permissioned, and offer more control.
- Public blockchains prioritise decentralisation and security, while private Blockchains prioritise privacy, efficiency, and controlled access.

Some considerations:

- **Public** blockchains are ideal for applications requiring transparency and decentralisation.
- **Private** blockchains are suitable for businesses seeking secure and efficient internal processes.

Understanding the distinctions between public and private blockchains is essential for selecting the right solution based on specific needs and use cases.

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PUBLIC vs PRIVATE BLOCKCHAINS

Public Blockchains enable anyone to participate by verifying and adding data, fostering greater decentralisation. All that is needed to join the network and add transactions to the ledger is **a computer** with the **relevant software**. There is no central owner and identical copies of the ledger are distributed to all network participants.

Conversely, **private Blockchains are restricted to approved entities** for participation and control, making them **less decentralised**.

- Public blockchains offer enhanced security due to their extensive node network, deterring malicious attacks.
- Private blockchains handle more transactions per second as they involve fewer authorised users. However, public blockchains consume more energy for consensus compared to energy-efficient private blockchains.

In private blockchains, validators are **identifiable with proper credentials**, preventing miner collisions, whereas public blockchains lack such identification, raising concerns about collusion or 51% attacks.

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CHAPTER:

5.

Conclusions

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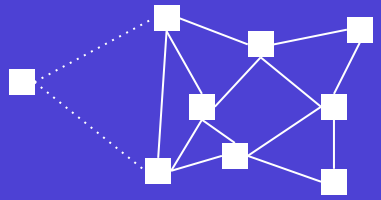
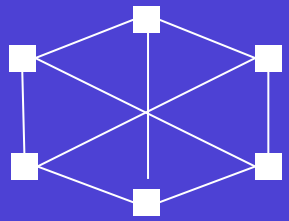
TAKE-AWAY MESSAGES

DISTRIBUTED LEDGER TECHNOLOGY



- Decentralised, immutable
- Provide high level of transparency
- Difficult to implement, new technology
- Resilience increases with nodes

CENTRALISED LEDGERS



- Centralised, modifiable
- Require more trust in the controlling entity
- Controlled access, management & maintenance. Rely on security measures

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CONCLUSIONS

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To conclude, a couple of remarks on **DLT use cases:**

1. Do not look for a use case. Ask yourself whether blockchain is the **best solution** to one of your problems.

2. Consider traditional network structures for your use case and **weigh the pros and cons of blockchain** compared to them.

3. If you are still planning to use a blockchain, **plan long-term** and consider public blockchain integration.

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USEFUL LINKS

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- "Coinbase" available at https://www.coinbase.com/de/learn/crypto-basics/what-is-a-token

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