

# POLITECNICO DI MILANO

School of Industrial and Information Engineering



Master of Science in Management Engineering

## “The Adoption of Blockchain and Distributed Ledger Technology: An Empirical Study on Companies and Public Administrations”

Supervisor: Prof. Perego Alessandro

Co-Supervisor: Portale Valeria

Fracassi Jacopo

Vella Giacomo

Ghezzi Davide

Graduate Student:

Sultanali Alikhanov - 962542

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## Abstract

Blockchain and Distributed Ledger Technologies (DLT) have captivated the interest of governments and enterprises globally. The world's trajectory towards continuous innovation propels the exploration for novel solutions that can drive down costs, enhance efficiency, and foster more trustworthy relationships. Recent years have unveiled the advantages reaped by pioneers who ventured into experimenting with Blockchain and DLT within their operations, sparking a worldwide fascination with the subject.

Although still at a nascent stage, the number of literature is expanding due to the heightened enthusiasm surrounding Blockchain, fueled by the positive outcomes observed in initial projects. Nevertheless, much of the existing literature predominantly focus on technical aspects and the technology's application across diverse sectors, offering limited insights into empirical studies capable of juxtaposing the spectrum of projects leveraging Blockchain and Distributed Ledger Technologies. This thesis strives to bridge the gap between the theoretical discourse found in literature and a more pragmatic approach that presents a holistic panorama of the technology's utilization.

An examination encompassing 2033 cases of global corporate and public administration projects forms the core of this analysis, conducted using a framework collaboratively developed with the Blockchain & Web3 Observatory at Politecnico di Milano.

The thesis work is structured into several key segments. Initial sections provides a comprehensive understanding of the technology and its evolutionary trajectory. Subsequently, the existing academic and consulting literature is analyzed, a vital step to identify gaps and formulate pertinent research inquiries. The third segment involves description of the garnered outcomes. Ultimately, the thesis concludes by offering a comprehensive synopsis of both the current state and future prospects.

## Abstract (Italian)

Blockchain e Distributed Ledger Technologies (DLT) hanno catturato l'interesse di governi e imprese a livello globale. La traiettoria del mondo verso l'innovazione continua spinge ad esplorare nuove soluzioni in grado di ridurre i costi, migliorare l'efficienza e promuovere relazioni più affidabili. Gli ultimi anni hanno rivelato i vantaggi ottenuti dai pionieri che si sono avventurati nella sperimentazione di Blockchain e DLT all'interno delle loro attività, scatenando un fascino mondiale sull'argomento.

Sebbene sia ancora in fase nascente, il numero di pubblicazioni si sta espandendo a causa del crescente entusiasmo che circonda la Blockchain, alimentato dai risultati positivi osservati nei primi progetti. Tuttavia, gran parte della letteratura esistente si concentra prevalentemente sugli aspetti tecnici e sull'applicazione della tecnologia in diversi settori, offrendo una visione limitata degli studi empirici in grado di giustapporre lo spettro dei progetti che sfruttano la Blockchain e le Distributed Ledger Technologies. Questa tesi cerca di colmare il divario tra il discorso teorico presente in letteratura e un approccio più pragmatico che presenta un panorama olistico dell'utilizzo della tecnologia.

Un esame che comprende 2033 casi di progetti globali di aziende e pubbliche amministrazioni costituisce il nucleo di questa analisi, condotta utilizzando un framework sviluppato in collaborazione con l'Osservatorio Blockchain & Web3 del Politecnico di Milano.

Il lavoro di tesi è strutturato in diversi segmenti chiave. Le sezioni iniziali forniscono una comprensione completa della tecnologia e della sua traiettoria evolutiva. Successivamente, viene analizzata la letteratura accademica e di consulenza esistente, un passo fondamentale per identificare le lacune e formulare le richieste di ricerca pertinenti. Il terzo segmento prevede la descrizione dei risultati ottenuti. Infine, la tesi si conclude offrendo una sinossi completa dello stato attuale e delle prospettive future.

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## Executive summary

In recent years, there has been growing interest in blockchain technology from businesses and governments around the world. Businesses are looking to use blockchain to improve efficiency, reduce costs, and increase trust. Governments are exploring how blockchain can be used to improve transparency and efficiency in their operations. The potential of blockchain is enormous. It has the potential to make our world more efficient, transparent, and secure. As more and more businesses and governments adopt blockchain technology, according to a report by PwC ("Blockchain: The Transformative Power of Trust"), the number of businesses using blockchain for their own projects has grown from 200 in 2017 to over 2,000 in 2022. We can expect to see even more innovative applications for this powerful technology.

The primary goal of this paper is to study the level of adoption of blockchain technology by businesses and public administrations and how effective its implementation is. In order to be able to do this, a few particular steps were taken. An analysis of the state of the art is done. It is feasible to comprehend the gaps between current knowledge and the kind of analysis used in this work by studying academic and gray literature. Next was a non-exhaustive census of blockchain projects from companies and public administrations. The analysis is then described, including the methods used and the conclusions drawn from combining some of the variables. The emphasis is on a new variable that is helpful to comprehend the level of maturity of blockchain and how businesses and government agencies are utilizing this technology. A summary of the current situation is provided as a conclusion.

## Literature review and research question

It was important to do literature research in order to grasp the current state of the art in blockchain and distributed ledger technology. It was feasible to determine the study issue for this work by understanding the major gaps in the literature by reading a number of academic publications and the so-called "grey literature." When examining scientific articles, a particular emphasis was placed on extracting details on how blockchain technologies were employed, as well as what problems or attempts at problems the authors of the research used blockchain technology to address.

Through literature research, it is possible to mention that decentralized registry systems and blockchain technology are gaining popularity both in academic settings and in the business world. Most blockchain-based innovations aim to increase transparency and autonomy, lower transaction costs and intermediaries, lessen the influence of human factors and potential errors, and give all stakeholders in the process the ability to participate and have an influence within the framework of established rights and rules.

## Research methodology

To answer the research question, we followed a specific methodology. This methodology involved using a census created with the support of the Blockchain & Web3 Observatory at Politecnico di Milano. The census tracks all news related to international companies and public administration projects that use blockchain technology.

The census is a valuable tool for understanding the world of blockchain. It provides data on the number and type of blockchain projects, the industries involved, and the maturity of the technology. This data can be used to identify trends and opportunities in the blockchain space.

There are two main criteria:

All the projects must be made by incumbent companies and not only by startups (if there is a partnership between an incumbent and a startup, the project can be inserted inside the database; if a technology solution is offered by a consulting firm or tech provider, it will

not be inserted inside the database; we use only cases of real adaptation of the technology).

All the projects must have international relevance.

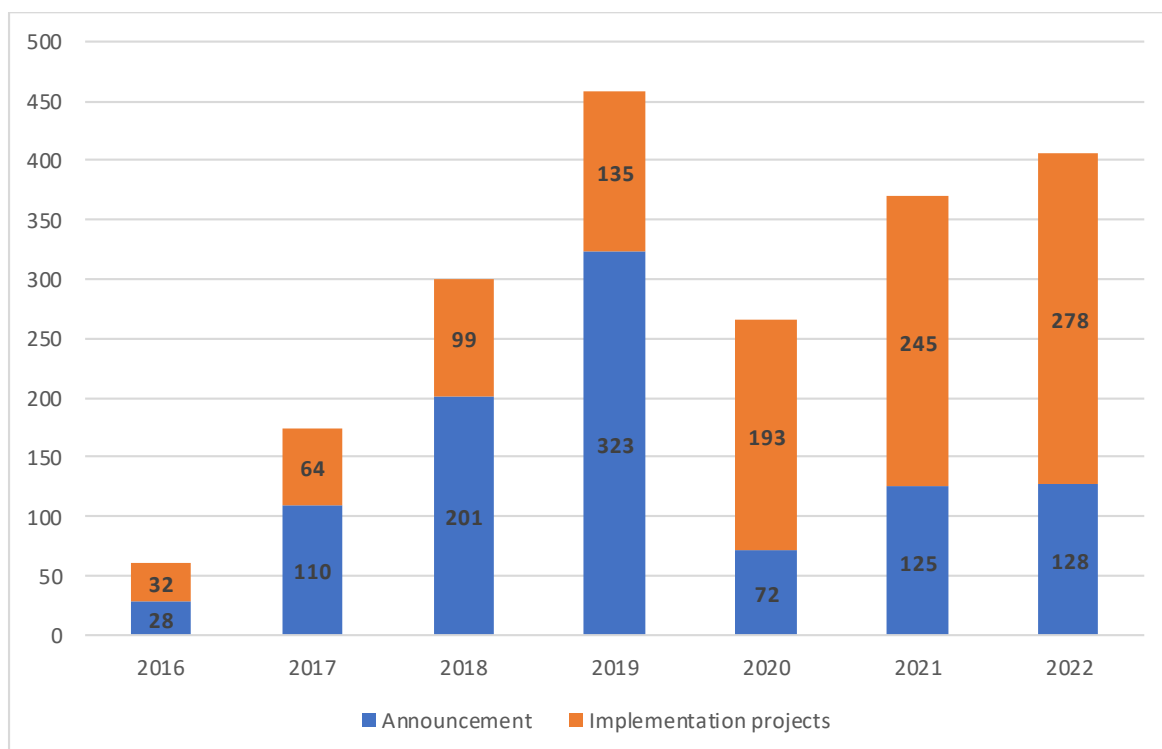
In collaboration with the Blockchain & Web3 Observatory of Politecnico di Milano, we updated the census with all the news from previous years. We also eliminated solutions that were not relevant or that referred to failed projects. In 2022, we added 418 new projects to the census, bringing the total number of use cases to 2033. These use cases will be analyzed in the next chapter.

Each project is added to the census by filling out the framework, which is composed of many variables and sub-variables that are described in detail in Chapter 4.

In the analysis we carried out this year, we decided to analyze specific business sectors more deeply. Finance, Media&Arts, and Government are some of the industries represented.

## Analysis and findings

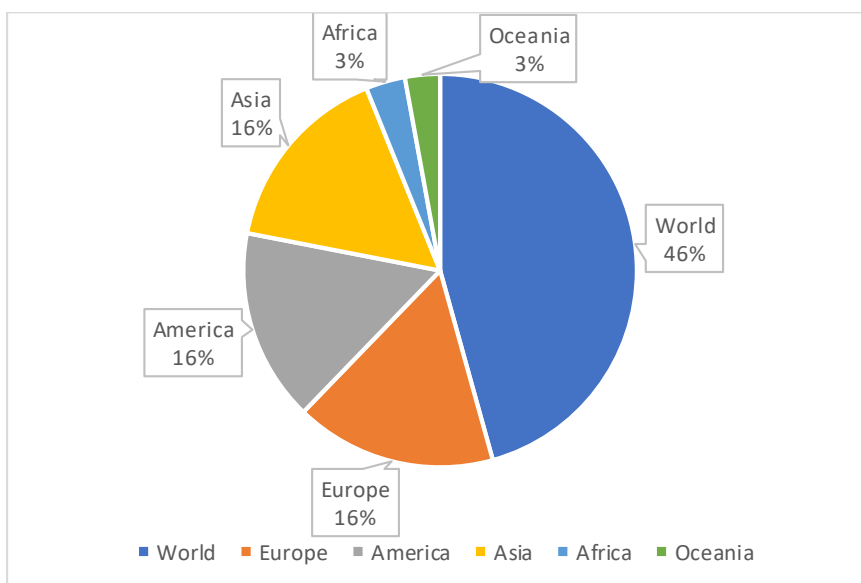
### Blockchain and Distributed Ledger use cases in the world



## 2033 Use cases

*Chart 1 Number of registered announcements and implementation projects*

The initial examination focused on the number of use cases recorded between 2016 and 2022. It revealed that blockchain and distributed ledger technology are progressively advancing and gaining practicality. The number of projects that were merely announced has decreased in the past couple of years, indicating that the excitement surrounding the technology in previous years is transforming into real, active projects in the market.



**1046 projects**

*Chart 2 Diffusion in the world of Blockchain and Distributed Ledger projects*

Analyzing the geographic distribution of different implementation projects in *Chart 2*, the data supports the notion of growing global interest in adopting blockchain technology. Notably, the European Blockchain Services Infrastructure (EBSI) has contributed to the expansion of various blockchain applications. The European Blockchain Services Infrastructure (EBSI) is a European Union (EU) initiative aimed at creating a cross-border and cross-sector infrastructure for blockchain applications and services. The primary purpose of EBSI is to facilitate the adoption and integration of blockchain technology across various sectors and countries within the European Union. It aims to promote the use of blockchain for public services and applications, enhance digital trust, and foster innovation. Additionally, Asia has emerged as a prominent continent showing interest in this technology, with particular emphasis on projects undertaken by Asian institutions to develop central bank digital currencies (CBDCs) on blockchain platforms. Central Bank Digital Currencies (CBDCs) are digital forms of a country's official currency issued and regulated by its central bank.

## The main sectors of application

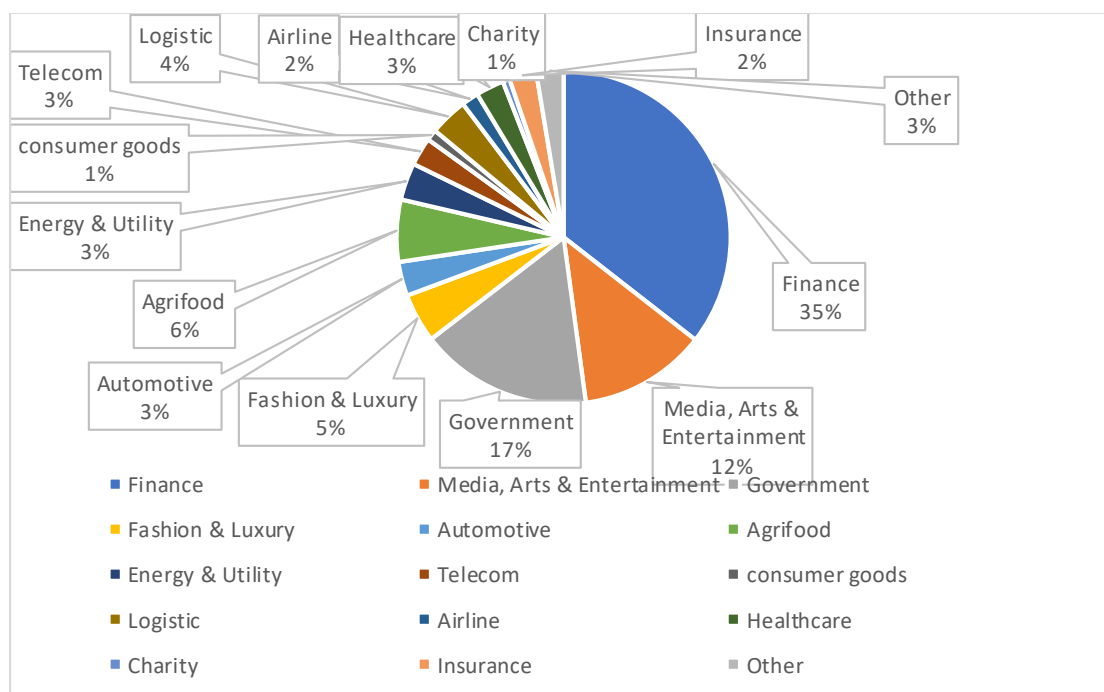


Chart 3 The main sectors of application

Another intriguing analysis focuses on the primary sectors of application. It is confirmed that between 2016 and 2022, the finance and government sectors witnessed the highest number of blockchain projects. While initially, blockchain and distributed ledger technology were predominantly utilized in these sectors, they have now become cross-industry solutions. Numerous sectors are embracing this technology to leverage its benefits. A notable example is the media and art sector, which experienced continuous growth in 2022 compared to previous years. This growth can be attributed to the NFT (non-fungible token) phenomenon. Sports companies, film companies, and renowned artists have harnessed the potential of blockchain technology, leading to the development of projects that have garnered significant media attention. As a result, blockchain technology has become more widely known to the general public.

In 2022, financial blockchain projects will continue to thrive, revolutionizing the financial landscape. Decentralized finance (DeFi) platforms like Aave (*Aave is a decentralized finance (DeFi) platform built on blockchain that allows users to lend, borrow, and earn interest on cryptocurrencies*) and Compound are reshaping lending and borrowing, enabling users to earn interest and access loans without intermediaries. Traditional

financial giants like JPMorgan are embracing blockchain for secure and efficient payment solutions, as exemplified by their use of Quorum (*a blockchain platform designed for use by businesses and organizations that need to maintain control over who can participate in the network and access the data*). Ripple's (*blockchain-based payment protocol*) cross-border payment solutions gain momentum, while Central Bank Digital Currencies (CBDCs) trials advance, like China's digital yuan. These projects highlight the diverse ways blockchain is redefining finance and fostering innovation, transparency, and accessibility across global markets.

Public administration and government blockchain projects are the second-most popular sector of blockchain applications and are at the forefront of digital transformation, aiming to enhance efficiency, transparency, and citizen-centric services. Estonia's e-Residency program stands as a pioneer, offering secure digital identities for global citizens to access government services remotely. Australia's digital health records system employs blockchain to ensure privacy and accessibility. Dubai's blockchain strategy continues to modernize public services, as exemplified by its trade finance platform. Meanwhile, countries like Sweden and China are piloting central bank digital currencies (CBDCs) to explore the potential of blockchain-based digital currencies. These initiatives underscore the growing momentum of government-led blockchain projects, with an emphasis on secure data management, efficient service delivery, and citizen empowerment. As these projects evolve, they not only showcase the transformative power of blockchain technology but also pave the way for a more digitally inclusive and responsive public sector.

The media, art, and entertainment industries are undergoing a paradigm shift through blockchain projects that prioritize transparency, authenticity, and creator empowerment. The emergence of NFTs (non-fungible tokens) has redefined ownership and monetization of digital art. Platforms like Rarible and OpenSea facilitate the trading of unique digital assets, enabling artists to directly engage with their audience and transforming the industry's revenue model. Additionally, blockchain-based content platforms like Decentraland and Somnium Space create virtual worlds where users can experience art and entertainment in new ways. These projects highlight how blockchain is revolutionizing content creation, distribution, and consumption, bridging the gap between

artists and audiences. As blockchain's influence in media and entertainment grows, it promises a future where creators have greater autonomy, consumers experience enhanced engagement, and artistic innovation thrives in a decentralized ecosystem.

### The main processes involved

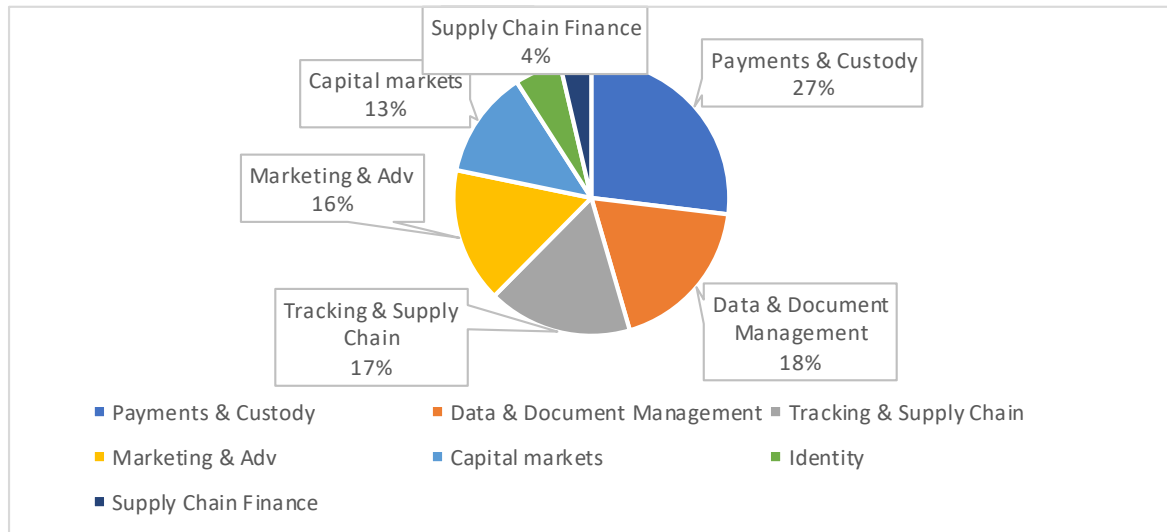


Chart 4 The main processes involved

Upon examining the gathered data, *Chart 4* reveals that the prominent processes involved in Blockchain applications are Payments, Data and Document Management, and Tracking & Supply Chain. The payment process has undergone significant development, primarily driven by numerous projects related to cryptocurrencies, stablecoins, and Central Bank Digital Currencies (CBDCs). Banks and institutions have also ventured into offering trading and custody services for digital assets, aiming to enhance the awareness and widespread adoption of cryptocurrencies. A notable recent development in this field is the emergence of CBDCs, which are being studied and tested by numerous central banks worldwide. CBDCs represent a digital form of fiat currency managed by a sovereign institution, such as a central bank.

Global payments processing firm Checkout.com has ventured into the cryptocurrency space by introducing a feature that allows merchants to accept payments in stablecoins (*cryptocurrency that is designed to maintain a stable value relative to another asset*). This move enables businesses to tap into the growing popularity of cryptocurrencies while



avoiding the price volatility often associated with traditional cryptocurrencies like Bitcoin. Merchants utilizing Checkout.com's platform can now offer their customers the option to pay with stablecoins, which are pegged to a stable asset like the US Dollar. This expansion into the cryptocurrency realm underscores the increasing acceptance of digital assets in mainstream commerce. As more companies explore integrating cryptocurrencies into their payment systems, it further cements the role of cryptocurrencies as a legitimate and accessible form of transaction.

In 2022, blockchain projects have had a profound impact on the data and document management business process, revolutionizing how information is stored, shared, and secured. Blockchain's inherent characteristics of transparency, immutability, and decentralization have introduced transformative changes in this domain, enhancing efficiency and trust while mitigating risks.

For instance, Factom, a blockchain-based data integrity solution, enables organizations to secure and verify critical documents by anchoring them to the blockchain. This ensures the authenticity and tamper-proof nature of records, making it highly valuable for industries like legal, healthcare, and supply chain management. Furthermore, blockchain-powered decentralized identity platforms like Sovrin provide individuals with control over their personal data, simplifying user authentication and reducing the need for redundant document submissions. In data sharing, Ocean Protocol utilizes blockchain to create a marketplace for data assets, enabling data owners to securely share their information while retaining ownership and control. This opens up opportunities for businesses to monetize their data assets.

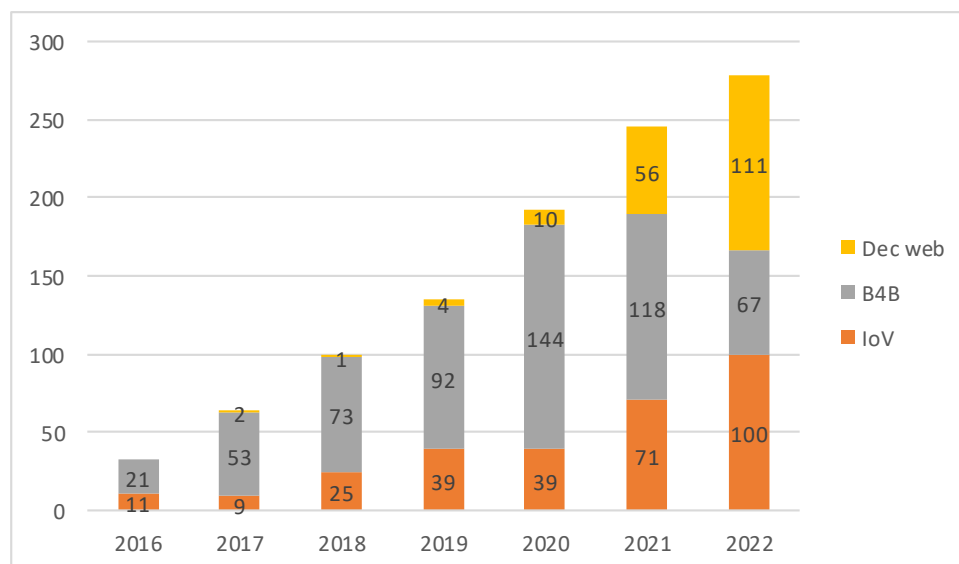
Blockchain projects have wielded significant influence over the tracking and supply chain business process, revolutionizing how goods are traced, monitored, and authenticated. Blockchain's inherent features of transparency, immutability, and decentralized verification have brought about transformative changes in this domain, enhancing accountability and efficiency while reducing fraud.

For example, IBM's Food Trust leverages blockchain to trace the journey of food products from farm to table, providing consumers with real-time information about the origin and handling of their food. This ensures food safety and quality while fostering consumer trust.

Another instance is VeChain, a blockchain platform that enables businesses to track and verify the authenticity of luxury goods, pharmaceuticals, and other high-value items. By storing product information on an immutable blockchain, it prevents counterfeiting and strengthens brand reputation.

Moreover, TradeLens, a blockchain initiative by IBM and Maersk, optimizes global trade logistics by providing end-to-end visibility into shipping processes. This streamlines documentation, enhances supply chain collaboration, and reduces delays.

### Types of Blockchain application



*Chart 5 Types of Blockchain application*

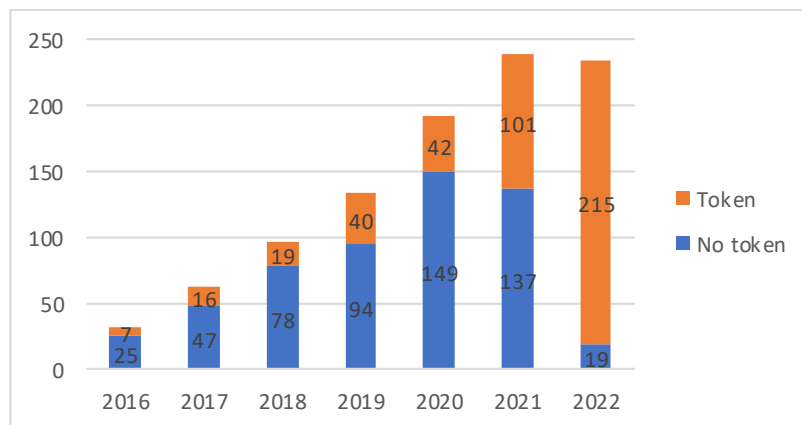
*Chart 5* demonstrates a notable increase in the number of use cases within the organization compared to the previous year. The Internet of Value is the way of blockchain applications, which refers to all applications that are used to exchange value, including digital currencies like cryptocurrencies, stablecoins, and CBDCs. This growth can be attributed to several trends that emerged in 2022. Throughout the year,

cryptocurrencies underwent continuous maturation, mainly due to the entry of various players who contributed to the expansion of this domain. Furthermore, institutions and significant companies shifted their focus towards stablecoins and CBDCs, resulting in a higher growth rate within this category.

In relation to Blockchain for Business projects, which include projects that use blockchain technology to replicate traditional business processes, These projects typically have the goal of making data more verifiable, coordinated, and reliable. There has been a slight decline in 2022. However, despite this decrease, it is evident that this category remains significant, given that it encompasses the highest number of implementation projects involving a majority of traditional companies.

Decentralized blockchain projects, which are focuses of the creation of an infrastructure, give an opportunity to develop new independent business solutions, not just replicate existing ones with blockchain adaptation. This type of application gained popularity in 2022 due to a growing recognition of the advantages offered by decentralization in terms of security, transparency, and trust. As traditional centralized systems faced various security breaches and data privacy concerns, decentralized blockchain technology emerged as a robust alternative.

### Using tokens



*Chart 6 Using tokens*

In 2022, it will have experienced remarkable growth, becoming a transformative force across various industries. Tokenization, the process of representing real-world assets as

digital tokens on a blockchain, offers new possibilities for ownership, liquidity, and innovation. This trend has been fueled by the increasing adoption of blockchain technology and the recognition of its potential to reshape traditional financial systems.

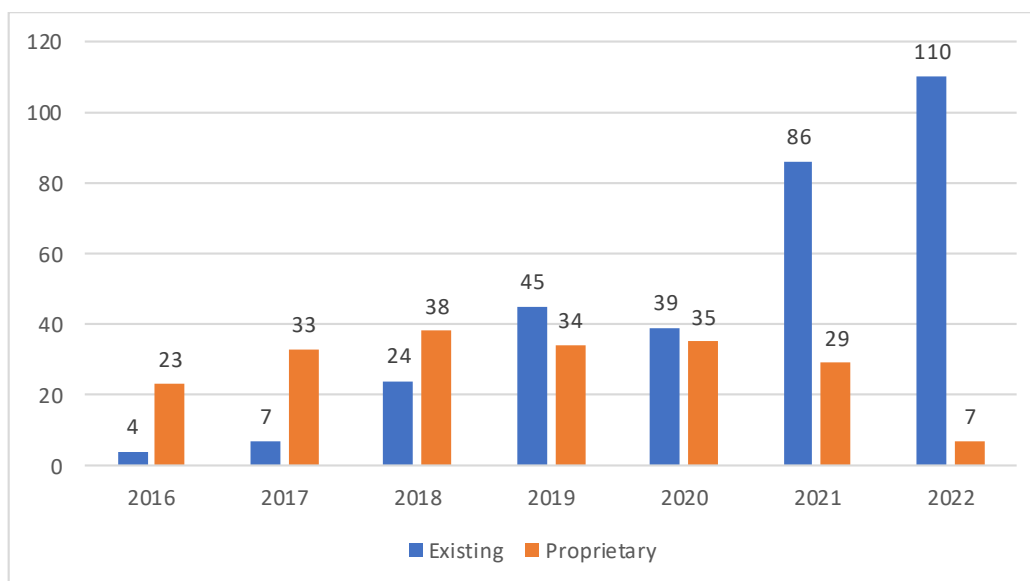
One notable example is the explosion of non-fungible tokens (NFTs) in the art and entertainment sectors. NFTs enable artists to tokenize their digital creations, granting them ownership and control while allowing collectors to purchase and trade unique digital assets. This has revolutionized the art market and paved the way for novel revenue streams for creators.

Real estate is also undergoing a transformation through tokenization. Companies like RealT tokenize real estate properties, allowing fractional ownership and democratizing access to real estate investments. This opens up opportunities for a broader range of investors to participate in the real estate market.

Furthermore, tokenization is impacting financial markets. Security tokens, representing ownership in traditional assets like stocks, bonds, and real estate, are gaining traction as they offer increased liquidity, transparency, and efficiency in trading.

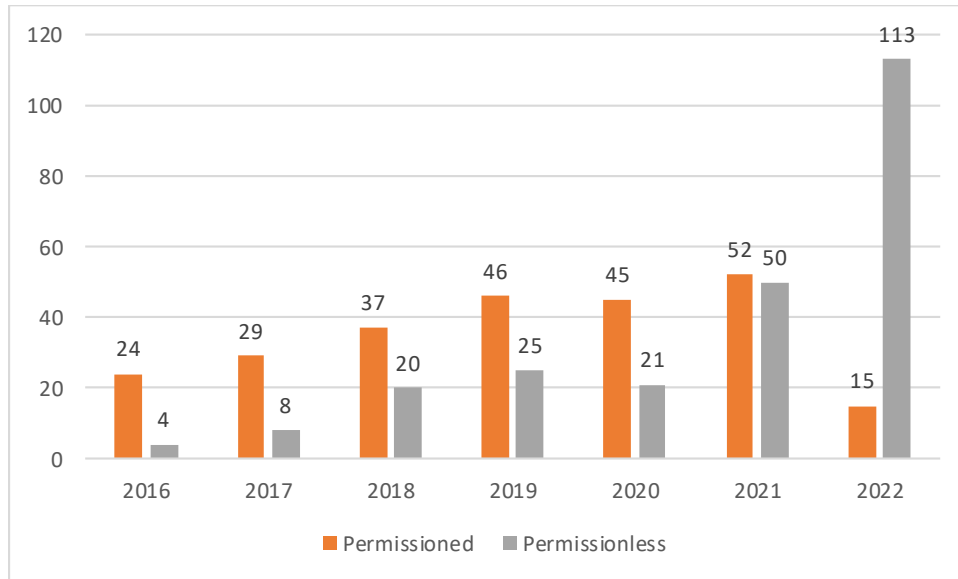
In the world of gaming, blockchain-based platforms like Axie Infinity have introduced play-to-earn models, where players can earn tokens for their in-game activities, blurring the lines between entertainment and financial gain.

## Finance, Government, Media&Arts projects platform analysis



*Chart 7 Types of platforms in Finance, Government, Media&Arts sector: existing or proprietary*

As we can see, finance, media, and government projects were more focused on using self-created platforms. Before 2021–2022, half of the projects were using proprietary platforms. One of the reasons why companies that use blockchain and DL are shifting to existing platforms is that the development of the technologies created platforms that could meet business requirements and satisfy the needs of companies. This choice offers a range of benefits, including efficiency, security, scalability, interoperability, and cost-effectiveness. The trend of existing platforms will increase, as we can see from the number of projects.



*Chart 8 Types of platforms in Finance, Government, Media&Arts sector: permitted or permissionless*

Permissionless platforms became more popular because they offered greater decentralization and transparency. Since anyone can participate in the network, there is no single point of failure, and transactions are validated by a distributed network of nodes. This can lead to increased trust in the network and a reduced risk of fraud or manipulation. Additionally, permissionless platforms offer more flexibility and innovation compared to permissioned platforms. Developers can create decentralized applications (dApps) on top of permissionless platforms, which can be used for a variety of use cases beyond finance, such as gaming, art, and social media.

## Discussion and conclusions

From the results obtained, it is possible to understand that blockchain technology will gain enormous popularity among incumbent companies in 2022. The development of the technology opened broad possibilities for companies and government agencies. The main benefits are cost-effectiveness, security, and increased efficiency.

This study has shown us the development of blockchain technology, characterized by significant advancements, increased adoption, and growing recognition of its potential across various industries. Its evolution has been driven by a combination of technological improvements, successful use cases, regulatory developments, and changing attitudes toward decentralized solutions. The rise in popularity of blockchain technology among incumbent companies reflects the growing realization of its transformative capabilities. Blockchain technology has evolved from its initial association with cryptocurrencies like Bitcoin to becoming a versatile tool with applications beyond digital currencies. New consensus algorithms, scalability solutions, and interoperability protocols have enhanced the performance and capabilities of blockchain networks, making them more suitable for various use cases. While cryptocurrencies remain a key application, the scope of blockchain's potential has expanded. Industries such as finance, supply chain, healthcare, real estate, and entertainment have identified how blockchain can address challenges like data security, transparency, fraud prevention, and efficient record-keeping.

The main sectors of blockchain application are finance, media and art, and government.

In recent years, the finance sector has had the highest number of blockchain projects. This surge in finance-related blockchain initiatives can be attributed to several key factors, including the technology's potential to transform financial services, address industry challenges, and enhance efficiency. Financial institutions and companies have gained a deeper understanding of blockchain's capabilities and how it can reshape traditional financial processes. One of the primary drivers behind the increasing number of financial blockchain projects is the potential for enhanced operational efficiency and significant cost savings. Blockchain's inherent transparency and immutability ensure that transactions are traceable and tamper-proof, reducing the risk of fraud and error. This appeal to security-conscious organizations has contributed to the rise in blockchain adoption.

Financial institutions are leveraging blockchain to enhance compliance and ensure accurate record-keeping, leading to more efficient audits and reduced regulatory risks. The emergence of decentralized finance (DeFi) has sparked a wave of innovation within the finance industry. DeFi projects leverage blockchain to create open, permissionless, and automated financial services, disrupting traditional financial intermediaries. This trend has contributed to the diversification of blockchain projects in finance.

Taking into consideration the year 2022 and analyzing 278 projects, the media and arts industry ranks second, contributing a total of 64 case studies to the survey. It is a significant rise in comparison with the 2021 number of cases, despite the fact that in 2021 there was a considerable increase versus 2020. The rise of non-fungible tokens (NFTs) has revolutionized how digital art and collectibles are bought and sold. NFTs, often built on blockchain platforms, provide a way to prove ownership and the scarcity of digital assets. Decentralized marketplaces like OpenSea and Rarible allow artists to directly connect with buyers, eliminating intermediaries and expanding the market for digital art. Blockchain technology enables the tokenization of media and art assets, allowing fractional ownership and new monetization models. Artists can tokenize their work, enabling fans and investors to own a stake in their creations. This opens up opportunities for crowdfunding, royalty sharing, and more direct relationships between creators and their audience.

From the census, we can mention that the number of blockchain projects initiated by government agencies around the world is one of the highest. This surge in government-driven blockchain initiatives is driven by various factors, including the technology's potential to enhance transparency, streamline processes, improve public services, and modernize government operations.

This paper will conduct a census of corporate and government projects that use blockchain technology. The goal of the census is to investigate the current state of blockchain technology, understand how it is used, and identify the concrete benefits that it can provide. The results of the census will be used to provide a comprehensive overview of the state of blockchain technology and its potential benefits. In our current study, we focused primarily on news pertaining to international projects utilizing blockchain



technology conducted by established companies and public administrations, which provided valuable insights into blockchain adaptation by incumbent companies and public administrations. However, it is essential to recognize that our research has certain limitations. Some of the things that could be done in the future to expand the research on blockchain technology are: meeting with experts in the field to get their insights on the technology; performing case studies to examine the success and failure of specific blockchain projects.

## 1 Introduction and objective of research

The roots of blockchain technology can be traced back to the conceptualization of the first decentralized digital currency, Bitcoin, in 2008 by an individual or group operating under the pseudonym Satoshi Nakamoto. The creation of Bitcoin introduced the concept of a decentralized and immutable ledger where transactions were cryptographically linked in blocks, forming a chain. This innovation provided an alternative to traditional financial systems, laying the foundation for a broader exploration of blockchain's potential applications.

Blockchain and distributed ledger technology (DLT) have emerged as groundbreaking innovations that are reshaping the landscape of business operations and public administration across various industries. With their potential to enhance transparency, security, efficiency, and trust in digital transactions, these technologies are gaining traction as powerful tools for addressing contemporary challenges.

Over the years, the concept of blockchain has evolved beyond cryptocurrencies, sparking interest in various industries seeking innovative solutions. Blockchain technology has undergone significant developmental phases, from the introduction of alternative consensus mechanisms such as proof-of-stake and delegated proof-of-stake to the rise of smart contracts and decentralized applications (DApps). This evolution has addressed scalability challenges, energy efficiency concerns, and interoperability issues, making blockchain more adaptable to the diverse needs of companies and public administrations.

Companies across sectors are harnessing blockchain's potential for supply chain management, digital identity verification, intellectual property protection, and more. Public administrations, on the other hand, are exploring the technology's potential to enhance government transparency, streamline administrative processes, and provide secure digital services to citizens.

The paper will be divided into several parts. The first part will introduce the current situation of blockchain technology and its most interesting features. The second part will provide information on how blockchain has influenced business sectors. The third part will analyze the state of the art in blockchain research and identify gaps in knowledge.

The fourth part will describe the methodology used to collect the data for the analysis. The fifth part will present the results of the analysis, focusing on more deep analyses in different business sectors that measure the maturity of blockchain adoption. The sixth part will discuss the implications of the findings.

## 2 Blockchain Technology

### 2.1 Blockchain today, growth of use of blockchain technology?

Blockchain technology is a rapidly growing field with a wide range of potential applications. It is most well-known for its use in cryptocurrencies, but it is also being explored for use in a variety of other industries, including finance, government, and advertising.

The growth of blockchain technology is being driven by a number of factors, including the increasing demand for secure and transparent data sharing, the need for more efficient and cost-effective business processes, and the growing interest in decentralized applications.

In the financial sector, blockchain is being used to develop new payment systems, improve fraud detection, and facilitate trade finance. In the government sector, blockchain technology can be leveraged to enhance transparency, security, and efficiency in various processes. By implementing blockchain-based systems for voting, public records, and identity management, governments can ensure tamper-resistant and auditable data, reducing the risk of fraud and manipulation. Additionally, blockchain can facilitate secure and traceable transactions, enabling streamlined interactions between different government agencies and citizens. In the advertisement sector, blockchain technology can be utilized to increase transparency and trust between advertisers, publishers, and consumers. By implementing decentralized ad networks, blockchain can enable more accurate and verifiable data on ad impressions and user engagement, reducing ad fraud and providing fair compensation for content creators and publishers.

The global blockchain market is expected to grow at a CAGR of 87.7% from 2023 to 2030. This growth is being driven by the increasing adoption of blockchain technology by businesses and governments around the world.

Some of the key benefits of blockchain technology include:

- **Security:** Blockchain is a very secure technology, as it is difficult to hack or tamper with data stored on a blockchain.
- **Transparency:** Blockchain provides a transparent way of recording data, as all transactions are stored on a public ledger.
- **Efficiency:** Blockchain can help improve efficiency in business processes as it can automate transactions and reduce the need for intermediaries.
- **Cost-effectiveness:** Blockchain can help reduce costs as it can eliminate the need for paper-based records and third-party verification.

Overall, blockchain technology is a promising new technology with a wide range of potential applications. The growth of blockchain technology is expected to continue in the coming years as more businesses and governments adopt this technology.

The growth of blockchain technology is still in its early stages, but it has the potential to revolutionize many industries. As the technology continues to mature, we can expect to see even more innovative applications of blockchain in the years to come.

## 2.2 Influence of blockchain technology in business sector

Blockchain technology is a distributed ledger technology that can be used to record transactions in a secure and transparent manner. It is often seen as a potential disruptor in the business sector, as it has the potential to improve efficiency, transparency, and security in a number of ways.

Blockchain technology also holds promise for improving data security and privacy in the business sector. With its cryptographic algorithms and decentralized architecture, blockchain ensures that data stored within the network is tamper-proof and highly resistant to hacking or unauthorized access. This is particularly relevant for industries that handle sensitive data, such as healthcare, where blockchain can secure medical records and facilitate secure data sharing between healthcare providers.

Additionally, blockchain technology offers potential for optimizing business processes through increased efficiency and automation. By leveraging smart contracts, businesses

can automate routine tasks, streamline workflows, and reduce human error. This can lead to cost savings, improved productivity, and enhanced customer experiences. Moreover, blockchain-based platforms and decentralized applications (DApps) enable businesses to create innovative solutions and foster collaboration in a trustless environment.

However, while the influence of blockchain technology in the business sector is promising, challenges exist. Scalability, interoperability, and regulatory frameworks are some of the hurdles that need to be addressed for wider adoption. Moreover, organizations need to adapt their processes and infrastructure to integrate blockchain effectively.

### 2.2.1. Finance

Blockchain technology has had a profound impact on the finance sector, revolutionizing traditional financial processes and systems. With its decentralized and transparent nature, blockchain has the potential to reshape various aspects of finance, from payments and remittances to lending and asset management.

One of the key areas where blockchain has influenced the finance sector is in the realm of payments and remittances. Traditional cross-border transactions can be slow, costly, and prone to errors. Blockchain technology offers a decentralized and secure platform for conducting global payments in a more efficient and cost-effective manner. By eliminating intermediaries and enabling peer-to-peer transactions, blockchain-based payment systems can reduce transaction fees, increase transaction speed, and enhance transparency.

Furthermore, blockchain technology has the potential to transform lending and credit processes. Through the use of smart contracts, blockchain can automate and enforce loan agreements, reducing the need for manual paperwork and intermediaries. This can streamline lending processes, increase transparency, and lower costs. Additionally, blockchain-based credit scoring systems can leverage non-traditional data sources and create a more inclusive lending environment, providing access to financial services for underserved populations.

Asset management is another area in the finance sector that is being influenced by blockchain technology. Blockchain-based systems enable fractional ownership and trading of assets, such as real estate or artwork, through tokenization. This opens up new

investment opportunities and enhances liquidity. Moreover, the decentralized and transparent nature of blockchain improves the tracking and authentication of assets, reducing the risk of fraud and improving the efficiency of asset management processes.

While the influence of blockchain technology on the finance sector is promising, challenges remain. Scalability, regulatory frameworks, and interoperability with existing financial systems are areas that need to be addressed for wider adoption. However, as the technology continues to mature and stakeholders collaborate to overcome these challenges, the influence of blockchain on the finance sector is expected to grow, creating a more efficient, transparent, and inclusive financial ecosystem.

### 2.2.2. Government

Blockchain technology has significantly influenced government applications by introducing transparency and accountability through immutable and decentralized data management. By implementing blockchain in voting processes, public procurement, and records management, governments can build trust with citizens and ensure tamper-resistant information. Moreover, blockchain facilitates secure identity management, streamlining access to government services, and reducing identity fraud.

The integration of smart contracts in governance enables automated and self-executing agreements, simplifying processes such as taxation, property registration, and social welfare distribution while minimizing bureaucracy. Decentralized applications (DApps) based on blockchain foster citizen engagement by allowing direct interaction with government entities, participatory decision-making, and policy voting. Furthermore, blockchain enhances data security through cryptographic algorithms and consensus mechanisms, safeguarding sensitive information from cyberattacks and unauthorized access. Overall, blockchain technology offers a promising pathway for more efficient, secure, and citizen-centric government applications.

### 2.2.3. Digital advertisement

Blockchain technology has the potential to revolutionize digital advertisement services, addressing critical challenges faced by the industry and introducing new possibilities for transparency, efficiency, and trust.

One of the key influences of blockchain technology on digital advertisement services is the improvement of transparency and accountability. With its decentralized and immutable ledger, blockchain enables advertisers and publishers to have a transparent view of ad placements, impressions, and payments. This eliminates the opacity often associated with traditional advertising ecosystems, allowing stakeholders to verify the accuracy of the data and ensure fair compensation for all parties involved.

Moreover, blockchain technology can combat ad fraud, which has been a persistent issue in digital advertising. By leveraging blockchain's transparency and tamper-proof nature, advertisers can verify ad impressions, clicks, and conversions, reducing the risk of fraudulent activities. Blockchain-based solutions can also detect and prevent click fraud, bot traffic, and unauthorized ad placements, leading to more effective and reliable advertising campaigns.

Data privacy is another significant area where blockchain technology can make a positive impact. With increasing concern for user data privacy, blockchain offers a decentralized and secure platform for storing and managing personal information. By providing users with control over their own data and enabling permission-based sharing, blockchain-based systems can protect user privacy and foster trust between advertisers and consumers.

While the integration of blockchain technology into digital advertisement services is still in its early stages, its potential for positive transformation is immense. Challenges such as scalability, adoption, and industry collaboration need to be addressed. However, as the technology continues to evolve, blockchain-based solutions have the capacity to reshape the digital advertising landscape, fostering transparency, reducing fraud, enhancing data privacy, and empowering users with more control over their online experiences.

### 3 State of the art/literature review

Methodology: when writing the literature review, we used a search for scientific articles based on the international scientometric database scopus (<https://www.sciencedirect.com>). This search was performed using the ключевым following keywords: blockchain, blockchain technology in business, blockchain in finance, blockchain in banks, blockchain in insurance, blockchain in government, blockchain supply chain, blockchain in logistic, blockchain in media.

The selected materials were grouped into the following areas: finance, public administration, supply chains, media and art. However, some articles and studies may have related to several of these areas at the same time. Therefore, the sequence of material presented in this review may cover several areas at once in separate places. A special focus in the analysis of scientific publications was focused on extracting information that described the ways of using blockchain technologies, as well as what tasks the authors of scientific research solved or tried to solve with the help of blockchain technologies.

Traditional approaches in the financial and banking system have a number of shortcomings, which are expressed in insufficient transparency and data security. In recent years, research has been conducted to improve the security of personal data and its exchange between government and financial institutions. It is proposed to improve the Know Your Customers system, which was also described by the authors M. Levi and M. Soudijn (Fugkeaw, 2022). They propose to strengthen the security system based on blockchain technology, as well as increase confidence in it. An updated version of the TrustBlock e-KUS system, in which encryption is built on the basis of attributes, to ensure the confidentiality and access of sensitive transactions stored in the blockchain.

Authorities around the world are trying to find more effective ways to fight financial crimes. According to the authors of the scientific article (Thommandru & Chakka, 2023) blockchain technology can become a means of solving the problem of money laundering. The study provides an example of the platform <https://bloomcredit.io> and in particular, the OnRamp application developed by them OnRamp, which is able to check IDs and



sanctions, as well as the verification of a politically exposed person (PEP). With the new addition of Plaid, users can now contact and verify their bank account information.

The study also mentions the company Quadrata, which also offers the services of the Know Your Customer system. One of its latest developments is the Quadrata Passport, which operates on the basis of Ethereum. The passport is a non-transferable NFT that users can use to store information that is necessary to comply with the requirements of KYC and anti-money laundering systems.

Like IBM, HSBC, Deutsche Bank and Mitsubishi UFJ Financial Group piloted a KYC information exchange service using blockchain technology. They were able to ensure the safe digital preservation of all consumer data and put an end to the unnecessary receipt of the same data by competing financial institutions.

Thus, the security of personal data and the use of blockchain technologies in these systems can directly affect the degree of money laundering in banking institutions. Blockchain technology can reduce these risks by introducing it into the KYC system.

China actively intends to develop and implement blockchain technology in the real economy. The number of enterprises engaged in development in this area continues to increase. Research team JingDu, YunShi, WanfuLi, YingChen (Du et al., 2023) asked what effect blockchain technologies bring to the level of corporate investment efficiency. And we concluded that blockchain technology significantly improves the efficiency of investment in companies engaged in blockchain-related activities, primarily to improve their own business operations, but not in companies engaged in blockchain-related activities to provide customers with products or services. Blockchain technology has a significant impact, on both deterring overinvestment and mitigating the effects of underinvestment.

Blockchain technologies are used in the field of "green" financing, aimed at the development of renewable energy and contributing to the energy transition. This transition depends on developing the city's renewable energy capacity and strengthening regional cooperation in energy trade, taking into account limited local resources. Together with the development of the digital economy and the development of green energy, financing can be carried out through peer-to-peer trading in the blockchain ecosystem (Delina, 2023). The authors of the study, based on a sociological method, attempt to analyze the potential

possibility of using the so-called Fintech RE, in solving energy and environmental problems on a local scale within the Hong Kong Administrative Region. It describes a decentralized system for distributing and trading surplus renewable energy with its consumer neighbors. This system of buying and selling electricity locally means increased efficiency, since losses are reduced when electricity is consumed near the place of its production. This approach requires advances in intelligent network operations, storage systems, and demand management. Blockchain can form the basis for creating safe and reliable energy trading platforms, for starters, at the local level.

The blockchain in this management system smooths out imbalances in energy supply and demand during peak hours, and also reduces consumers' electricity costs. In addition, the authors provide evidence that such systems are successfully functioning. In the New York State territory of Brooklyn, such a digital accounting system allowed those who do not have solar panels to purchase solar electricity directly from this power supply system, and not from the network (Gunarathna et al., 2022). At the same time, the authors cite contradictory facts that the use of blockchain technologies also consumes a lot of electricity, which can nullify the effect of using renewable energy sources.

There are other studies confirming the possibility of using blockchain in energy systems as part of the environmental agenda. The authors in their scientific article (Valdivia, 2023) provide the results of an analysis of the creation of equal trade in energy resources, where producers of renewable energy sources, including small power plants, will be united with large network operators of traditional electricity. Such a bidirectional exchange will be built on the basis of tokenization with the introduction of devices with Internet of Things technologies. Thus, according to the authors, the proposed integrated model allows creating mechanisms for decentralized management between traditional and new participants within the platform.

It is also noted that depending on the protocol used in the blockchain technology, the level of energy intensity can change and even significantly. Therefore, decentralized platforms, including decentralized finance, for all their advantages, require additional study, in particular, in-depth analysis and development of more efficient protocols.

Understanding the architecture and operating mechanisms of various DeFi protocols becomes crucial for creating new and innovative products (Shah et al., 2023). The scientific article concludes that протоколы DeFi protocols have similar implementation methods, despite providing different services. Their modularity allows for easier innovation with minimal barriers, which will lead to an accessible and liberalized financial system, while addressing data security concerns. The article provides data on the use of blockchain technology in new types of derivatives, automated exchanges, lending and asset management.

Blockchain technology has not spared accounting either. In the article (Han, Shiwakoti, et al., 2023) describes how blockchain technology can increase transparency and trust in accounting practices, as well as improve the efficiency of decision-making based on verified and consensus data. Multi-stage verification of blockchain protocols adds real-time trusted data for artificial intelligence, which is now used by auditors for reliability and efficiency. The authors suggest that, by combining blockchain technologies with artificial intelligence, it is possible to increase the efficiency of decision-making based on blockchain data. Smart contracts automate processes that can reduce management manipulation and opportunistic behavior. The authors of the study believe that Blockchain technology needs further in-depth research, requires стандартизация standardization and improvements to overcome technical, organizational and regulatory challenges in order to become a truly integral part of the financial system.

Researchers Julia Kreppmeier, Ralf Laschinger, Bertram I. Steininger, Gregor Dorfleitner in their work (Kreppmeier et al., 2023) show how blockchain affects the investment market. In particular, they considered the possibility of tokenization and the real estate market in order to reduce barriers for participants with small amounts of money, as well as increase liquidity. This leads to a higher degree of diversification of small investors and a decrease in the degree асимметрии of information asymmetry in this market.

Authors (Barbureau et al., 2023) conclude that despite the fact that DeFi, in particular the Bloomberg index Galaxy was considered, DeFi is not inherently decentralized, as it seems at first glance. The authors found that the voting rights of DeFi projects are very concentrated, and the implementation of these rights is very low

In blockchain-based insurance, multinational insurance policies are being developed. For example, this was stated by AIG in partnership with IBM and Standard Chartered Bank (IBM Newsroom, b. d.). As a pilot project, three firms were able to convert one multinational policy in the UK to three local policies in the US, Singapore and Kenya into smart contracts, thus, making the policy accessible to all stakeholders and improving the efficiency and management of multinational policies. The French company AXA offered another product for passenger insurance when traveling by plane. Their product is based on smart contracts and is designed to process claims and pay compensation to those passengers who suffer from flight delays. The smart contract is responsible for determining whether to compensate the traveller for the damage or not, and the consumer will be notified accordingly of the decision. It also develops an element of trust with the consumer.

Blockchain technologies they offer a new claim insurance scheme based on smart contracts. The authors of the article combine the publicly verifiable zk-SNARK technology with digital signature technology for data authentication in the FAD phase. The solution has the following properties: authentication correctness, fullota, perfect zero knowledge (Zheng et al., 2022).

The Media&Art areas are related, in one way or another, to the creation of content and creativity. For example, blockchain technologies are used as the basis for a platform for joint content creation between different participants in the process. For example, the CryptPad application is used for co-writing text. At the same time, none of the users and editors have the predominant ownership and administration rights in the collaboration. And in the study (Zhan et al., 2023) describes the use of blockchain in creating a social media platform. For example, we took the world's first decentralized social network "Pixie" for sharing photo and video content that can be used in design and art. There was also an attempt to do research on the use of blockchain in journalism (Pham & Nguyet, 2023)

Marketing, design, and other similar areas often use a system of hiring employees for certain projects temporarily. Here, smart contracts help regulate the relationship between the employer and the performer, automating the process of cooperation. Smart contracts

are also planned to be used to regulate copyrights and licenses for используемый the content used in advertising campaigns. The impact of blockchain technology on marketing is discussed in this article (Haynes & Hietanen, 2023), in which this technology is considered not just as a technological protocol, but also as a social machine in which the exchange is carried out between users without the participation of a central authority.

Authors of another study (Han, Chen, et al., 2023) create a tokenized caption crowdsourcing system based on blockchain technology and smart contracts. In their opinion, the operating environment currently used has an insufficient level of trust between video content creators and subtitle creators. The authors of the study propose to solve this problem with the help of blockchain. The system will monitor the quality of subtitles in which content viewers themselves participate, ensure that video and subtitle creators are rewarded automatically, and function independently within the community.

The regulation and protection of copyright is a fairly broad area for the application of blockchain technologies. For example, in the study (Ferro et al., 2023) points out that intellectual property governance must evolve in a digital world where not only companies, but also many independent content creators contribute to our culture through their art, music, and videos. Through the use of smart contracts, it can allow for more flexible management of digital rights and optimize royalty payments. Within the framework of the international project "MediaVerse", an innovative approach to digital rights management was proposed, which offers a combined use of legal smart contracts and blockchain smart contracts to take care of the legally binding contractual aspects of intellectual property rights and, at the same time, the need for notarization, transfer of rights and royalty payments. This innovation increases the level of fairness of the monetization process for creators of copyrighted works and content.

A study was also made on the problem of copyright protection in the digital space (Siddique & Fatima, 2022), in which the authors propose a concept that integrates a digital signature, a structure similarity index measurement indicator, and blockchain technology for digital lifecycle rights management. At the same time, copyrights are granted using the SSIM method. The SSIM algorithm checks the newly added media file with the ones stored in the database. If there is a similar file, the system classifies it as a duplicate. If an

identical file is not found in the database, it is saved in the database as a unique one, which is assigned copyright according to the digital signature of the creator.

Authors of the article (Huynh-The et al., 2023) explore the problems and prospects of blockchain in the development of the metaverse, which is being developed by Meta. They represent some technical improvements to the metaverse blockchain that improve the performance of various applications and services in the virtual world. There are the following factors that hinder the development of the blockchain and metaverse today. First, we need research and development that will help unite different blockchain networks, because so far each blockchain network is created for specific tasks and areas. But for further development of the metaverse, a broader scope is required, which is several different blockchain networks. For example, users will be able to send information from the Ethereum blockchain to the Polygon blockchain and vice versa. We need "bridges" between blockchain networks. Secondly, with the development of blockchain technologies and the expansion of their use, a higher load on the energy potential will be created. It is necessary to find less energy-intensive ways of functioning of blockchain technologies. We consider the Stellar consensus protocol, which allows you to authenticate transactions based on a set of reliable nodes, rather than running the authentication process for the entire network as a PoW or PoS algorithm, which, in turn, speeds up speed and reduces energy consumption.

Authors of the article (Furones & Monzón, 2023) on the example of urban water supply and sewerage systems in Spain, they consider the possibility of using blockchain technology. On the one hand, the author points out that blockchain technology and smart contracts based on them can increase productivity in water resources management. But on the other hand, it considers this technology as an auxiliary one, which is limited in its use and getting an effect from it. Because it can only be used as part of the management and improvement of control and accounting for the water supply system. And for the main activity, which is production, the effect of using the blockchain is not significant.

It is concluded that processes related to the management of maintenance contracts, incidents and deliveries can bring the greatest benefits with the use of blockchain technology.

For further research, it is important to focus on the combination of blockchain with other new technologies in order to get a synergistic effect (Sandner et al., 2020). Because in combination with artificial intelligence and the Internet of Things, blockchain technology can have a more tangible effect on production processes.

In another study and the authors propose the introduction of blockchain technology to optimize the work of public institutions. In particular, an institution in the UK called House. They have developed a blockchain application that facilitates the distributed exchange of information within and between government agencies and shows how this allows for better public value. Effective tracking will help identify and verify fraud cases. This increases not only the internal public value, which is expressed in the transparency of employees' work and their professionalism, but also the external value. The authors argue that the use of blockchain can not only encourage professional and ethical behavior in a public institution, but also prevent users of public services from behaving unethically or illegally. Thus, the blockchain has an impact on the growth of public value, internal and external, in the field of public services and public administration. It also predicts a reduction in fraud and increased transparency of activities.

The blockchain network is used as a way to increase transparency in government, with the aim of reducing corruption and fraud among civil servants. In a scientific study describes a prototype of the app. It represents a blockchain system that uses smart contracts deployed on the Ropsten Ethereum network. It can store confidential user data off-chain via IPFS and restrict access to the data in such a way that only authorized users can manage it. This complex architecture has been made more user-friendly by creating a client-side website in React. In this system of a decentralized registry, nothing should be removed, but only added. This feature is particularly useful for government processes that need to track previous data or information that was created decades ago.

In the context of land ownership, for example, the Government would be able to maintain a complete historical record of property rights and transfers of land ownership, thus ensuring that landowners receive appropriate documentation. The distributed nature of

blockchain technology means that each relevant public entity has its own copy of the ledger. This allows them to independently verify the operations of other nodes in a decentralized manner. This mechanism helps ensure that the network accepts only valid transactions and prevents erroneous transactions from being invalidated by the ledger. This is especially useful in government processes involving more than one actor and none of the actors can be trusted and should only be trusted with data management, as they can perform malicious actions.

There are studies that indicate deeper and more radical changes in the social structure of states or small cities using blockchain technology. Digitalization, including blockchain technology, is changing not only business processes, but also gradually changing society. In the article (Rasillo, 2023) examines the activist collective FairCoop. Inspired by the ideas of decentralization and post-capitalism, this group of people developed their own cryptocurrency, FairCoin, along with tools and infrastructures that seek to challenge the economic and digital status quo. Through their FairCoop cryptocurrency, FairCoop activists and users have attempted to develop a post-capitalist financial structure by providing banking services that were designed to expand these alternative economies.

Therefore, of course, such technologies and digital projects on a decentralized basis are in a constant process of change and evolution. When implementing new ideas and projects using the blockchain, previous mistakes and successes are taken into account. Literature and research related to digital projects rightly note their existence, especially given the rapid spread of platform capitalism and the enormous power that large technology corporations wield.

An analysis that examines internal governance issues, as well as the challenges associated with creating post-capitalist projects in a neoliberalized society, can help to understand how social tensions and asymmetries create problems for the reproduction of digital resources.

In public administration, it is important to evaluate the public value and strive to increase it. At the same time, digital technologies today play a significant role in creating such interaction that would contribute to the growth of public value. Авторы (Rukanova et al., 2023) argue that in modern conditions, the efforts of both the state and business are



necessary to create social value. But ensuring interaction between the state and business in the process of creating and increasing public value will cost digital infrastructure, one of which may be blockchain technology.

Greater adoption of digital technologies and digitized data in companies' business processes will require increased trust in data interchange. Supply chains, especially global value chains, are most in need of this trust. Since this sphere unites many participants, most of whom are unknown to each other. This further complicates the issue of trusting other partners, who in some cases are strangers. Consequently, greater digitization will also mean an increase in the need for trust and security in transactions. Therefore, the authors of the study (Tiwari et al., 2023) believe that blockchain is one of the most effective ways to solve this problem in the field of supply chains.

The authors describe the use of the TradeLens blockchain platform, which is a joint project of IBM and Maersk (Rukanova et al., 2023). This blockchain platform for tracking global maritime traffic was also explored in the article (Lorenz-Meyer & Santos, 2023).

Previously, according to the head of IBM Blockchain, Marie Wieck, "blockchain reduces the processing of paper documents by 10 times, allowing you to quickly and easily write out invoices for cargo, issue sanitary certificates, obtain customs permits, payment invoices and other documents. Before the introduction of blockchain, a container with cargo spent more time in ports than it sailed from Kenya to Holland" (IBM-Maersk blockchain alliance cuts oceanic shipping times by 40% - CNET, b. d.) she gave an example. But this project, as it turned out later in early 2023, was closed due to its inability to withstand competition from the Hong Kong consortium Global Shipping Business Network (GSBN). In July 2021, GSBN (in partnership with Oracle, Microsoft Azure, AntChain and Alibaba Cloud) launched its first blockchain-based application in China called Cargo Release, which was directly developed to speed up data processing time by eliminating paper documents and storing data on the blockchain (New blockchain platform aims to track one-third of all shipping containers globally, b. d.). Not all applications and systems built on the previously announced blockchain technology remained successful. It is necessary to monitor on an ongoing basis the future fate of such projects.

Tracking supply chains and transparency in food production and delivery is essential, especially when the risk of a food crisis is emerging. At least, this is what the authors of the study believe (Patel et al., 2023) which raises the issue of traceability of food products from farm to fork in traditional supply chains. And the requirements of regulatory authorities in the field of food safety are very often ignored during transportation and storage. In particular, it is not uncommon to find cases of falsification of invoices and contracts, not to mention changing the information describing the product and its composition and date of manufacture. The authors see a solution to the problem in the use of blockchain technology and the Internet of Things technologies in tracking the entire food supply chain, in particular livestock products. At the moment, there are constraints in this direction, which are related to training and understanding among participants and food companies. Perhaps some of them will not benefit from this innovation for their own selfish purposes. It is also important to understand the regulatory framework in order to apply this technology tactically.

Transparency in the food sector is particularly relevant to the Common Agricultural Policy (CSP) of the European Union, which came into force in January 2023. This policy is aimed at differentiating products by quality, ensuring greater transparency regarding the origin of food, as well as operations and participants in the value chain. In this regard, the authors of another study suggest the use of blockchain in the process of certification of food production conditions, using the example of Spain (Martínez-Castañeda & Feijoo, 2023). Blockchain offers supply chain capabilities to enhance end-to-end visibility and traceability, resulting in increased transparency (Sunmola & Burgess, 2023).

The problem of integrating other technologies with blockchain technologies is one of the constraints to development and wider use. So in the study (Ashraf & Heavey, 2023) attempts to introduce an integrated system for digitizing information and supply chains based on blockchain and the Internet of Things. This architecture allows you to track the product from source to destination, through multidisciplinary suppliers, logistics, manufacturers to the end user. The model uses blockchain the Solana blockchain. The developed device блокчейн stores data on temperature, humidity, light, location, tilt, opening of doors, vibration, and magnetic field in the blockchain.

Blockchain technologies are also used in other areas. From the selected scientific publications, for example, there is a study in which blockchain technology is considered as a means to create a tool that will verify, and confirm the legality of any product. Since the blockchain provides transparency and decentralization, such data cannot be tampered with by anyone. Using this property of the blockchain, the authors of the study (Anthony et al., 2023) develop a system that can be used by manufacturers and companies of goods to increase the level of trust in themselves on the part of consumers. And the consumer will know and can independently verify the quality and legality of a particular product.

In a comparative study the authors propose using blockchain, in particular, Hyperledger Fabric and Ethereum blockchain platforms to improve the intelligent Mobility-as-a-Service transport system that combines different types of transport. And make it more transparent and reliable, as well as decentralized. Other researchers also propose to introduce a Ride-Sharing blockchain system in Ride-Sharing services *блокчейн*, in order to increase the decentralization of the system. Their experimental results proved the applicability and effectiveness of blockchain-based RSS and IPFS, *е обеспечиваю* which provide efficient storage of ride-sharing data, immutable history, and overall better efficiency in a decentralized manner.

The use of blockchain has prospects in machine learning. Research (Wang & Tsai, 2022), (Qiao & Lv, 2023), related to the improvement of the machine learning technique, which is called Federated learning, indicate that by combining this technique with the blockchain, a more efficient learning model will be obtained. The so-called Asynchronous Federated Learning System, which operates on the basis of the main node of the blockchain network and its associated sub-blockchain networks. Sub-blockchains or subsystems are designed to monitor and be responsible for partial model changes. And the main node of the blockchain is responsible for global updates of the model. This approach, according to the authors, can facilitate a synchronous machine learning model (Federated learning) and, consequently, reduce associated costs and increase data reliability.

However, as the authors of the research note, today the development and implementation of such a configuration is constrained by several factors: the speed of recording parameters of the main blockchain network requires 2000 ms per record, which is much less than the speed of data transfer of the processor, and there is also a limit on the speed of data transfer in the network.

Blockchain technologies and decentralized registry systems are increasingly attracting attention, both in academic circles and for practical applications. Most innovations using blockchain systems are used to increase transparency, autonomy, reduce transaction costs and intermediaries, reduce the impact of human factors and possible errors, and allow all participants in the process in the blockchain system to participate and influence the system within the established rights and rules.

Systems created on the basis of blockchain have a serious impact on the business processes of enterprises and corporations. Mainly, the effect of using blockchain in business processes of enterprises is expressed in optimizing management, improving the quality of information monitoring and accumulating relevant data for decision-making. And if we talk about the main production processes, and not management processes, then in this aspect the use of blockchain is still limited. These limitations are mainly related to the lack of development of IoT devices that would serve as an intermediary between production processes and management. In addition, as many researchers note, the integration of blockchain with other technologies is not sufficiently developed to achieve a higher effect from the use of blockchain. Therefore, many theoretical studies are aimed at finding different combinations of different technologies with the blockchain. Also, previous studies show that in some cases, the existing processor and network capacities do not allow us to use the full potential of technologies and integrated systems built on the blockchain.

Despite the significant advantages of using blockchain technologies in business and communities, there are certain risks and threats. For example, in the study (Kokaras & Foti, 2023) provides evidence that providing an additional level of anonymity, in particular, concealing identity, can significantly increase the cost of gas, up to 2.5 times, depending on the choice of cryptographic tools that determine the use of storage and computing resources of the blockchain. Also, everyone knows that mining farms require a large amount of electricity. Therefore, these aspects should also be taken into account when implementing technologies, since increasing capacity and productivity can have zero effect on society. The other side of the coin is the spread of blockchain technologies and

platforms built on its basis can shake the socio-political foundations as a result of a gradual change in the thinking of society. This was also discussed in this review.

A number of studies also characterize blockchain technologies with some degree of inconsistency. While pursuing the goal of decentralization, it should be understood that ("What Is DAO - Decentralized Autonomous Organizations", etc.) there can be no complete or absolute decentralization. A system cannot exist without a specific center. Depending on the management rules, there are different levels of decentralization. Even if the network is geographically decentralized and the participants are independent, the rules that are embedded in the blockchain protocol or smart contract will be the point of centralization.

Thus, on a global scale, digitalization and blockchain technologies, together with the Internet of Things, can significantly reduce the role of a person and his participation in the management of processes themselves, whether in business or in the social sphere. At the same time, the role of rules and regulations defined by the blockchain network protocol increases.

### 3.1 Gaps and research question

It has been discovered through a review of academic literature that blockchain technology has been explored in a technical and theoretical manner, often through specific solutions to particular industries. Taking into account the gray literature as well, it is clear why this is a crucial subject for businesses and government agencies. The projections and research presented in the various publications help us comprehend how this is a technology with a bright future and the potential to be crucial in gaining a competitive edge. Additionally, it is possible to see in the reports that were examined distinct data gathering methodologies that produced findings on the same subject but from various angles. There aren't many scholarly studies that analyze the subject from an empirical standpoint. Even if there has been an increase in recent years, there is still a need to research blockchain technology and distributed ledger technology from a wider viewpoint, based on actual projects and real-world experience.

The primary research topic for this work originated from the following ideas:

"How are blockchain and distributed ledger technology influencing the internal business processes of business companies and public administrations?"

The census created with the support of the Blockchain and Distributed Ledger Observatory of Politecnico di Milano since 2016 was studied and updated to help answer this question and analyze the true trends that blockchain technology is bringing to the globe. This ongoing study gathers data and information on major business and government initiatives.

### 3.2 Future research directions

The publications taken into consideration for the literature study show that the technology under analysis is still in its infancy. It is a setting that is growing and changing quickly and has the potential to be of significant benefit to businesses and government agencies. There will undoubtedly still be a need for empirical research on this subject, looking at the benefits and drawbacks of businesses and government agencies using blockchain technology. It's critical to comprehend what the true advantages are that this may offer in the company sector. In order to combine different perspectives and have a comprehensive picture of what is occurring in the market, the study will need to be both qualitative and quantitative. The use of distributed ledger technology and blockchain may be viewed as a new paradigm that has the potential to significantly change the understanding of the economy, business, and society. However, because so many countries are attempting to take advantage of this innovation through initiatives including digital currencies, it is important to watch and comprehend this transformation.

## 4 Methodology

This chapter outlines the methodology employed to address the research question at hand. To gain insights and comprehend the landscape of blockchain technology, the Blockchain & Web3 Observatory at Politecnico di Milano established a comprehensive database in 2016. This database tracks and documents news pertaining to international projects utilizing blockchain technology conducted by established companies and public administrations.

The methodology follows two primary criteria:

- 1) Projects must be initiated by incumbent companies, although partnerships with startups are also considered for inclusion.
- 2) Projects must possess international relevance.

The census conducted is non-exhaustive but aims to identify implementation projects and announcements made by incumbent companies and public administrations. Monitoring of prominent blockchain-related websites and newspapers such as [ledgerinsights.com](https://ledgerinsights.com), [coindesk.com](https://coindesk.com), [cointelegraph.com](https://cointelegraph.com), and [decrypt.co](https://decrypt.co) was undertaken to ensure comprehensive coverage.

In collaboration with the Observatory, regular updates were made to incorporate the latest news from previous years. Solutions deemed irrelevant or associated with failed projects were removed. In 2022, a total of 406 new projects were added to the census, bringing the overall count to 2,033 use cases, which will be further analyzed in subsequent chapters.

Each project is included in the census by providing relevant details through a framework consisting of various variables, which will be described in detail later on.

## 4.1 Census

The census is made up of variables that collect as much information as possible about each project. This information is used to track the history of each project and make decisions about future projects.

### 4.1.1 Data and links

The date and link to the online publication of a project

### 4.1.2 Project state

This variable is utilized to track the various stages of a project, capturing its history and evolution. The following categories are employed:

*Announcement:* This stage signifies the initial announcement of a project, typically in its early phase. Information provided at this stage is limited, and technical details are often not specified. However, it is crucial that the involved companies or public administrations intend to utilize blockchain technology for this type of category.

*Proof of Concept (PoC):* This stage represents the second phase of a project, where more information is released. Often, a white paper or document is shared, outlining the technical choices made to implement the project. The data collected during this phase aims to assess the feasibility of the proposed solution.

*Pilot:* This is a significant phase wherein the project is tested within a defined environment without directly impacting operational processes. Through experimentation, companies and public administrations stress-test the solution to identify any potential issues and gather initial feedback from participants. During this stage, an initial analysis of costs and benefits is conducted to compare actual values with the assumptions made during the design phase.

*Operating project:* This stage indicates that all preceding steps have been successfully completed and the project is now operational. At this point, the project is publicly available and can be utilized by a wide range of end-users.



#### 4.1.3 Project Type

The number of companies involved in a project is represented by this variable. The categories used are:

*Single company:* The project is carried out by only one company. Government projects are also considered "single companies" in this category.

*Consortium:* The project is carried out in collaboration with several companies. For simplicity, a joint venture is also considered in this group.

*By sector:* The project is carried out by many companies in the same sector, with the aim of influencing the latter.

#### 4.1.4 Type of News

This variable is divided into four categories that explain the type of news published online. The categories are:

*New project:* This category includes news about the development of a new project.

*New participant:* This category includes news about the addition of a new participant to an existing project.

*New phase:* This category includes news about the progress of a project from one phase to another. For example, a news article about a platform passing the testing phase and becoming operational for users would fall into this category.

*New application or service:* This category includes news about the introduction of a new feature within an already active project.

#### 4.1.5 Phase

This variable has been incorporated into the census to maintain a chronological record of the different phases of a project, ranging from the initial announcement to its operational stage. Its purpose is to ensure that the relevant information related to a project can be organized and accessed in a sequential order when necessary.

#### 4.1.6 Sector

This variable considers the sector in which the project-promoting company operates. The categories employed are based on NACE REV2, which is the statistical classification system for economic activities in the European Community. The categories include:

*Agri-food*: companies involved in the production, distribution, and retail of food products, from raw materials to end consumers.

*Airline*: Companies engaged in the transportation of passengers by air

*Automotive*: Companies that are involved in the development, manufacturing, sale, and maintenance of vehicles

*Consumer goods*: companies engaged in the wholesale and retail sales of various products or services

*Finance*: Companies involved in financial activities such as investments, financing, and pension funding

*Government*: projects carried out by governmental entities, irrespective of specific sectors or fields.

*Healthcare*: Companies providing healthcare and social work activities

*Insurance*: companies offering insurance services

*Logistics:* Companies specializing in the organization and management of product and goods transportation between different points

*Luxury:* Companies engaged in the production and provision of luxury goods or services

*Media, arts, and entertainment:* companies catering to the diverse cultural, entertainment, and recreational interests of the general public

*Mining:* Companies involved in the extraction, processing, and marketing of solid minerals, liquids, and gases

*Telecom:* companies involved in the rapid remote transmission of information through telephone, telegraphy, radio, television, or radar.

*Utility:* companies providing essential services such as electric power, natural gas, steam, hot water, etc., through a permanent infrastructure network.

*Other:* Companies that do not fall into any of the aforementioned sectors

These categories are utilized to classify the projects according to the respective sectors of the promoting companies.

#### 4.1.7 Process impacted

This variable enables the recording of the specific business processes impacted by the utilization of blockchain technology. It provides insights into how companies and public administrations leverage this technology to enhance efficiency and explore new sources of profit. The categories used for classification include:

*Advertising management:* encompasses activities related to promoting and advertising products or services with the aim of increasing customer engagement.

*Capital markets:* covers activities associated with financial markets and the trading of debt and securities.

*Data and document management:* refers to activities and platforms focused on managing, sharing, and exchanging crucial data and virtual documents.

*Identity:* involves processes related to verifying a person's identity.

*Payments:* encompasses activities related to the exchange of value, including transactions involving cryptocurrencies, stablecoins, and letters of credit.

*Property registry:* includes projects aimed at digitizing cadastral registers to achieve transparency and security through blockchain technology.

*Rewarding activities:* This category pertains to activities such as loyalty programs or community points that enable companies to reward customers based on their participation.

*Supply chain finance:* encompasses solutions that enable companies to finance their working capital by leveraging their role within the supply chain and relationships with other chain participants.

*Tracking and Supply Chain Management:* encompasses activities focused on product management and traceability throughout the supply chain.

*Voting:* Covers governmental and corporate projects related to online voting processes that leverage blockchain technology.

These categories serve to classify projects according to the specific business processes impacted by the utilization of blockchain technology.

#### 4.1.8 Value Creation

The concept of value creation is essential to understanding the benefits and motivations for adopting blockchain technology within companies and public administrations. The categories used to describe different forms of value creation are as follows:

*Crypto-asset:* This category pertains to the transfer of value using crypto-assets facilitated by blockchain technology. It involves the exchange of money or other valuable assets using cryptographic tokens.

*Data coordination:* Projects falling under this category aim to enhance the sharing of data among multiple actors, enabling more effective and efficient coordination. Blockchain technology is employed to facilitate secure and transparent data sharing among relevant parties.

*Data visibility:* This category involves recording specific data or document characteristics on the blockchain to ensure their visibility and verifiability by ecosystem actors or third parties. It enables increased transparency and trust in the recorded information.

*Trustable process:* Projects in this category utilize blockchain to conduct processes entirely on the distributed ledger, ensuring that each step is verifiable and traceable. This enhances trust in the overall process and eliminates the need for intermediaries.

These categories help define and classify the advantages and purposes of implementing blockchain technology, highlighting the different ways in which value can be created within organizations and public administrations.

#### 4.1.9 Types of Blockchain Applications

*Internet of Value:* This typology encompasses projects that heavily rely on cryptocurrencies and the exchange of value. The technology utilized in these projects is primarily focused on facilitating secure and efficient transactions involving digital assets.

*Blockchain for Business:* This category includes projects aimed at optimizing business processes. It encompasses the use of smart contracts, timestamping, and certain types of non-fungible tokens (NFTs) as tools to achieve specific objectives related to process optimization and efficiency within enterprises.

*Decentralized Web:* Within this typology of blockchain, projects related to decentralized applications (DApps) are registered. Additionally, projects associated with self-sovereign identity are included in this category. It also encompasses the inclusion of "collectibles," which is a significant trend observed in recent years, aiming to provide enhanced tracking capabilities.

#### 4.1.10 Application Governance

These three typologies represent distinct applications and use cases of blockchain technology, and tracking their evolution helps in understanding the advancements and developments within each area.

This variable explores the governance and control structure of the application, focusing on who holds decision-making power, the ability to write information, and the validation process. The following categories are used:

*Single company:* In this category, the application is controlled and managed by a single company. Although the network is distributed and leverages the benefits of blockchain technology, a single entity oversees the participants and determines the rules regarding authorizations.

*Joint venture*: This category involves the joint management and control of the application by two companies. This approach is chosen when the company initiating the project lacks the necessary expertise to manage the application and seeks collaboration with another company possessing the required knowledge.

*Consortium*: In the consortium category, the control of the application is shared among multiple companies. All participating entities have equal governance rights, without any one party exerting greater control over others.

*DAO (Decentralized Autonomous Organization)*: A DAO is characterized as an entity without central leadership. Decisions are made from the bottom up, governed by a community organized around specific rules enforced on a blockchain. DAOs operate in a decentralized manner, allowing participants to have a say in the decision-making process.

These categories help classify and understand the different governance and control structures implemented in blockchain applications, providing insights into the distribution of power and decision-making within these projects.

#### 4.1.11 Platform governance

This variable focuses on the governance of the network infrastructure within a blockchain project. It indicates who holds control and decision-making power over the platform's technical aspects and infrastructure. The following categories are used:

*Single company*: In this category, a single company has full control over the platform. It determines the technology used and the type of infrastructure implemented for the project.

*Joint venture*: The governance of the platform is shared between two companies. Often, one company develops the project while the other specializes in the technical aspects, leading to a collaborative governance structure.

*IT provider:* The control of the platform is entrusted to a specialized company with expertise in the technology used for building the network infrastructure. Sometimes, the company initiating the project may lack the necessary technical knowledge and prefer to delegate the governance responsibilities to an IT provider.

*Consortium:* In this category, the control of the platform is distributed among multiple companies that hold equal levels of importance. These companies collaboratively manage the governance of the network infrastructure.

These categories help classify and understand the different governance models applied to the network infrastructure of blockchain projects, providing insights into the distribution of control and decision-making within the technological aspects of these projects.

#### 4.1.12 Platform

This variable captures information about the platform used for developing the project and its characteristics. It consists of the following sub-variables:

*Platform:* This sub-variable indicates whether the project utilizes an existing platform ("existing") or a proprietary platform ("proprietary") that has been specifically designed for the project.

*Platform name:* If there is a specific name associated with the platform used, it is mentioned in this sub-variable.



*Permissioned or permissionless*: This sub-variable indicates the type of network adopted for authorization and validation of information. It specifies whether the network is permissioned, where access and validation rights are controlled and restricted, or permissionless, where the network is open for participation by anyone.

*Private/public*: This sub-variable describes the type of network used in terms of information access authorization. It indicates whether the network is private, allowing access only to authorized participants, or public, where information is accessible to anyone.

These sub-variables provide details about the platform used, its nature (existing or proprietary), its name (if applicable), and the characteristics of the network in terms of authorization and accessibility.

#### 4.1.13 Protocol

This variable pertains to the first-layer protocol employed to identify the primary blockchain platform, including its consensus mechanism and distributed ledger (mainnet or main chain). This platform can serve as a foundation for developing additional second-tier applications or solutions.

The sub-variables within this category are as follows:

*Protocol*: This sub-variable specifies whether the solution utilizes an existing first-layer protocol ("existing") or a newly created one ("new").

*Protocol name*: If a specific protocol is employed in the project, its precise name is provided in this sub-variable.

In summary, this variable captures information about the first layer protocol utilized in the project, indicating whether it is an existing protocol or a new one and specifying the name of the protocol if applicable.

#### 4.1.15 Token

This variable documents the attributes of tokens utilized in projects by filling in the sub-variables with "1" if a specific attribute is present or "0" if it is not.

The sub-variables are as follows:

*Use of token:* This variable indicates whether the project utilizes any type of token.

*Non-fungible:* It indicates whether the project incorporates a non-fungible token (NFT) or not.

*Fungible:* This sub-variable denotes whether the project employs a fungible token.

In essence, this variable captures information about the presence or absence of tokens in the project as well as the specific type of token used (non-fungible or fungible).

#### 4.1.16 Token Type

This variable provides additional details regarding the various types of tokens and their specific characteristics. The token typologies covered include:

*Asset token:* These tokens represent ownership of another asset, which can be either digital or physical in nature.

*Utility token:* These tokens grant holders the right to utilize a network, access a service, or participate in voting on certain matters.

*Security token*: These tokens typically derive their value from an external asset and may be subject to regulatory considerations.

In summary, this variable captures the different types of tokens used in projects and describes their intended purposes and underlying value propositions.

#### 4.1.17 Application

This variable pertains to the classification of applications based on their relationship with the underlying platform.

*Native*: refers to applications that are developed directly on the platform itself.

*Added*: represents applications that are built on top of an existing platform, expanding its functionalities.

#### 4.1.18 Participants

This variable contains information about all the participants that are involved in the project.

#### 4.1.19 Providers

There are also registered the names of all the companies that provided the know-how and the technical competence to develop the project.

#### 4.1.20 Nationality of the project

This variable indicates the country in which a project was developed. However, it may not always be possible to determine a single country for every project. In some cases, multiple countries may be involved, and for such instances, the category "world" is used. It's important to note that this variable focuses on the country where the project was developed or where the initial investment was made, rather than the country in which the project will be operational. The specific location of project operations will be tracked in a subsequent variable.

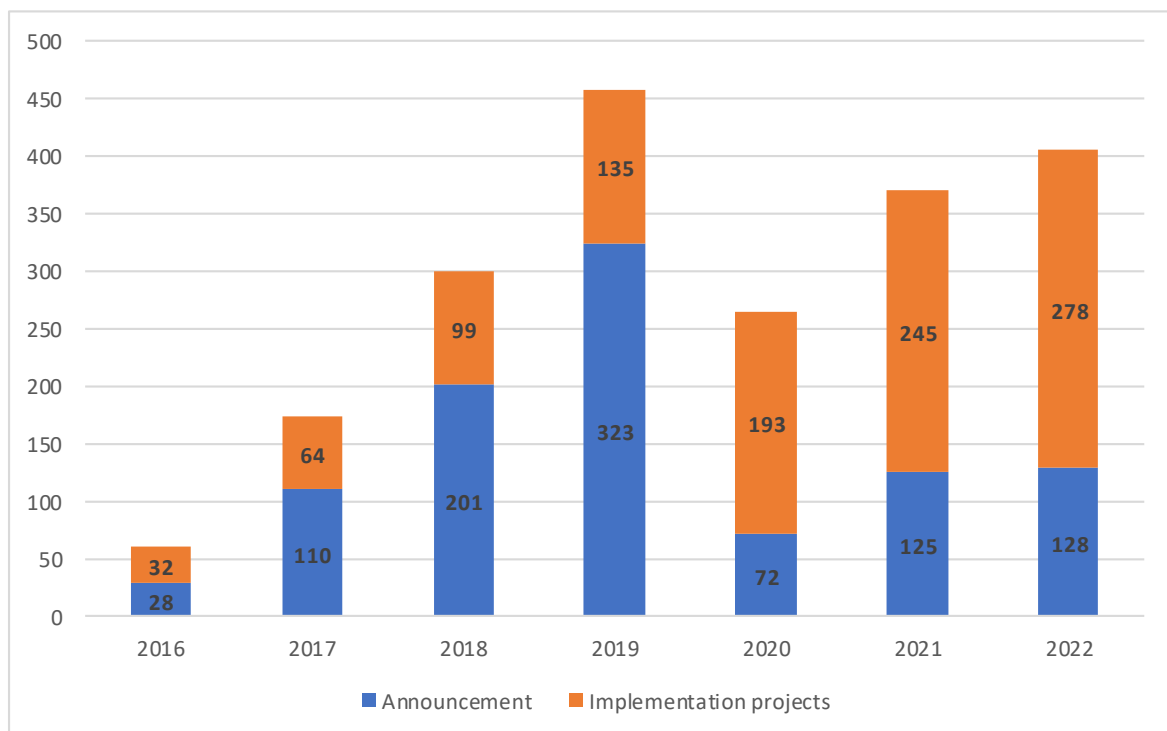
#### 4.1.21 Geographical Area

It differs from the project's nationality since it represents where the project is operational.

## 5 Census Analysis

This chapter provides a comprehensive examination of the census, focusing on its crucial variables and utilizing insights that highlight the primary trends of the continuously advancing technology known as Blockchain and Distributed Ledger. To ensure greater statistical significance, only the most recent updates of the project have been taken into account, disregarding previous phases. Furthermore, certain analyses have been refined by considering only projects in advanced stages, thereby excluding announcements and providing a clear and precise understanding of the market.

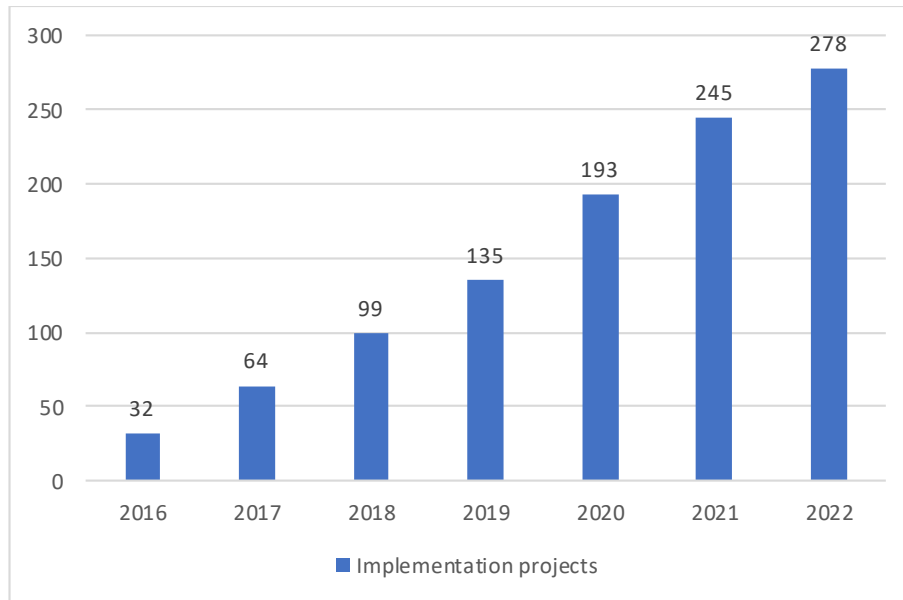
### 5.1 Blockchain and Distributed Ledger use cases in the world



*Chart 9 Number of registered announcements and implementation projects*

Between 2016 and 2022, a total of 2033 case studies were incorporated into the census. They were categorized based on the development stage of the project they were associated with, thereby dividing them into announcements if they were in the initial stages or into implementation projects if they had progressed further. We can see the continuous growth in the total number of cases starting in 2016. An additional moment is that we can mention the ongoing recovery from the decrease in total cases in 2019 due to COVID-19. 418

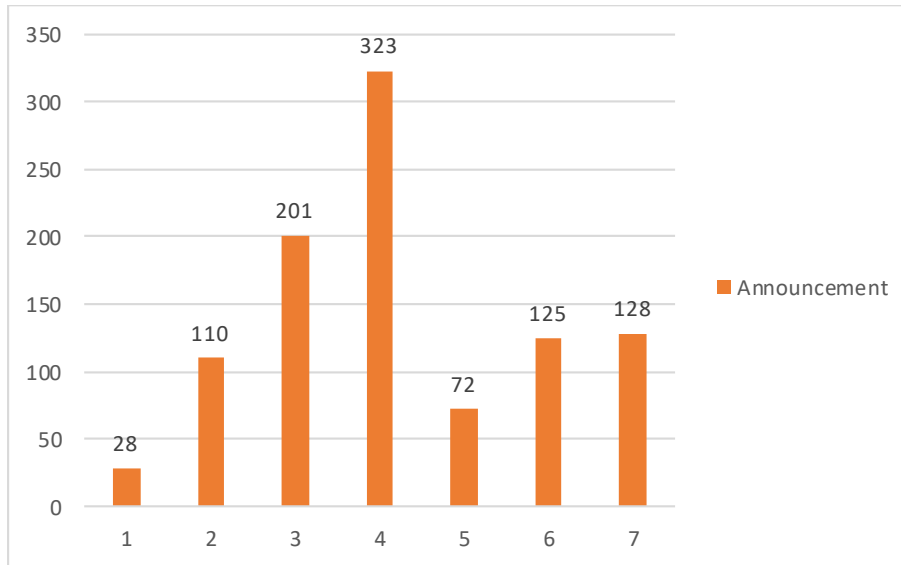
cases were included, with an increase in projects of around 21% in comparison with the prior year.



1046 cases

*Chart 10 Total number of implementation projects*

In addition to examining the overall number of cases, it is also worthwhile to analyze the proportions between the total cases and the implementation projects. It progressed from 32 cases in 2016 to 278 cases in 2022. In conclusion, starting in 2016, there was non-stop growth in the number of implementation projects, despite the decrease in the overall number of projects in 2020. Between 2021 and 2022, there was an increase of 38 cases.



987 cases

*Chart 11 Total number of announcements*

Various conclusions can be drawn by considering the pattern depicted in *Chart 8* regarding announcements. Between 2016 and 2019, there was a notable surge in the number of such news items due to the extensive media attention surrounding the new technology. In fact, the number of announcements increased from 28 in 2016 to 324 in 2019. However, starting in 2020, there was a sharp decline in announcements and a shift towards more concrete projects. This decline could be attributed to the pandemic-induced crisis, during which companies prioritized the development of projects that had already been announced. Alternatively, it could be attributed to the technology reaching a level of maturity that allowed companies to effectively utilize it in practical applications.

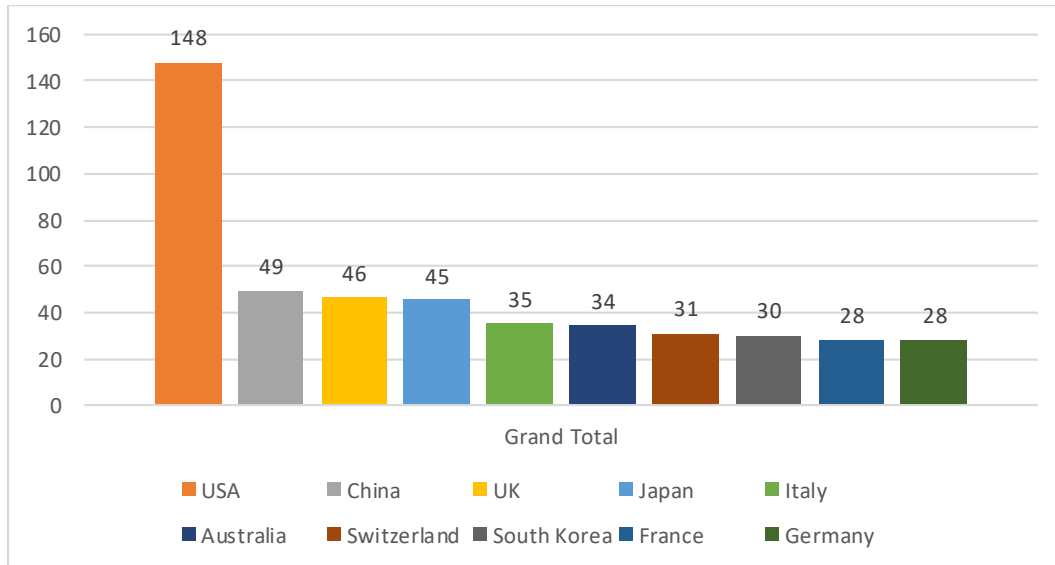


Chart 12 Projects developed in the top 10 countries

Projects developed in the top countries 474

Projects worldwide 275

Studying the projects developed in the top 10 countries, we can mention that the USA is the primary one with 148 projects because it is a major financial and technological hub. China is also a major player in the blockchain space due to its government support for blockchain technology and level of innovation. The UK is the third due to the many financial institutions and technology companies that are interested in exploring the potential of blockchain technology. The growth of blockchain projects in Italy is a positive sign for the country's technology sector. It shows that Italy is open to innovation and is willing to invest in new technologies. This could lead to increased investment and job creation in the blockchain sector in Italy.

## 5.2 The main sectors of application



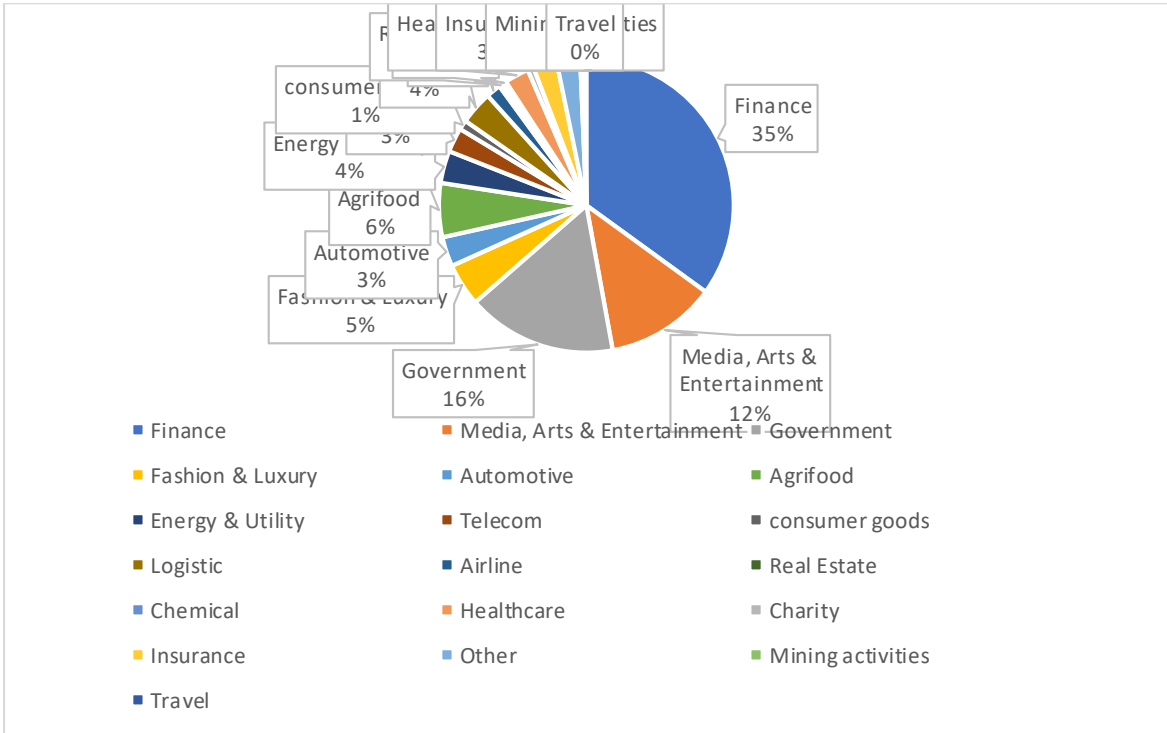


Chart 13 The main sectors of application

The primary sectors represented in the census can be observed in *Chart 14*. There are : Finance sector with 35% , government with 16% and the Media & Arts sector with 12%.

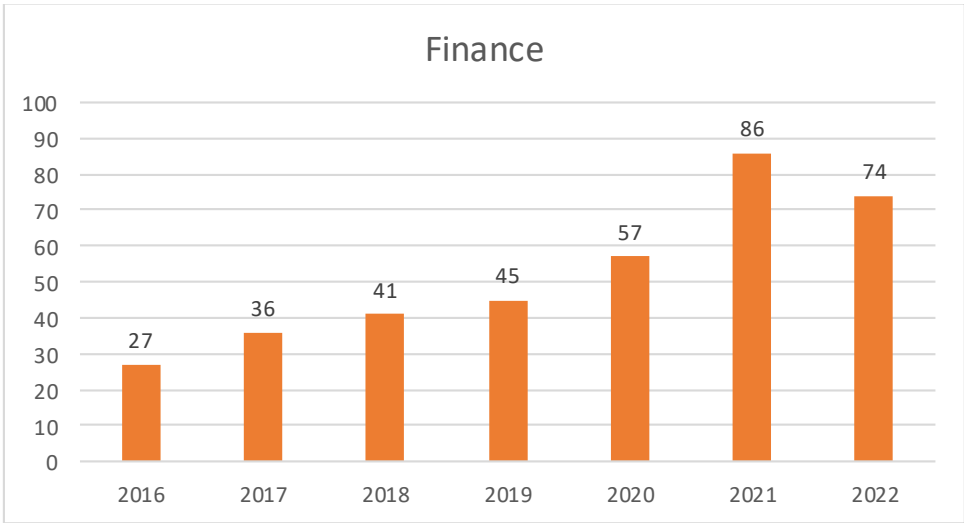


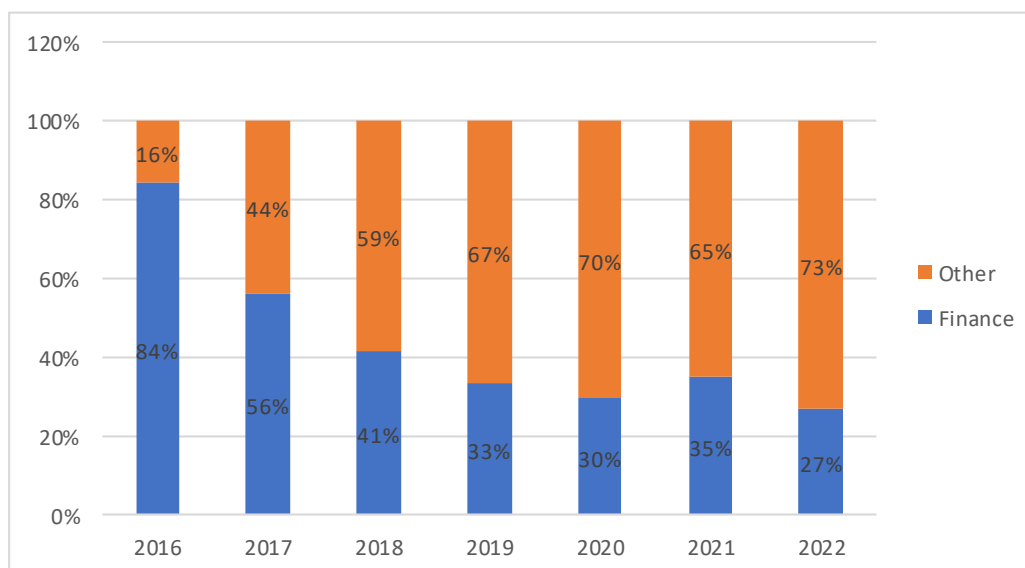
Chart 14 Financial projects over the years

The finance sector has consistently held the highest significance in terms of quantity, as evident in *Chart 15*. Notably, between 2016 and 2022, the number of cases added to the census increased annually. A substantial increase of 26 cases occurred specifically between 2020 and 2021. It is worth mentioning that numerous projects centered around

Central Bank Digital Currencies (CBDCs), stablecoins, and cryptocurrencies are progressively advancing and gaining institutional attention. Organizations have increasingly recognized the efficiency, transparency, and security advantages that blockchain can provide to financial transactions. This growing interest has led to a greater number of finance-focused entities exploring and adopting blockchain solutions.

For example, French banking giant BNP Paribas is entering the cryptocurrency custody space via a partnership with Swiss digital asset safekeeping firm Metaco. The bank will also be working with crypto custody firm Fireblocks to develop its digital asset infrastructure. The move by BNP Paribas is part of the growing trend of institutional adoption of cryptocurrencies. A number of other large banks, including Goldman Sachs, Morgan Stanley, and Citigroup, have also announced plans to offer crypto custody services. This trend is likely to continue as more institutions see the potential of cryptocurrencies as a new asset class.

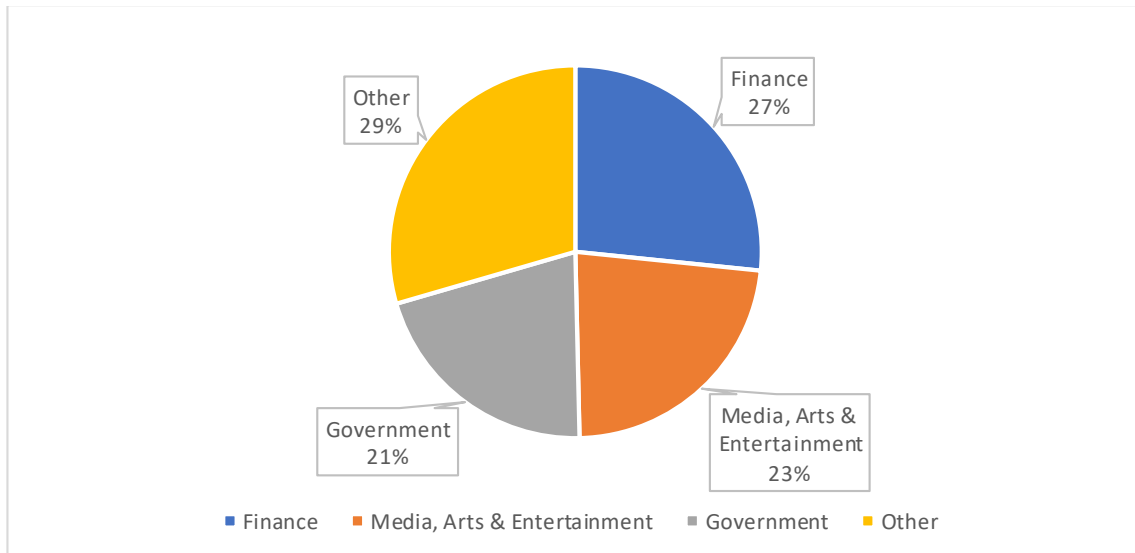
Blockchain and distributed ledger technology (DLT) exhibit a cross-sector presence, despite their initial use being predominantly limited to the finance and government sectors in the early years.



*Chart 15 Distribution of projects by sector over the years*

As evidenced by *Chart 15*, the proportion of financial projects has experienced a significant decline in comparison to other sectors. It has decreased from 84% in 2016 to

the current level of 27%. This decline suggests that the utilization of blockchain technology has become increasingly diverse across various industries over the years, demonstrating a more heterogeneous adoption across all business sectors.



*Chart 16 Distribution of projects by sector in 2022*

In *Chart 16*, focusing on the year 2022 and analyzing 278 projects, the media and arts industry ranks second, contributing a total of 64 case studies to the survey. It is a significant rise in comparison with the 2021 number of cases, despite the fact that in 2021 there was a considerable increase versus 2020. In 2021, the number of projects added to the census was 38, compared with 3 in 2020. In 2022, the media and arts industry experienced significant continuous growth, fueled by the popularity of the NFT (non-fungible token) phenomenon. NFTs received a lot of media attention in 2022, which helped to raise awareness of the technology and its potential applications. Several high-profile companies and brands, like the NBA, Warner Music Group, Universal Music Group, and Coca-Cola, partnered with NFT projects in 2022, which gave the technology a boost of credibility.

### 5.3 The main processes involved

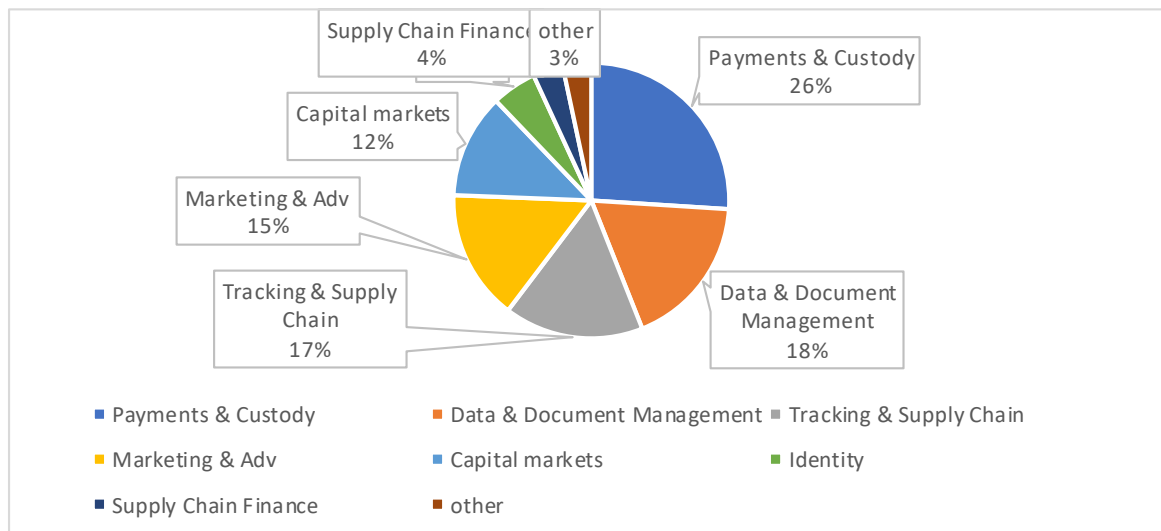


Chart 17 The main processes involved

The utilization of blockchain and distributed ledger technology, as described in the introduction, offers several benefits and significantly influences business operations. Upon analyzing the accumulated data from previous years, it is evident from chart 17 that the primary processes impacted are payment-related, comprising 26% of the total with 272 projects. Data and document management follow closely, accounting for approximately 18% of the 182 projects. Additionally, tracking and supply chain processes constitute 17% of the projects, amounting to a total of 160.

The payment process has witnessed significant advancements, primarily due to numerous projects centered around cryptocurrencies, stablecoins, and central bank digital currencies (CBDCs). Cryptocurrencies have consistently served as the pioneering application of blockchain technology, enabling businesses to eliminate intermediaries in value transfers. In 2022, this solution experienced a continuous evolution, largely driven by substantial investments made by publicly traded companies. Additionally, financial institutions and banks continued to enter the scene by offering trading and custody services for digital assets, contributing to the growing familiarity and potential mass adoption of the cryptocurrency realm. Stripe, a prominent online payment processing platform, has announced the launch of payment services tailored specifically for businesses operating in

the cryptocurrency space. This move aims to facilitate smoother and more efficient transactions for companies dealing with cryptocurrencies. By integrating cryptocurrency payment capabilities into their platform, Stripe aims to address the unique needs of crypto businesses and further the adoption of digital currencies in the mainstream economy.

CBDCs, which are currently under examination and experimentation by numerous central banks worldwide, represent a contemporary solution in the field. They serve as digital versions of fiat currency and are overseen by sovereign institutions like central banks. These CBDCs employ blockchain and distributed ledger technology to effectively manage transactions and the issuance of coins.

Blockchain technology has revolutionized data and document management in business by enhancing security, enabling efficient data sharing and collaboration, and providing transparent provenance and auditing capabilities. It ensures immutability, decentralization, and trust, leading to more efficient and reliable management of critical business information.

Projects that have an impact on tracking and supply chain management processes occupy the third position. One key area where blockchain has influenced tracking and supply management is by enhancing transparency and visibility. With traditional supply chain systems, information is often siloed and fragmented, making it challenging to track the movement of goods accurately. By utilizing blockchain's decentralized and transparent nature, all relevant stakeholders can access real-time information about the origin, journey, and current status of products. This increased transparency enables better inventory management, reduces the risk of fraud, and enhances overall supply chain efficiency. Coca-Cola has entered into a partnership with Diginex, a blockchain technology provider, to enhance its environmental, social, and governance (ESG) efforts within its supply chain. The collaboration aims to leverage blockchain technology to improve traceability and transparency throughout Coca-Cola's supply chain, allowing for better monitoring and verification of sustainability initiatives. By utilizing blockchain, the partnership intends to enhance the company's ESG reporting and provide consumers with more accurate information about the origin and sustainability of its products.

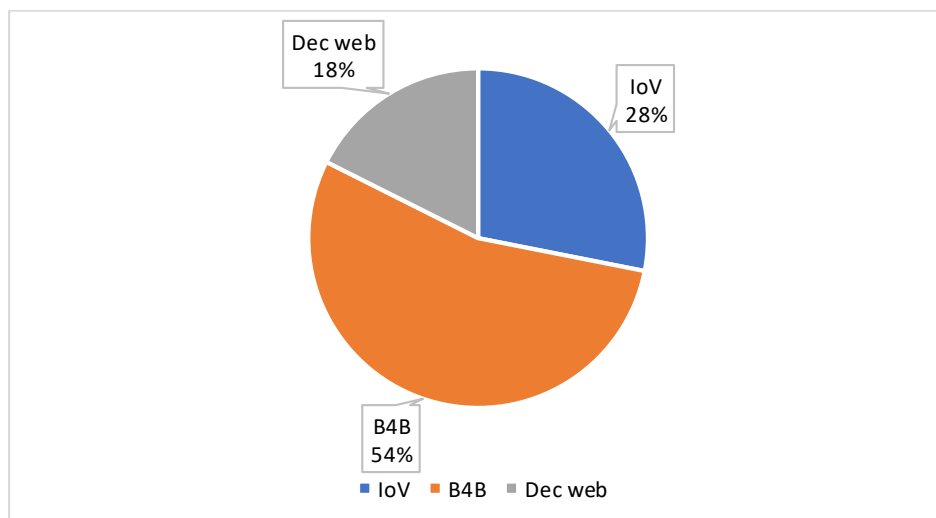
#### 5.4 Types of Blockchain application

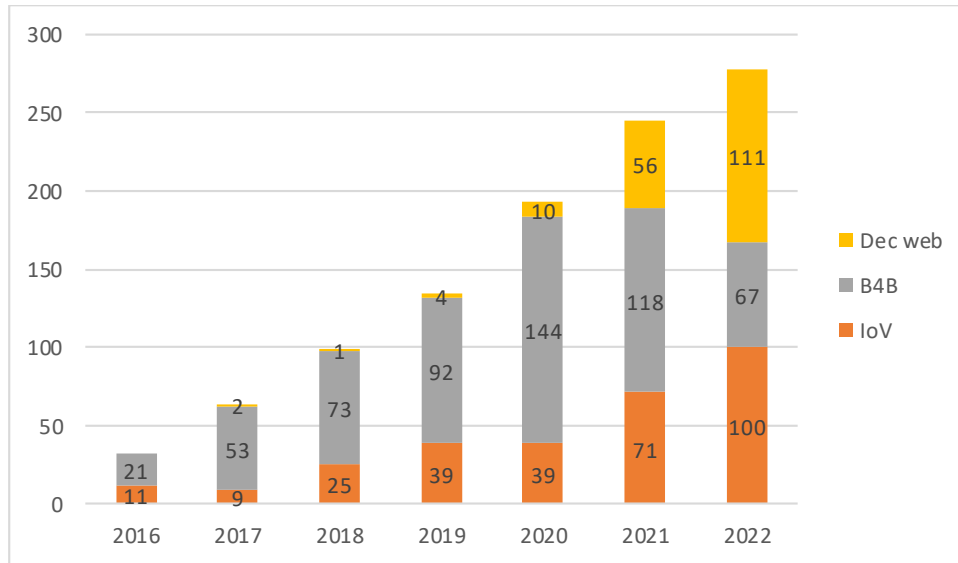
To comprehend the evolution and adoption of blockchain technology, implementation projects were analyzed based on the types of blockchain applications utilized. This analysis aimed to gain insights into how the technology is progressing and becoming integrated, excluding any preliminary announcements. As mentioned earlier in this document, three distinct categories of blockchain applications have been identified.

**Internet of Value:** which considers all applications focused on the exchange of value, typically cryptocurrencies, stablecoins, and virtual currencies promoted by central banks (CBDCs).

**Blockchain for Business,** which includes projects in which traditional business processes are replicated using blockchain technologies, typically has the objectives of data verifiability, coordination, and the implementation of reliable processes.

**Decentralized Web:** which, in this census, covers decentralized applications (DApps), the new projects related to SSI, and the world of collectibles, turning the blockchain into an infrastructure for the creation and development of innovative business solutions.





*Chart 18 Types of Blockchain application*

According to the data presented in *Chart 18*, the Internet of Value category represents approximately 28% of the total number of analyzed implementation projects, encompassing 294 out of 1046 projects. This category shows a continuous growth rate of +29% in comparison to the previous year. The growth can be attributed to various trends observed in 2022. Notably, there has been a notable maturation of cryptocurrencies, with the entry of multiple players contributing to the expansion of this domain. Furthermore, institutions and major companies increased their attention towards stablecoins and central bank digital currencies (CBDCs), further driving the growth percentage within this category.

When considering the Blockchain for Business projects, which make up nearly 54% of the analyzed projects (a total of 568 out of 1046), it is noteworthy that there was a decline of 43% in 2022. However, despite this decrease, the significance of this category remains evident as it encompasses the highest number of implementation projects, involving a majority of traditional companies. This indicates the continued importance and relevance of blockchain technology in the business sector, despite the observed decrease in project numbers during the specified period.

In 2022, the business landscape witnessed a strong maturation of decentralized web technology. With 18% of the total number of projects, 184 out of 1046. This category

shows a continuous growth rate of +50% in comparison to the previous year. It is related to the continuous growth of interest in NFT projects.

To delve into the specifics of each application type, it is insightful to examine the value creation aspect, which helps comprehend how these technologies can generate value for companies or public administrations embracing them. Overall, four distinct pillars of value creation have been identified, providing a comprehensive understanding of the benefits these technologies offer to adopters.

Transfer of value or crypto-asset: where blockchain-enabled cryptocurrencies are used to exchange money or other valuable assets

Data visibility: to record certain characteristics of data or documents so that they are visible and verifiable by other actors in the ecosystem or by third parties.

Data coordination: in order to share data among several actors so that coordination is more effective and efficient,

A trusted process is one where processes are executed entirely on the blockchain to ensure that each step is verifiable.

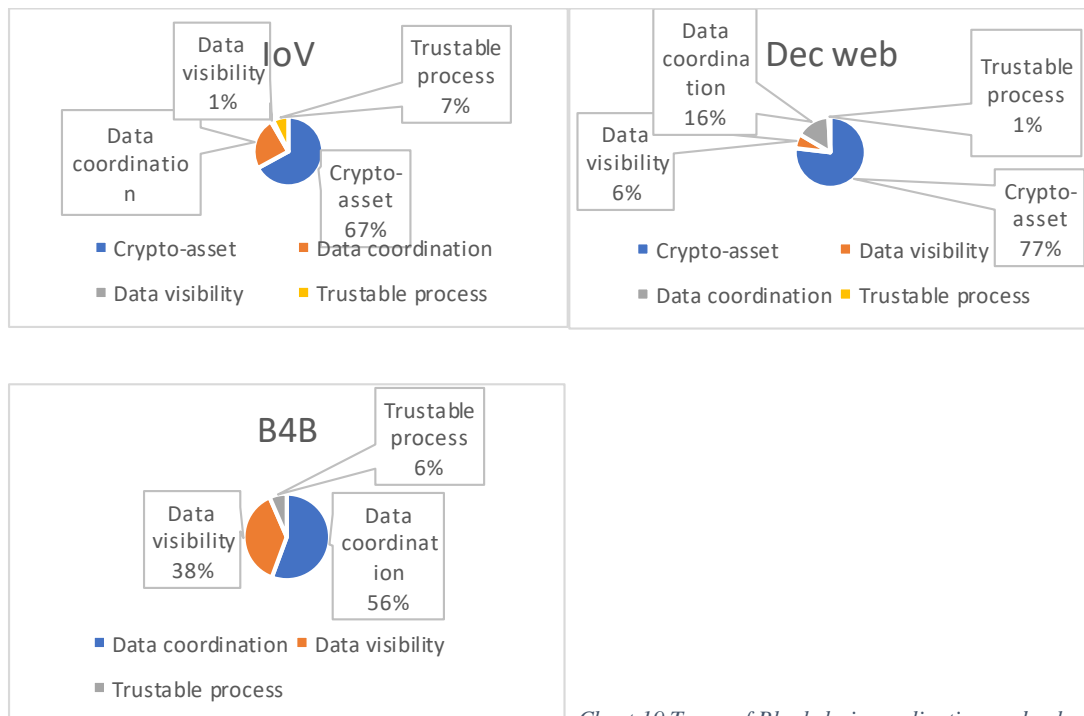


Chart 19 Types of Blockchain application and value creation



When examining the Internet of Value projects, value creation primarily revolves around crypto assets, representing more than half of the projects at 67%. The second category focuses on data coordination, followed by trustable processes. As for blockchain for business projects, it is not surprising that value is derived from data coordination, accounting for 56% of the total projects in this category. Additionally, data visibility contributes to value creation, encompassing 38% of the projects within this category.

For December Web, most of the projects related to crypto-assets (77%, followed by data coordination (16%).

Upon analyzing the 1046 implementation projects in a comprehensive manner, it is evident that data coordination and data visibility have emerged as the most appealing value creations for companies and public administrations. This observation does not undermine the growing importance of the transfer of value or crypto assets, which is gaining prominence, particularly with the rise of collectibles in the corporate realm. Conversely, value creation in the trustable process category remains relatively unexplored, with minimal percentages across each application type. This can be attributed to the challenges associated with fully running a process on the blockchain, indicating that there is still room for advancement in this area.

## 5.5 Platform analysis

When examining blockchain technology, it becomes essential to assess the attributes of the platforms. By considering particular variables included in the survey, one can observe the progression of platform characteristics. It should be noted that the data sample may differ based on the variable under analysis, as the amount of information available can vary depending on the stage of the implementation project.

### 5.5.1 Existing or Proprietary

The initial variable being examined pertains to the 'ownership' of the platform utilized by companies and public administrations. Platforms have been classified into two categories: existing platforms, which are employed when projects make use of pre-existing platforms, and proprietary platforms, which are developed by companies themselves.

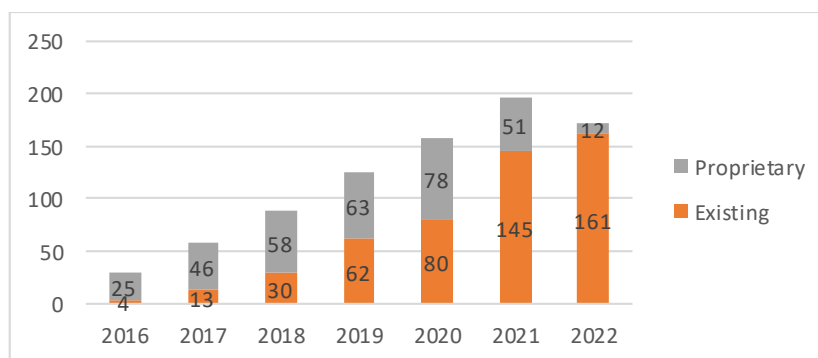


Chart 20 Types of platforms: existing or proprietary

In the past, companies that used blockchain and distributed ledger technology (DLT) typically built their own platforms. However, there is a growing trend toward using existing platforms rather than building new ones. This shift is due in part to the increasing maturity of the blockchain market as well as the availability of more reliable and scalable platforms.

In 2022, the number of projects using existing platforms will surpass the number of projects using proprietary platforms. This trend was particularly pronounced in the financial sector, where the number of existing platforms doubled in 2021. This suggests that financial institutions are increasingly seeing the benefits of using existing blockchain platforms rather than building their own.

There are several reasons why companies are choosing to use existing blockchain platforms. First, existing platforms offer a number of advantages, such as a proven track record, a large user base, and a well-established ecosystem of developers and partners. Second, using an existing platform can save companies time and money, as they do not need to invest in building and maintaining their own platform. Finally, using an existing platform can help companies comply with regulatory requirements.

The shift from proprietary blockchain platforms to existing platforms is a sign of the maturity of the blockchain market. As the market continues to grow, we can expect to see even more companies adopt existing platforms.

Here are some examples of how incumbent companies use existing platforms: The Australian Open tennis tournament is planning to launch an interactive NFT initiative in partnership with an existing blockchain platform, Decentraland. This initiative will involve the creation of unique digital collectibles in the form of NFTs that are directly related to the tournament. These NFTs could represent iconic moments from matches, player achievements, memorable shots, and other significant aspects of the tournament. The United States Air Force has chosen Simba Chain, a blockchain technology company, to develop a budgeting and accounting system. This blockchain-based system aims to streamline and enhance the Air Force's financial processes, including budget management and accounting tasks. By leveraging blockchain technology, the Air Force seeks to improve the transparency, security, and efficiency of its financial operations.

### 5.5.2 Private or Public

There are four main types of blockchain platforms: public, private, permissioned, and permissionless. These types are determined by two variables: who regulates access to data (public or private) and who has the power to validate new information (permissioned or permissionless).

Public platforms are quite common, accounting for 51% of all platforms. Public platforms are open to anyone to join and use, which means that there is no control over who can access the data or what data can be shared. This can be a security risk for businesses that need to protect sensitive data. However, public platforms can be more transparent and democratic, as anyone can participate in the validation process.

Private platforms, accounting for 49% of all platforms. Private platforms allow companies and governments to have control over who can access the platform and what data can be shared. This can be important for businesses that need to protect sensitive data or for governments that need to comply with regulations.

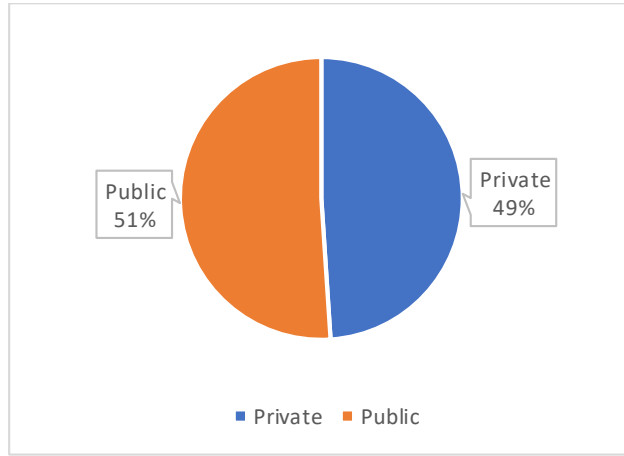


Chart 21 Types of platforms: rivate or public

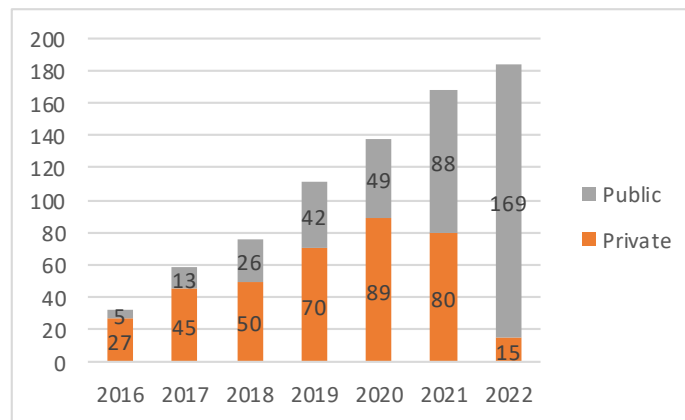


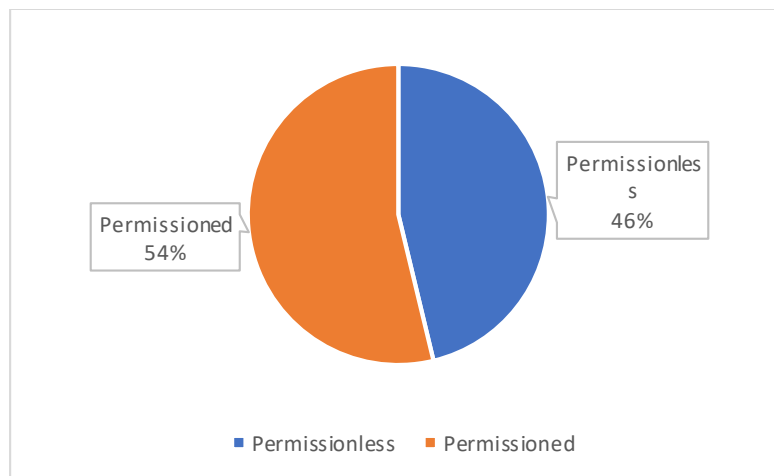
Chart 22 Percentage distribution of public and private platforms over the years

The chart shows the percentage of public and private blockchain projects evaluated each year. While private platforms remain the preferred choice for businesses, public platforms are also gaining traction. In 2016, less than 20% of projects were public, but this figure has increased to 61% in 2022. This shows that businesses are becoming more interested in the potential of public blockchains.

It is important to note that public and private blockchains serve different purposes. Public blockchains are designed to be open and transparent, while private blockchains are designed to be more secure and controlled. This means that the best platform for a particular business will depend on its specific needs.

The choice of which platform to use depends on the specific needs of the business. By understanding the different types of blockchain platforms and their respective strengths and weaknesses, businesses can make informed decisions about which platform is right for them.

### 5.5.3 Permissioned or Permissionless



*Chart 23 Types of platforms: permissioned or permissionless*

The chart shows that permissioned blockchain platforms are still the most popular choice for businesses and governments. Permissionless blockchain platforms, which account for 46% of all projects analyzed, are mainly used for Internet of Value (IoV) solutions or blockchain for business projects.

The gap between the two types of platforms is decreasing, and it is interesting to understand the reasons for this. By analyzing the advantages and disadvantages of each type of platform, we can better understand why businesses and governments prefer permissioned platforms.

Permissioned blockchain platforms are more secure than permissionless blockchain platforms because they have a higher level of access control. This means that only authorized users can participate in the network, which makes it more difficult for hackers to attack the network. In addition, permissioned blockchain platforms are highly customizable. This means that they can be configured to meet the specific needs of businesses and organizations. They can also be integrated with other systems and

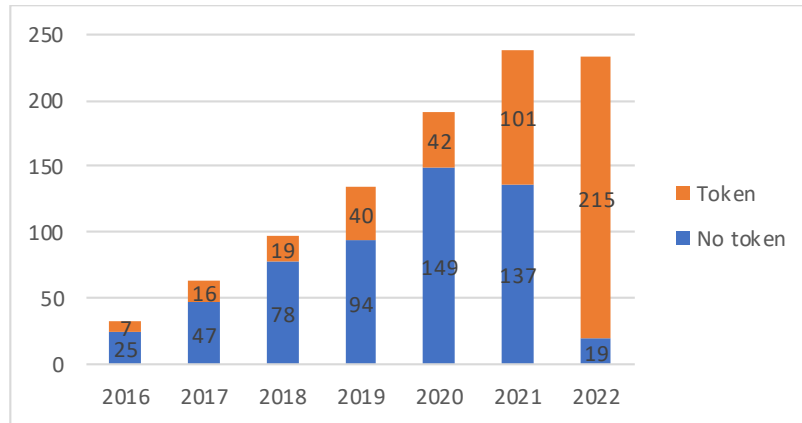
applications. Finally, permissioned blockchain platforms are scalable. This means that they can handle a large number of transactions without affecting performance. This is because they have a limited number of nodes that need to verify transactions.

Permissioned blockchain platforms offer many advantages, but they also have some disadvantages. One of the biggest disadvantages is the lack of transparency. Because permissioned blockchain platforms are only accessible to a limited number of participants, it can be difficult to track the flow of data and identify potential conflicts of interest. To address these challenges, some organizations choose to use permissionless blockchain platforms. Permissionless blockchain platforms are open to anyone to participate, which makes them more transparent and less susceptible to corruption. However, permissionless blockchain platforms also have some disadvantages. One of the biggest disadvantages is the high energy consumption required to reach consensus. Because permissionless blockchain platforms typically have a large number of nodes, they require a significant amount of computing power to operate. This can be a major barrier for some organizations, especially those with limited resources.

Ultimately, the decision of whether to use a permissioned or permissionless blockchain platform depends on the specific needs of the organization. If transparency and accountability are the top priorities, then a permissionless blockchain platform may be the best choice. However, if security and privacy are more important, then a permissioned blockchain platform may be a better option.

## 5.6 Using tokens

Tokenization, a highly transformative concept inherent in blockchain technology, involves bridging the divide between the physical and digital realms. This practice is gaining significant popularity among businesses and public administrations.



*Chart 24 Presence of tokens in implementation projects*

The chart shows that the number of tokenization case studies has been growing steadily since 2016. In 2016, there were only 7 case studies, but by 2022, that number had grown to 215. The most significant increase occurred in the last two years, with the number of case studies more than doubling from 101 in 2021 to 215 in 2022.

The growth of tokenization can be attributed to a number of factors, including the increasing popularity of blockchain technology, the growing awareness of the benefits of tokenization, and the increasing availability of tokenization platforms.

The increasing awareness of the benefits of tokenization is driving the growth of this market. Businesses and investors are increasingly recognizing the potential of tokenization to improve efficiency, security, and transparency. This is leading to increased investment in tokenization projects and platforms. Also, this situation increased the interest of incumbent companies in this technology, and here are some examples.

Consumer goods company Unilever and technology firm SAP have joined forces for a blockchain-powered token traceability pilot project. This initiative aims to enhance supply chain transparency by utilizing blockchain technology to track and verify the movement of goods within Unilever's supply chain. The project involves the creation of digital tokens that represent physical products, enabling real-time monitoring and validation of product movements. Through this partnership, Unilever and SAP aim to improve traceability, reduce fraud, and strengthen sustainability efforts by providing consumers with accurate information about the products' origins and journey.

MUFG (Mitsubishi UFJ Financial Group), a prominent Japanese financial institution, has announced plans to issue stablecoins specifically for settling security tokens. This move is intended to improve the efficiency and speed of settling transactions involving security tokens, which are digital representations of ownership in traditional assets like stocks and bonds. By utilizing stablecoins, which are cryptocurrencies pegged to a stable asset like a fiat currency, MUFG aims to expedite the settlement process while minimizing volatility risks. This development showcases the financial industry's growing interest in leveraging blockchain and cryptocurrencies to enhance traditional financial processes and infrastructure.

Finally, the increasing availability of tokenization platforms is also contributing to the growth of this market. There are now a number of platforms that allow businesses and individuals to tokenize their assets. This makes it easier for businesses and individuals to get started with tokenization, and it is also leading to increased innovation in the tokenization space. Overall, the growth of tokenization is a positive development. It is a technology that has the potential to improve efficiency, security, and transparency in a number of industries. As the technology matures and the market grows, we can expect to see even more innovative and exciting applications of tokenization in the years to come.

### 5.7 Finance, Government, Media&Arts projects analyze

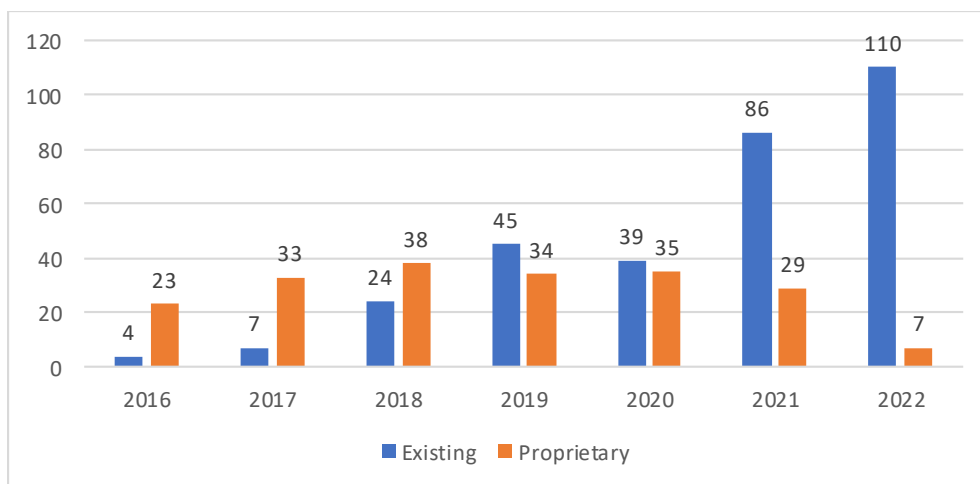


Chart 25 Types of platform in Finance, Government, Media&Arts projects: existing or proprietary



The change started in 2021, before companies preferred to build new platforms rather than use existing ones.

The reasons for using the existing blockchain platforms

1. **Cost:** Building a proprietary blockchain from scratch can be expensive and time-consuming. Existing blockchain platforms, such as Ethereum or Bitcoin, have already invested significant resources into building and maintaining their infrastructure and may offer more cost-effective options for financing blockchain projects.
2. **Interoperability:** By using an existing blockchain platform, financial blockchain projects can benefit from the network effects of a large and established ecosystem of users and developers. This can facilitate cross-chain interoperability, allowing different blockchain networks to communicate with each other and exchange assets and data.
3. **Security:** Established blockchain platforms typically have stronger security measures in place than a new or proprietary blockchain. This can provide greater peace of mind for financial blockchain projects, particularly if they are handling sensitive financial information.
4. **Scalability:** Existing blockchain platforms have already solved many of the technical challenges involved in scaling a blockchain network to support large numbers of users and transactions. By using an existing platform, finance blockchain projects can benefit from this expertise and avoid the potential technical difficulties associated with scaling a proprietary blockchain.
5. **Regulatory Compliance:** Established blockchain platforms are often better equipped to comply with relevant legal and regulatory requirements. This can be particularly important for financial blockchain projects that are subject to strict regulations, such as KYC and AML requirements.

Overall, using an existing blockchain platform can provide several advantages for Finance, Media&Arts, and Government blockchain projects, including cost savings, interoperability, security, scalability, and regulatory compliance. However, the decision to

use an existing platform versus building a proprietary blockchain ultimately depends on the specific needs and goals of the project in question.

As we analyze the finance sector, we can see that Finance projects were more focused on using self-created platforms. Before 2021–2022, half of the Finance projects were using proprietary platforms. One of the reasons why companies that use blockchain and DL are shifting to existing platforms is that the development of the technologies created platforms that could meet business requirements and satisfy the needs of companies. The trend of existing platforms will increase, as we can see that the number of Finance projects will increase too.

Finance incumbent companies often prefer to use existing blockchain platforms rather than develop proprietary ones due to several compelling reasons. This strategy offers a range of benefits, including efficiency, security, scalability, interoperability, and cost-effectiveness.

1. **Efficiency and Time-to-Market:** Developing a proprietary blockchain platform from scratch is a complex and time-consuming endeavor. Existing blockchain platforms, on the other hand, provide ready-made solutions that can be customized to meet specific financial use cases. This significantly reduces the time-to-market for new products and services. For instance, JPMorgan's use of Quorum, an enterprise-focused Ethereum blockchain, allowed them to rapidly create and test blockchain-based applications for areas like supply chain finance and payment settlements.
2. **Security and Reliability:** Established blockchain platforms often have robust security mechanisms built into their architecture. They have been rigorously tested by the community and have undergone multiple iterations to address vulnerabilities. Finance incumbents deal with sensitive financial data and transactions, making security a paramount concern. Utilizing a proven blockchain platform helps ensure the safety and integrity of financial operations. IBM's Hyperledger Fabric, an open-source blockchain framework, has been used by companies like CLS Group to improve post-trade processing and settlement processes securely.

3. **Scalability and Performance:** Many existing blockchain platforms have been designed with scalability in mind. They have mechanisms to handle a high volume of transactions without compromising performance. Developing a proprietary blockchain with similar capabilities would require significant resources. NASDAQ's Linq platform, built on the Chain blockchain, demonstrates how using an existing platform can enable efficient and scalable trading of private securities.
4. **Interoperability:** Interoperability is crucial in the finance sector, where various systems and institutions need to seamlessly communicate and share data. Existing blockchain platforms often follow established standards and protocols, facilitating integration with other systems. R3's Corda, a blockchain platform designed for financial services, enables various parties to collaborate securely while ensuring regulatory compliance. It allows for the creation of private, permissioned networks that can interact with each other when necessary.
5. **Cost-Effectiveness:** Developing a proprietary blockchain platform requires substantial investment in terms of development, testing, maintenance, and ongoing upgrades. Utilizing existing platforms eliminates many of these costs, allowing finance incumbents to allocate resources more efficiently. Fidelity's decision to leverage existing blockchain infrastructure for their Fidelity Digital Assets subsidiary highlights how cost-effectiveness can be achieved while entering the cryptocurrency custody and trading space.

In conclusion, incumbent financial companies opt to use existing blockchain platforms over proprietary ones due to the efficiency, security, scalability, interoperability, and cost-effectiveness they offer. These platforms provide tested and reliable solutions that can be tailored to suit specific financial use cases. Examples such as JPMorgan's Quorum, IBM's Hyperledger Fabric, NASDAQ's Linq, and R3's Corda illustrate how leveraging established blockchain platforms can accelerate innovation and enhance the capabilities of financial services while minimizing risks and resource expenditures. As the finance industry continues to evolve, collaborating with the wider blockchain community through existing platforms remains a strategic and prudent choice.

The Media&Arts sectors have increasingly turned to existing blockchain platforms rather than developing proprietary ones, primarily due to the unique advantages that established

platforms offer. These advantages encompass transparency, provenance, copyright management, democratization, and cost efficiency.

1. **Transparency and Provenance:** Blockchain technology's inherent transparency and immutability make it an ideal tool for tracking the provenance of digital assets in the media and art sectors. Existing blockchain platforms provide a secure and traceable record of ownership, allowing creators and consumers to verify the authenticity of artwork or media content. A prime example is the platform Verisart, which uses blockchain to create certificates of authenticity for artworks, enabling artists and collectors to track the history of each piece transparently.
2. **Copyright Management:** Copyright infringement is a significant concern in the media and art industries. Blockchain platforms offer solutions to manage copyrights by establishing a decentralized and tamper-proof record of intellectual property rights. Monegraph is a notable example that employs blockchain to link digital media to verifiable ownership records, providing artists with more control over their creations and enabling secure licensing.
3. **Democratization and Tokenization:** Blockchain technology facilitates the tokenization of assets, enabling fractional ownership and democratizing access to traditionally exclusive media and art assets. Existing platforms allow for the creation and trading of digital tokens representing ownership in art pieces, music, and other media. A good example is the platform SuperRare, which uses blockchain to tokenize digital artworks, enabling artists to sell limited editions directly to collectors.
4. **Cost-Efficiency and Intermediary Reduction:** Blockchain's peer-to-peer nature reduces the need for intermediaries in the media and art supply chains, leading to cost savings. Utilizing existing platforms eliminates the need to build complex infrastructure from scratch, making it a cost-effective solution for artists and organizations. SingularDTV is a platform that leverages blockchain to distribute and monetize films and content directly to consumers, bypassing traditional distribution channels.
5. **Ecosystem Collaboration:** Existing blockchain platforms in the media and art sectors often come with established communities and networks. Artists, collectors, and enthusiasts can connect, collaborate, and share resources within these

ecosystems. This collaborative environment fosters innovation and the exchange of ideas, driving the industry forward collectively. Ascribe is an example that allows artists to register their digital creations on the blockchain, enabling secure transfer and attribution within a global network.

In conclusion, the Media&Arts sectors adoption of existing blockchain platforms reflects the sector's recognition of the transformative potential that blockchain technology offers. Through transparency, provenance tracking, copyright management, democratization, and cost efficiency, these platforms provide valuable tools for artists, creators, collectors, and consumers. Examples like Verisart, Monegraph, SuperRare, SingularDTV, and Ascribe highlight how leveraging established blockchain platforms empowers the media and art industries to reshape traditional paradigms, foster innovation, and create more transparent and inclusive ecosystems. As this sector continues to evolve, collaboration with existing blockchain platforms is poised to play a pivotal role in shaping its future.

Government agencies tend to prefer existing blockchain platforms over proprietary ones for several reasons. Existing platforms offer established solutions that have been tested and verified and often come with a community of developers and users that contribute to ongoing improvements. This preference aligns with government priorities such as cost-effectiveness, security, interoperability, and efficiency. By leveraging established platforms, governments can expedite the adoption of blockchain technology and focus on addressing specific challenges and opportunities.

Government agencies often lean toward **open-source**, existing blockchain platforms as they provide transparency, community support, and a foundation for innovation. These platforms are accessible and adaptable, allowing agencies to customize them to their needs while benefiting from continuous updates and enhancements.

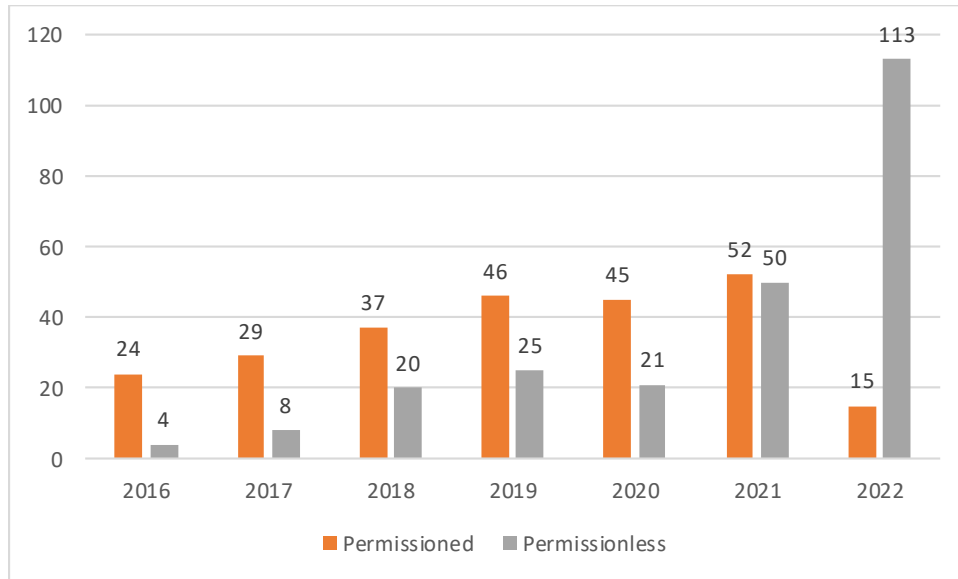
An example that illustrates the preference of government agencies for existing blockchain platforms due to their open-source nature is the adoption of Hyperledger Fabric by various government entities. Hyperledger Fabric, an open-source enterprise-grade blockchain platform, has gained significant traction among government agencies for its flexibility,

security, and modularity. It's hosted by the Linux Foundation and aims to provide the tools necessary to build permissioned blockchain networks for various use cases.

The United States Election Assistance Commission (EAC) is working with Hyperledger Fabric to develop a secure and transparent voting system. The system would use blockchain to record votes, verify identities, and prevent fraud. The government of Australia is using Hyperledger Fabric to track the provenance of goods and materials. The system would use blockchain to record the movement of goods, ensure authenticity, and prevent counterfeiting.

Government systems are usually interconnected, necessitating compatibility between different technologies. Existing blockchain platforms are more likely to adhere to industry standards, making integration with other systems smoother. This interoperability ensures that government agencies can effectively communicate and share data across various departments and agencies.

The government of Estonia is using the Hyperledger Fabric platform to create a secure and interoperable network for sharing data between different government agencies. The Estonian government's project, called the X-Road, aims to create a single platform for sharing data on things like education, healthcare, and taxation. This would allow the Estonian government to provide better services to its citizens, and it would also improve the efficiency of its government. The Dubai government's project, called the Smart Dubai Blockchain Platform, aims to create a single platform for sharing data on things like transportation, waste management, and energy. This would allow the city of Dubai to become more efficient and sustainable.



*Chart 26 Types of platform in Finance, Government, Media&Arts projects: permitted or permissionless*

As we know in the finance business sector, there is a shift in dominance from permitted to permissionless platforms. Before recent years, permitted platforms were more popular for blockchain projects, but in 2022, permissionless platforms became more popular.

Maybe because payment and custody processes are more relevant to permissionless platforms,

One reason why Finance and Government blockchain projects may choose to use permissionless platforms more often than permitted platforms is that permissionless platforms offer greater decentralization and transparency. Since anyone can participate in the network, there is no single point of failure, and transactions are validated by a distributed network of nodes. This can lead to increased trust in the network and a reduced risk of fraud or manipulation.

Additionally, permissionless platforms offer more flexibility and innovation compared to permitted platforms. Developers can create decentralized applications (dApps) on top of permissionless platforms, which can be used for a variety of use cases beyond finance, such as gaming, art, and social media. This opens up new opportunities for financial

blockchain projects to collaborate with other industries and create new products and services.

However, it's worth noting that permissionless platforms may also come with higher transaction fees and slower transaction speeds compared to permissioned platforms due to the increased computational requirements of a decentralized network. Therefore, the choice of blockchain platform ultimately depends on the specific needs and goals of the finance blockchain project in question.

Here are some examples of how incumbent finance companies use permissionless blockchain platforms:

**JPMorgan Chase & Co., Quorum, and JPM Coin:** JPMorgan Chase developed Quorum, an enterprise-focused version of the Ethereum blockchain. Quorum is designed to facilitate secure and efficient transactions and has been used for applications such as supply chain finance and payment settlements. Additionally, JPMorgan introduced JPM Coin, a digital currency built on Quorum. This permissionless blockchain technology enables instantaneous transfers of value between institutional clients, enhancing cross-border payments and settlement processes.

**JP Morgan Chase announced a collaboration with the Interbank Information Network (IIN)** to explore the use of the IIN blockchain for cross-border payments. The two companies plan to develop a prototype for a payment system that would use the IIN blockchain to facilitate real-time payments between banks in different countries.

**Visa's Collaboration with Ethereum-Based Platforms:** Visa, a global payments technology company, has been exploring ways to integrate blockchain technology into its operations. Notably, Visa has partnered with Ethereum-based platforms like Crypto.com to enable cryptocurrency-backed debit cards. By leveraging the Ethereum blockchain's permissionless nature, Visa and its partners allow users to spend their cryptocurrencies for everyday purchases at merchants that accept Visa cards.



Standard Chartered announced a collaboration with the R3 Corda blockchain platform to develop a solution for supply chain finance. The two companies plan to develop a platform that would use Corda to automate the supply chain finance process, making it more efficient and secure.

**UBS: Experimentation with Ethereum for Bond Issuance:** UBS, a Swiss multinational investment bank, conducted a successful experiment using Ethereum's public blockchain to issue a \$30 million bond. While UBS primarily operates within permissioned networks, this initiative demonstrated how permissionless blockchain platforms can offer benefits like transparency and efficiency in the issuance process. The experiment showcased the potential for incorporating public blockchain technology into traditional finance processes.

Permissionless blockchain platforms became popular in 2022 and had a positive impact on the Media&Art sectors. They are helping to protect copyrights, automate royalties, crowdfund projects, distribute content, and increase transparency. As the technology continues to mature, we can expect to see even more innovation in the Media&Arts sectors that is powered by permissionless blockchain platforms.

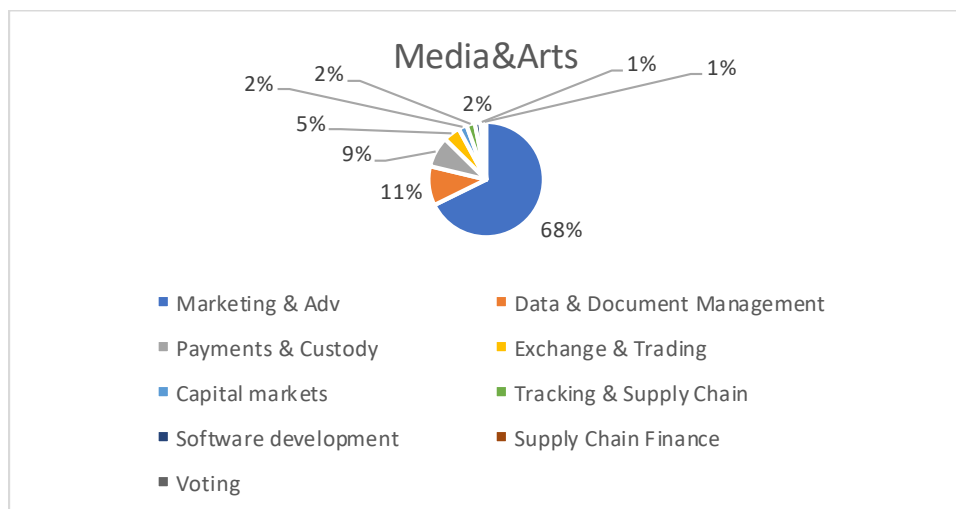
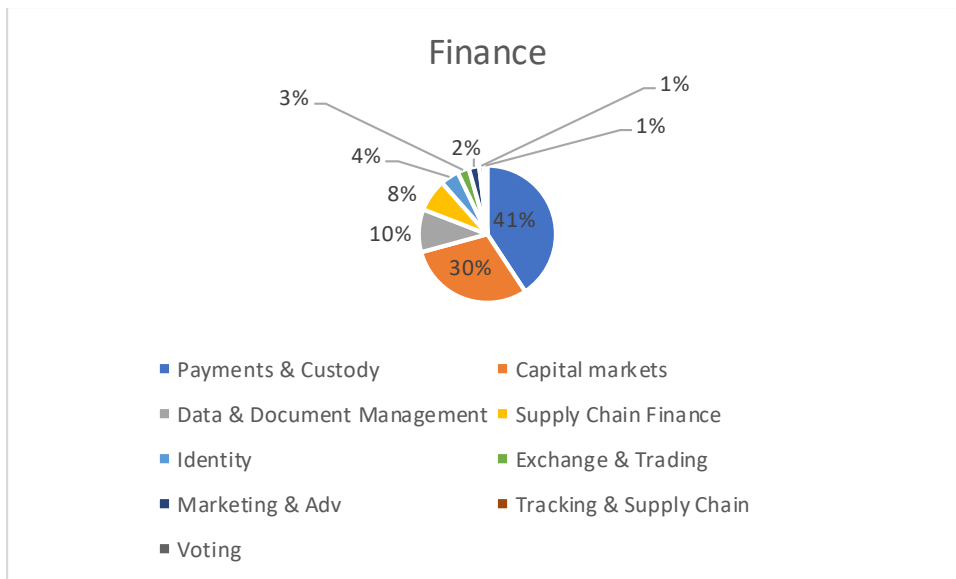
One of the reasons why permissionless platforms became more popular in the media and arts sector is the maturity of NFT technology.

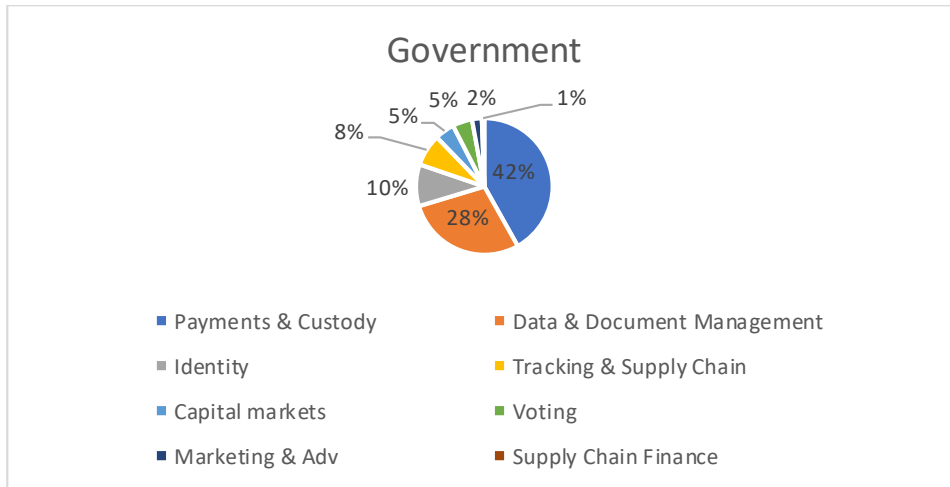
Non-fungible tokens (NFTs) are unique digital assets that are stored on a blockchain. They can represent anything from digital art to in-game items. NFT permissionless platforms allow anyone to create and trade NFTs without having to go through a centralized authority.

There are a few reasons why NFT permissionless platforms became more popular in 2022:

- **Lower fees:** NFT permissionless platforms typically have lower fees than centralized platforms. This makes them more attractive to artists and creators who want to sell their NFTs without having to give up a large portion of the sale price to fees.

- Greater control: NFT permissionless platforms give artists and creators more control over their NFTs. They can set their own prices, royalties, and terms of sale. This gives them more freedom to experiment and reach a wider audience.
- Transparency: NFT-permissionless platforms are more transparent than centralized platforms. This is because all transactions are recorded on the blockchain, which is a public ledger. This makes it easier for artists and creators to track the sales of their NFTs and ensure that they are fairly compensated.





*Chart 27 Types of processes in Finance, Government, Media&Arts projects*

As we can see, Finance blockchain projects are aimed at developing payments and custody processes, accounting for 40% of all projects. Starting in 2016, payment processing was the most popular among finance blockchain projects. Another process that was impacted by finance blockchain projects is capital markets, which account for 30% of all projects.

The adoption of Media&Arts blockchain projects had a huge impact on marketing and advertising processes. Through new blockchain projects, companies increased their marketing audience. The second most popular process, which was influenced by media arts blockchain projects, is the data and document management process.

This kind of blockchain technology project could enable users to have greater control over their personal data and documents related to media and the arts and even monetize them directly by providing secure and decentralized storage for their information.

Also, data management in media and the arts can improve the content distribution process. By using blockchain-based platforms, creators can eliminate the need for intermediaries such as music labels and streaming services and instead distribute their work directly to their audience.

In 2022, most Government blockchain projects were focused on payments and custody processes. We can see how the number of projects related to payments and custody increased starting in 2018. The process related to payments is the most developed due to the several projects related to cryptocurrencies, stablecoins, and CBDCs. A huge number of governments have increased their interest in stable coin technologies and started to develop local CBDC.

One of the reasons why governments are interested in payments blockchain projects is security, as this technology offers a high level of security. It provides an opportunity for governments to keep financial information and transactions safe. Another option is transparency, which could help decrease the risk of fraud. The second process influenced by this project is data and document management. Media&Art projects, especially NFT (non-fungible token) projects, use existing platforms more often because it is easier, faster, and more cost-effective to leverage the infrastructure and user base of an established platform rather than building their own from scratch. Many NFT projects require a marketplace to sell and trade their digital assets, and creating a marketplace is a complex and time-consuming process. By using an existing platform, such as OpenSea, Rarible, or SuperRare, NFT projects can list their tokens for sale and benefit from the platform's existing user base, marketing, and promotional efforts. Additionally, established platforms provide tools and resources that can make it easier for NFT projects to create and manage their tokens, such as templates for creating NFTs, built-in wallets for storing and managing tokens, and APIs for integrating with other platforms and applications. Using an existing platform can also lend credibility to a new NFT project by associating it with a trusted brand and established community. This can be especially valuable for new projects that are trying to gain traction and build a following.

## 6 Discussion and conclusions

In the rapidly evolving landscape of technology, the utilization of blockchain and distributed ledger technology (DLT) by companies and public administrations has emerged as a transformative force, reshaping traditional paradigms of data management, transparency, and security. As we draw the curtain on this thesis, exploring the profound impact of blockchain and DLT up until the present, it is evident that their significance will only amplify in the future.

Throughout the period under scrutiny, as exemplified by the year 2022, the adoption of blockchain and DLT garnered considerable attention due to their ability to create tamper-proof, transparent, and decentralized networks. Companies across industries recognized the potential of these technologies to enhance supply chain traceability, optimize complex processes, and foster trust among stakeholders. Meanwhile, public administrations seized upon blockchain's potential to revolutionize governance, introducing efficiencies in record management, ensuring the integrity of transactions, and promoting citizen participation through secure and transparent voting systems.

However, the true power of blockchain and DLT has yet to be fully realized. The future holds a plethora of opportunities and challenges that will define the trajectory of these technologies. As we peer into the horizon, several key perspectives come into focus.

Firstly, interoperability and scalability will be critical areas of development. While blockchain and DLT have showcased their potential on individual platforms, the ability to seamlessly interact with other systems will be essential to unlocking their full potential. Industry consortia, collaborative research, and standardization efforts will play a pivotal role in achieving this interoperability, enabling data and value to flow seamlessly across diverse networks.

Secondly, regulatory frameworks will evolve to address the novel challenges posed by blockchain technology. The decentralized and global nature of blockchain and DLT raises questions about jurisdiction, data privacy, and legal recourse. Policymakers and legal

experts will need to work in tandem with technologists to strike a balance between fostering innovation and safeguarding societal interests.

Furthermore, the convergence of blockchain with emerging technologies like the Internet of Things (IoT), artificial intelligence (AI), and edge computing will usher in a new era of possibilities. Smart contracts, self-executing code on the blockchain, have the potential to automate complex processes across industries, reducing the need for intermediaries and minimizing human error.

In the financial realm, blockchain's role in reshaping the concept of money itself is a prospect that cannot be ignored. Central bank digital currencies (CBDCs) are gaining traction, leveraging blockchain's efficiency and security to reimagine traditional monetary systems. The integration of cryptocurrencies into mainstream financial services will necessitate collaboration between financial institutions, regulatory bodies, and technology providers.

Lastly, blockchain's impact on sustainability and social impact initiatives is an exciting avenue that is gaining momentum. Through enhanced transparency and traceability, supply chains can be made more ethical and environmentally responsible. Additionally, blockchain can play a crucial role in enabling financial inclusion for unbanked populations by providing secure digital identities and access to financial services.

In conclusion, the integration of blockchain and DLT by companies and public administrations has set the stage for a future where technology will continue to redefine our interactions with data, transactions, and governance. While challenges remain, the potential for innovation, efficiency, and transparency that these technologies offer is unparalleled. As we step into this future, collaboration, adaptability, and a commitment to ethical and responsible deployment will shape the trajectory of blockchain and DLT, creating a world where trust is inherent in every transaction and accountability is woven into the fabric of digital interactions.

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