



Decentralized Dreams: The Role of Blockchain in Transforming Digital Startups in Iringa Municipal

Lusekelo Kibona

Department of Computer Science, Ruaha Catholic University, Tanzania

Corresponding Author: Lusekelo Kibona lusekelo2012@gmail.com

ARTICLE INFO

Keywords: Adoption Barriers, Blockchain Technology, Business Model Innovation, Decentralization, Digital Startups

Received : 20, July

Revised : 27, August

Accepted: 26, September

©2024 Kibona : This is an open-access article distributed under the terms of the [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/).



ABSTRACT

This study explored the transformative role of blockchain technology in digital startups, focusing on its adoption, impact on operational efficiency, and potential to drive innovation. Utilizing a sample of 95 respondents, the research employed a mixed-methods approach to gather quantitative data and qualitative insights. Key indicators included the adoption of blockchain technology, its effects on operational processes, and its influence on funding mechanisms. Findings revealed a high level of awareness and implementation among startups, indicating that blockchain significantly streamlined processes, enhanced transparency, and fostered innovative business models. However, challenges such as technical difficulties and security concerns were also identified, highlighting the need for ongoing support and education. The study concludes that while blockchain presents substantial opportunities for digital startups, addressing the associated challenges is essential for realizing its full potential.

INTRODUCTION

In recent years, blockchain technology has emerged as a groundbreaking innovation, reshaping industries through its decentralized nature and enhanced security features. While initially developed to support cryptocurrencies like Bitcoin, blockchain's applications have extended far beyond financial transactions. One of the most exciting areas of blockchain's influence is its potential to transform digital startups. These early-stage ventures often face significant challenges related to funding, data management, transparency, and trust. Blockchain, with its ability to decentralize processes, create immutable records, and facilitate peer-to-peer transactions, offers a new paradigm for overcoming these hurdles.

Digital startups have traditionally relied on centralized systems for essential services, but these systems often present challenges in terms of cost, efficiency, and security (Almashaqbeh, 2021). Decentralized approaches, particularly blockchain technology, are emerging as potential solutions to these issues. Blockchain-based systems can provide secure and transparent fundraising for startups, addressing investor concerns about asset safety and fund misappropriation (Shelke et al., 2022). These decentralized technologies also enable the creation of peer-to-peer resource markets, offering more flexible and equitable service provision (Almashaqbeh, 2021). In multi-stakeholder activities, decentralized approaches improve coordination and cooperation by enhancing data integrity and resilience (Reed & Dailey, 2023). Furthermore, blockchain-based commercial platforms, such as Lyzis Marketplace, offer decentralized alternatives to traditional centralized structures, providing secure asset exchanges and protected data storage without relying on trusted third parties (Zeggari et al., 2023). These innovations have the potential to revolutionize how digital startups operate and scale.

Blockchain technology offered a revolutionary solution for startup financing and decentralized finance by reducing transaction costs, enhancing transparency, and enabling peer-to-peer interactions (Ahluwalia et al., 2020; Chen & Bellavitis, 2019). This technology addressed key challenges in entrepreneurial financing, such as information asymmetry and high transaction costs associated with matching entrepreneurs and investors (Ahluwalia et al., 2020). Decentralized financial services, empowered by blockchain, had the potential to broaden financial inclusion, encourage permissionless innovation, and create new opportunities for entrepreneurs (Chen & Bellavitis, 2019). These services were characterized by their decentralized nature, interoperability, borderless transactions, and transparency. As a result, blockchain technology was poised to reshape modern finance, potentially creating a new landscape for entrepreneurship and innovation. However, researchers also acknowledged the need to evaluate potential challenges and limitations of this emerging technology in the financial sector (Chen & Bellavitis, 2019).

Blockchain technology was first introduced in 2008 as the underlying technology for Bitcoin, the pioneering cryptocurrency system (Golosova & Romanovs, 2018; Hilary, 2022; Kogias & Patrikakis, 2024). Created by an anonymous individual or group known as Satoshi Nakamoto, blockchain was

initially designed as a decentralized, peer-to-peer electronic cash system that aimed to reduce transaction costs and fraud in digital payments (Golosova & Romanovs, 2018). Although originally developed for financial transactions, blockchain's potential soon extended beyond cryptocurrencies (Hilary, 2022). The technology combined existing elements such as encryption, distributed computing, and digital signatures (Kogias & Patrikakis, 2024). As blockchain evolved, it found applications in various industries, including supply chain management, electronics manufacturing, and power systems (Javaid et al., 2022). The decentralized record-keeping capabilities of blockchain offered increased transparency, security, and reliability, making it a promising technology for transforming business and commerce (Javaid et al., 2022).

Blockchain technology appeared as a decentralized digital ledger system that revolutionized various industries by enabling secure, transparent, and immutable record-keeping without the need for central authorities (Ahram et al., 2017). It operates as a distributed database where transactions are recorded in chronologically linked blocks, stored across a network of computers (Ahram et al., 2017; Mignon, 2019). This structure allowed for peer-to-peer interactions, reducing costs and increasing efficiency in sectors such as finance, supply chain management, and healthcare (Ahram et al., 2017). Blockchain's key features included decentralization, cryptographic security, and public auditability (Mignon, 2019; Sheth & Dattani, 2019). Smart contracts, particularly on platforms like Ethereum, enabled secure transactions with minimal third-party interference (Sheth & Dattani, 2019). Despite its transformative potential, challenges such as scalability and regulatory concerns persisted (Ahram et al., 2017). Nonetheless, blockchain technology continued to reshape global economies and societies through its applications in various fields (Ahram et al., 2017; Mignon, 2019).

Blockchain technology presented significant opportunities for digital startups to overcome traditional growth barriers and innovate. It enabled more efficient operations by reducing intermediary costs and increasing transparency (Ahluwalia et al., 2020). Blockchain-based platforms offered potential for decentralized entrepreneurial financing, addressing issues like information asymmetry in startup funding (Ahluwalia et al., 2020). However, these platforms faced numerous challenges, including high failure rates and the need to manage growth carefully (Garcia Saez, 2020). While blockchain could significantly reduce transaction costs and opportunistic behavior, potentially impacting the role of open innovation intermediaries, it was unlikely to completely eliminate the need for matchmaking and resource provision services (Schenk et al., 2020). For startups to succeed in the digital era, they needed to adopt multifaceted approaches, including agile methodologies, digital literacy, and customer-centric innovation, while leveraging emerging technologies like blockchain and AI (Joel et al., 2024). By leveraging decentralized platforms, startups operated more efficiently, reduced intermediary costs, and increased trust through transparency (Joel et al., 2024). Blockchain emerged as a disruptive technology, offering various business applications and enabling new startup business models (Bhattarai et al., 2022). Initial Coin Offerings (ICOs) provided a revolutionary alternative to traditional venture capital funding, allowing startups to raise

capital more democratically and independently (Akbarpour, 2019). Blockchain-based applications in startup financing addressed issues such as information asymmetry and high transaction costs, leading to a more effective and decentralized entrepreneurial financing process (Ahluwalia et al., 2020). The integration of blockchain technology, along with other emerging technologies like AI, proved critical for enhancing innovation and operational efficiency in startups, emphasizing the importance of digital ecosystems and platform-based models for future growth (Joel et al., 2024).

Research studies found that blockchain technology arose as a transformative force for digital startups, offering new avenues for growth, funding, and innovation. It disrupted traditional business models, particularly in the Finance & Insurance and Information & Communication industries (Friedlmaier et al., 2018). Blockchain-based applications facilitated innovative financial services, especially in payment networks and processing (Friedlmaier et al., 2018). The technology played a crucial role in digital transformation across various sectors, including the Indian startup ecosystem (Basu, 2020). Blockchain, along with other emerging technologies like AI, enabled operational efficiency and innovation for startups navigating the digital transformation journey (Joel et al., 2024). Furthermore, blockchain-based applications in startup financing addressed issues such as information asymmetry and high transaction costs, leading to a more effective and decentralized entrepreneurial financing process (Ahluwalia et al., 2020). These developments empowered startups to reimagine conventional processes, offering new pathways for scalability, funding, and innovation in the digital era.

Blockchain technology has emerged as a transformative force for digital startups in Tanzania and other developing countries. It offers enhanced security, transparency, and efficiency across various sectors, including healthcare, land registration, and banking (Nkwabi, 2021). Despite its potential, blockchain adoption in Tanzania has been slow due to a lack of knowledge and infrastructure. To address this, initiatives like the Dinari blockchain lab have been implemented to support learning, research, and innovation (Kigombola et al., 2023). In healthcare, blockchain can address issues such as data privacy, secure information sharing, and data integrity (Kombe et al., 2019). The technology's impact extends beyond Tanzania, with startups in countries like India leveraging blockchain for digital transformation and innovative solutions like crowdfunding platforms (Basu, 2020). As blockchain continues to evolve, it presents new opportunities for scalability, funding, and innovation in Tanzania's digital startup ecosystem.

As the blockchain ecosystem matured, digital startups explored new applications of this technology across various industries. Blockchain's ability to authenticate digital information and create smart contracts expanded its usefulness beyond financial institutions (Attaran & Gunasekaran, 2019). Startups capitalized on blockchain-based services, developing innovative business models and solutions for existing problems (Bhattarai et al., 2022; Semenova, 2021; Semenova et al., 2023). The technology found applications in areas such as decentralized finance, marketing platforms, and Industrial Internet of Things

(IIoT) (Meydani et al., 2023). Blockchain's versatility allowed startups to thrive in competitive digital environments, creating high value-added and cross-industrial offerings (Semenova, 2021; Semenova et al., 2023). The emergence of programmable blockchain platforms like Ethereum further expanded the technology's applicability (Attaran & Gunasekaran, 2019). As blockchain ecosystems developed, innovative entrepreneurs played a key role in ecosystem formation, demonstrating real-world use cases across numerous industries and leveraging distinctive capabilities to gain competitive advantages (Semenova, 2021; Semenova et al., 2023). As the blockchain ecosystem matured, digital startups in Tanzania explored new applications of this technology. Blockchain's versatility paved the way for startups to thrive in an increasingly competitive digital environment. The technology expanded beyond its initial use in cryptocurrency services to various business applications (Bhattarai et al., 2022). Startups capitalized on blockchain-based services, creating new business models and ecosystems (Bhattarai et al., 2022; Semenova et al., 2023). The technology's ability to authenticate digital information and create smart contracts made it applicable to a wide range of industries (Attaran & Gunasekaran, 2019). Blockchain adoption led to the formation of new ecosystems, with innovative entrepreneurs playing a key role in developing real-world use cases across multiple sectors (Semenova, 2021). As blockchain technology evolved, it found applications in emerging domains such as the Industrial Internet of Things (IIoT) and Industry 4.0, fostering innovation and creating new market opportunities (Meydani et al., 2023).

Blockchain technology has enabled the creation of innovative business models, particularly in decentralized finance and applications (Chen & Bellavitis, 2020; Ciupa, 2019). These new models offered increased transparency, reduced transaction costs, and enhanced trust in distributed systems (Chen & Bellavitis, 2019). Blockchain-based business models experienced rapid growth, with technologies like NFTs and play-to-earn games supporting new ventures (Taherdoost & Madanchian, 2023). The technology improved organizational performance through four key benefits: value capture via increased profitability, value creation through private partnerships, value delivery using smart contracts, and value proposition driving business value through operational improvements (Aini et al., 2023). Despite its potential, blockchain adoption faced challenges and limitations, creating a complex ecosystem that diverged from the original blockchain proposition (Ciupa, 2019). Nevertheless, blockchain technology continued to provide opportunities for financial inclusion, permissionless innovation, and entrepreneurship in various industries (Chen & Bellavitis, 2020).

The problem addressed in the study stemmed from the significant challenges that digital startups faced in their early stages of development. These startups often struggled with issues such as limited access to funding, lack of transparency in operations, and difficulties in securing customer trust, particularly in the digital age where data privacy and security concerns were prevalent. Traditional systems of raising capital, managing data, and building trust proved inadequate and expensive, leaving many startups vulnerable to

inefficiencies and competitive pressures. While blockchain technology emerged as a potential solution, there was insufficient understanding of its practical impact on digital startups. This gap created the need to explore how blockchain could transform these businesses, particularly in terms of decentralization, transparency, and security. The study aimed to address this problem by investigating the role of blockchain in overcoming the key challenges faced by digital startups and its potential to reshape their operational and financial models.

The objective of the study was to examine how blockchain technology transformed the operations and growth of digital startups by enhancing decentralization, transparency, and security. Specifically, the study aimed to assess the adoption of blockchain technology, impact on operational efficiency, and its role in driving innovation within startups, while also exploring how these changes contributed to the overall success and sustainability of digital startups in a competitive market.

The main contribution of the study was that it provided valuable insights into how blockchain technology had revolutionized digital startups by enabling decentralized operations, reducing reliance on intermediaries, and enhancing data security. Additionally, it contributed to the understanding of how blockchain had reshaped business models in the digital space, offering a new framework for startup sustainability and competitive advantage.

METHODOLOGY

The study employed a mixed-method research design to explore the role of blockchain in transforming digital startups in Iringa Municipal, Tanzania. A total of 95 participants, primarily founders, managers, and IT professionals within the digital startup ecosystem, were selected through purposive sampling. This approach ensured that individuals with direct experience in blockchain technology were included in the study.

Quantitative data was collected using structured questionnaires, focusing on aspects such as adoption of blockchain technology, impact on operational efficiency, role in driving innovation within startups and challenges and barriers. Additionally, qualitative data was gathered through semi-structured interviews to gain deeper insights into the challenges, opportunities, and strategic impacts of blockchain on startups. The data was analyzed using statistical tools for quantitative responses, while thematic analysis was applied to interpret qualitative findings. This methodology provided a comprehensive understanding of how blockchain influenced the operational and strategic outcomes of digital startups.

RESEARCH RESULT AND DISCUSSION

The results and discussion section provided an in-depth analysis of how blockchain technology impacted digital startups, based on data gathered from 95 respondents in Iringa Municipal. The findings highlighted key trends in blockchain adoption, its influence on operational efficiency, and its role in driving innovation within startups.

3.1 Demographic information of the respondents

The demographic information of the study, which included a sample size of 95 respondents, provided key insights into the characteristics of the participants. The data captured key demographic variables such as age, gender, professional experience, and roles within digital startups. These factors were essential in understanding the diversity of the respondents and how their backgrounds influenced their perspectives on the role of blockchain technology in transforming digital startups. This demographic profile set the foundation for analyzing how different groups interacted with and benefited from blockchain integration.

3.1.1 Age of the respondents

In analyzing the age distribution of the respondents, as indicated on table 1, it became evident that the majority fell within the 30-39 age group, comprising 42.1% of the sample with 40 individuals. This group likely represented a blend of young professionals and those with a few years of experience in the digital startup ecosystem. Following closely was the 18-29 age group, which accounted for 36.8% of the respondents, totaling 35 individuals. This segment likely included emerging entrepreneurs and early-career professionals who were eager to engage with innovative practices.

The 40-49 age group constituted a smaller portion of the respondents, with 15 individuals representing 15.8%. This demographic might have brought a wealth of experience and insights, albeit from a less prominent representation in this particular study. Lastly, the 50 and above category comprised only 5.3% of the sample, with just 5 respondents. This group likely reflected a more seasoned perspective on the challenges and opportunities within the digital startup landscape, though their limited numbers suggested a lesser involvement in the current entrepreneurial climate.

In summary, the age distribution indicated a strong presence of younger to middle-aged professionals, which could have implications for the types of strategies and technologies being explored in the study.

Table 1: Showing the demographic information of the respondents

Demographic Variable	Category	Frequency	Percentage (%)
Age Group	18-29	35	36.8
	30-39	40	42.1
	40-49	15	15.8
	50 and above	5	5.3
Gender	Male	55	57.9
	Female	40	42.1
Professional Experience	Less than 5 years	30	31.6
	5-10 years	40	42.1
	11-15 years	15	15.8
	More than 15 years	10	10.5

Demographic Variable	Category	Frequency	Percentage (%)
Role in Startup	Founder	25	26.3
	Developer	35	36.8
	Marketing Specialist	20	21.1
	Investor	15	15.8

3.1.2 Gender of the respondents

In examining the gender distribution of the respondents, it was observed as on table 1, that there was a slight predominance of male participants in the study. Out of the 95 respondents, 55 were male, accounting for 57.9% of the total sample. This imbalance reflected a common trend in technology and startup ecosystems, where men often represented a larger portion of professionals involved in these sectors. The higher number of male respondents may have influenced the types of insights provided, particularly in areas such as risk-taking, decision-making, and leadership roles within digital startups.

On the other hand, 40 respondents were female, making up 42.1% of the sample size. Although women were slightly underrepresented, their involvement remained significant, and they likely provided valuable perspectives on the role of blockchain technology and its transformative potential in digital startups. The presence of women in the study highlighted the growing involvement of females in the tech industry, even if the overall numbers still reflected a male majority.

This gender distribution provided a well-rounded set of views but indicated the need for greater gender balance in future studies within the digital startup space.

3.1.3 Professional Experience of the respondents

The study as per table 1, revealed a varied range of professional experience among the respondents, with a significant proportion having 5 to 10 years of experience. Out of the 95 participants, 40 individuals, or 42.1%, fell within this category. This group likely contributed insights that reflected a solid understanding of the digital startup landscape, coupled with a degree of industry familiarity that allowed them to navigate the challenges of integrating blockchain technology into business operations. Their experience positioned them to offer practical perspectives on both the potential and limitations of blockchain in transforming startups.

Meanwhile, 31.6% of the respondents, representing 30 individuals, had less than 5 years of professional experience. This group, being relatively new to the industry, likely approached the role of blockchain in startups with fresh ideas and enthusiasm, though they may have faced challenges due to their limited exposure to the complexities of the tech sector. Their input would have provided an interesting contrast to the more seasoned professionals, possibly highlighting areas where younger professionals see greater opportunities for innovation and adaptation.

Additionally, 15 participants, or 15.8%, had 11 to 15 years of experience, and 10 respondents (10.5%) had more than 15 years of experience. These groups brought a wealth of expertise and historical perspective, which may have influenced their views on the viability of blockchain as a disruptive technology in digital startups. Those with extensive experience likely focused on long-term sustainability, scalability, and the risks involved in integrating emerging technologies into existing business models.

Together, this range of experience provided the study with a well-rounded view of how blockchain could impact the digital startup ecosystem.

3.1.4 Role in Startup of the respondents

The respondents as shown on table 1, represented a variety of roles within their respective startups, each contributing unique perspectives on the impact of blockchain technology. Among the 95 participants, 35 individuals, or 36.8%, identified as developers. This group provided valuable insights into the technical aspects of blockchain integration, discussing the challenges and benefits they encountered while implementing decentralized solutions. Their response often emphasized the importance of robust coding practices and the necessity of understanding blockchain architecture to create scalable applications. Developers also highlighted the need for ongoing education in blockchain technology, as the field was rapidly evolving, requiring them to stay updated with the latest trends and best practices.

Founders constituted the next largest group, with 25 respondents (26.3%) sharing their experiences. They spoke passionately about their vision for leveraging blockchain to enhance operational efficiency and transparency within their startups. Many founders discussed the transformative potential of blockchain in disrupting traditional business models and creating new market opportunities. Their insights revealed a strong belief in the ability of blockchain to build trust among stakeholders by ensuring secure and immutable transactions. However, they also acknowledged the significant barriers to entry, such as regulatory uncertainties and the high initial investment required for integrating blockchain solutions.

Additionally, 20 respondents (21.1%) identified as marketing specialists, bringing a distinct perspective on how blockchain could reshape customer engagement and brand loyalty. They discussed strategies for utilizing blockchain to enhance transparency in supply chains and improve consumer trust. The marketing specialists emphasized the need to communicate the benefits of blockchain to customers effectively, as understanding the technology's value proposition was crucial for driving adoption.

Finally, 15 respondents (15.8%) identified as investors, focusing on the financial implications of blockchain in startups. They expressed a cautious optimism about investing in blockchain-enabled ventures, weighing the potential for high returns against the risks associated with a nascent technology.

The diversity of roles among the respondents enriched the study's findings, showcasing the multifaceted impact of blockchain in the startup ecosystem.

3.2 Adoption of Blockchain Technology

The study examined the adoption of blockchain technology among startups, focusing on key sub-indicators such as awareness and knowledge, integration into business models, and the implementation rate. Startups were evaluated on how well they understood blockchain technology, how effectively they integrated it into their core business functions, and the extent to which they successfully implemented blockchain solutions. This analysis provided insights into the levels of blockchain adoption and its practical application within the startup ecosystem.

Table 2: Showing the adoption of blockchain technology sub-indicators

Sub-Indicators	Category	Frequency (n=95)	Percentage (%)
Awareness and Knowledge	High	65	68.4
	Moderate	20	21.1
	Low	10	10.5
Implementation Rate	Successfully Implemented	50	52.6
	Partially Implemented	30	31.6
	Not Implemented	15	15.8
Integration into Business Models	Fully Integrated	45	47.4
	Partially Integrated	35	36.8
	Not Integrated	15	15.8

3.2.1 Awareness and Knowledge of Blockchain Technology

In the study, the level of awareness and knowledge about blockchain technology as table 2, varied significantly among the respondents. The majority of the interviewees, 65 in total, demonstrated a high level of understanding, with many startup founders and team members expressing confidence in their familiarity with blockchain concepts. These individuals had engaged with blockchain technology for a variety of purposes, from decentralized finance to secure data handling. As one respondent shared:

"...blockchain has become an essential part of our strategy; it's no longer just a buzzword but a tool that we understand and rely on..."

This group had a clear comprehension of the potential benefits of blockchain, particularly in enhancing transparency, efficiency, and security in their business operations.

However, there was also a group of respondents, 20 in total, who reported a more moderate level of knowledge. While they recognized the potential of

blockchain, they admitted to not having fully grasped its complexities or practical applications. One interviewee noted:

"...I have heard about blockchain, but I don't have a deep understanding of how it works. I am interested in learning more about its potential applications in startups..."

For these startups, blockchain remained an intriguing possibility, but the technical expertise needed for full implementation seemed out of reach. They expressed a desire for more educational resources and support to improve their understanding and use of the technology.

A smaller portion of respondents, 10 in total, showed low awareness and knowledge of blockchain. These startups had not invested significant time or resources in learning about blockchain, and for some, it was still a relatively new concept. As one respondent reflected:

"...I am not very familiar with blockchain technology. I have heard the term, but I don't know much about its benefits or limitations..."

This group indicated a need for foundational training to bridge their knowledge gaps, reflecting a slower adoption curve for these businesses compared to their more informed counterparts.

In general, the variance in awareness and knowledge across the respondents highlighted the differing stages of blockchain adoption within the startup community.

3.2.2 Implementation Rate of Blockchain Technology

In the study, the implementation rate of blockchain technology among startups according to table 2, showed diverse levels of progress, with a notable portion of businesses having successfully integrated blockchain into their operations. Out of the 95 respondents, 50 had fully implemented blockchain solutions, accounting for 52.6% of the sample. These startups highlighted how blockchain had become an integral part of their business, streamlining processes, enhancing security, and providing transparency. One respondent shared:

"...blockchain is now deeply embedded in our core operations, from tracking transactions to verifying customer identities. It has revolutionized how we handle data and interact with clients..."

The startups in this group not only embraced blockchain but also expressed high satisfaction with the outcomes, citing improved efficiency and customer trust.

Meanwhile, 30 respondents, or 31.6%, reported partial implementation of blockchain within their startups. These businesses had begun adopting blockchain for specific purposes but had not yet fully integrated it into all areas of their operations. A common theme among these respondents was the gradual nature of their implementation. One interviewee explained:

"...we've started using blockchain for certain processes like payments and contracts, but we're still figuring out how to expand its use across other departments..."

For these startups, the adoption of blockchain was seen as a work in progress, with technical challenges and the need for further resources slowing down the full-scale implementation. While they acknowledged blockchain's potential, these respondents often mentioned difficulties in scaling the technology across their entire business model.

Lastly, 15 respondents, making up 15.8%, had not yet implemented blockchain technology at all. For these startups, blockchain remained a future consideration rather than a current reality. Many cited barriers such as cost, lack of technical expertise, or uncertainty about how to best integrate blockchain into their existing systems. As one respondent noted:

"...we're aware of blockchain and its benefits, but we just don't have the infrastructure or knowledge to implement it right now..."

This group reflected a cautious approach to blockchain adoption, with several businesses expressing interest in the technology but lacking the immediate capacity to incorporate it into their operations.

The varying levels of implementation across the respondents underscored the different challenges and stages of blockchain adoption among startups.

3.3.3 Integration into Business Models

In the study, as illustrated on table 2, the integration of blockchain technology into the business models of startups revealed varying degrees of success. Out of the 95 respondents, 45 startups, or 47.4%, reported that blockchain was fully integrated into their core business operations. These startups emphasized that blockchain had become a fundamental aspect of their value proposition, influencing everything from financial transactions to customer engagement. One respondent noted:

"...Blockchain is now the backbone of our business model, particularly in ensuring transparency and security in our supply chain. We cannot imagine going back to the traditional systems..."

For these startups, blockchain provided a strategic advantage, enhancing operational efficiency and allowing them to offer unique, innovative solutions that set them apart from competitors.

On the other hand, 35 respondents, accounting for 36.8% of the sample, had only partially integrated blockchain into their business models. These startups utilized blockchain for specific functions, such as payment systems or contract management, but had not yet embedded the technology into all aspects of their operations. One respondent explained:

"...We've seen the benefits of blockchain in certain areas, like automating contracts, but we're still in the process of figuring out how to fully align it with our overall business strategy..."

For these startups, the partial integration of blockchain represented a transitional phase, where the technology was being tested and gradually expanded. They were optimistic about further integration but acknowledged that factors such as technical complexity, resource constraints, and a lack of specialized knowledge had slowed down the process.

Finally, 15 startups, or 15.8%, reported no integration of blockchain into their business models. These respondents often highlighted significant barriers, such as high costs or a lack of understanding of how blockchain could fit within their existing frameworks. As one respondent stated:

"...We're still exploring how blockchain could benefit our business, but at this point, we don't see a clear path to integrating it into what we do..."

For these startups, blockchain remained an intriguing but distant concept, with the perceived challenges outweighing the immediate benefits. This group reflected a cautious approach, where blockchain was not yet seen as an essential component of their operations, often due to a limited understanding or concern over the feasibility of implementation.

The differences in the level of integration accentuated the varying maturity levels of startups in adopting blockchain as part of their business models.

3.3 Impact on Operational Efficiency

In the study, the impact of blockchain technology on operational efficiency among digital startups was evaluated through key sub-indicators such as the streamlining of processes and reduced operational costs, improved transparency and accountability, and enhanced data security and privacy.

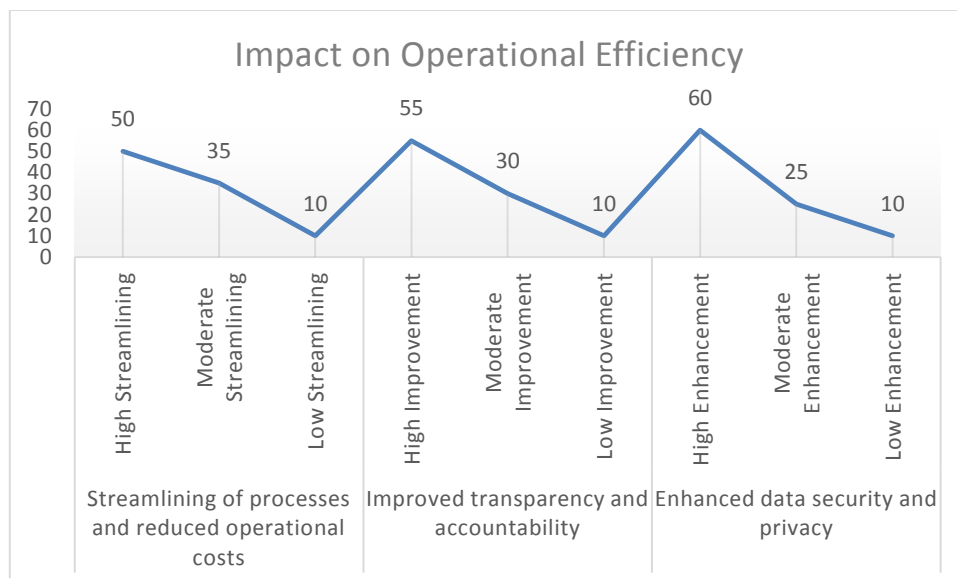


Figure 1: Showing the impact of blockchain on operational efficiency sub-indicators

3.3.1 Streamlining of processes and reduced operational costs

The respondents expressed significant insights regarding the streamlining of processes and the resultant reduction in operational costs following the adoption of blockchain technology. According to figure 1, among the 50 respondents who reported high streamlining, many highlighted that the integration of blockchain led to a notable improvement in efficiency. One respondent stated:

"...After we implemented blockchain, our workflows became much more streamlined. We saw a reduction in the time spent on administrative tasks, which directly cut our operational costs..."

This sentiment was echoed by others, indicating that automating various processes eliminated redundancies and minimized errors, allowing teams to focus on more strategic activities.

In addition, 35 respondents indicated moderate streamlining benefits, suggesting that while improvements were evident, full automation had not yet been achieved. One interviewee mentioned:

"...while we didn't achieve full automation across the board, we certainly noticed improvements. Some processes are faster, but there's still room for further integration..."

This highlights the partial success in streamlining efforts, where businesses experienced benefits but also faced challenges in fully realizing their goals.

Conversely, 10 respondents felt that the impact was low, with one stating:
"...we have seen some changes, but it's hard to say that blockchain made a significant difference in our operational costs..."

This variability in experiences underlines the diverse outcomes of blockchain adoption, suggesting that while many startups reaped substantial benefits, others faced hurdles that limited their ability to fully leverage the technology for cost reduction.

3.3.2 Improved transparency and accountability

Respondents as per figure 1, reported significant improvements in transparency and accountability following the adoption of blockchain technology. A total of 55 participants noted high improvement levels, emphasizing that blockchain's inherent characteristics, such as immutability and decentralization, played a crucial role in enhancing their operations. One respondent articulated this point, stating:

"...the moment we integrated blockchain into our processes, everything became more transparent. We could track every transaction in real-time, which built trust both internally and with our clients..."

This perspective was shared by many, who found that the ability to audit transactions easily fostered a culture of accountability within their teams.

In contrast, 30 respondents indicated moderate improvements, suggesting that while they experienced some benefits, the impact was not as pronounced. One interviewee reflected:

"...we've seen better transparency in some areas, particularly in our supply chain. However, there are still parts of our operations that could benefit from further blockchain integration..."

This comment illustrates that while blockchain enhanced accountability in specific contexts, there remained challenges in achieving comprehensive transparency across all facets of their operations.

Finally, 10 respondents reported low improvement in transparency and accountability. One such respondent mentioned:

"...we implemented blockchain, but I'm not convinced it has significantly changed how we operate. We still face issues with accountability in some processes..."

This comment indicates that despite the potential benefits of blockchain, not all startups fully realized its advantages, highlighting the importance of tailored implementation strategies to maximize effectiveness.

The diverse experiences of the respondents underline the varied impact of blockchain on transparency and accountability within different startup contexts.

3.3.3 Enhanced data security and privacy

Respondents expressed a strong belief that adopting blockchain technology significantly enhanced data security and privacy within their organizations. As shown in figure 1, out of the participants, 60 reported a high level of enhancement, emphasizing how blockchain's cryptographic features and decentralized nature contributed to safeguarding sensitive information. One respondent stated:

"...since we started using blockchain, our data security has drastically improved. The encryption protocols ensure that our customer data is not only secure but also private, which is essential in today's market..."

This sentiment was echoed by many, who recognized that the technology offered a robust framework for protecting against unauthorized access and data breaches.

In contrast, 25 respondents indicated moderate enhancements in data security and privacy. While they acknowledged improvements, they also noted that the transition to blockchain was not without its challenges. One interviewee mentioned:

"...we've certainly seen a level of increased security, especially with sensitive transactions. However, we still face challenges with integrating our legacy systems, which sometimes leaves vulnerabilities..."

This opinion highlighted that while blockchain brought about notable improvements, complete security was contingent upon effectively addressing existing system weaknesses.

On the other hand, 10 respondents reported low enhancements regarding data security and privacy. These respondents reflected concerns about the perceived complexity of blockchain technology and its integration. One participant remarked:

"...we implemented blockchain thinking it would solve our security issues, but the reality is that it created more complexity. I feel like we're still figuring out how to fully utilize it..."

This comment underlines the idea that while blockchain holds potential for enhancing data security, its successful implementation requires a thoughtful approach and a comprehensive understanding of the technology.

The response from respondents illustrated a range of experiences, showcasing both the significant benefits and the challenges associated with blockchain adoption in enhancing data security and privacy.

3.4 Role of Blockchain in Driving Innovation within Startups

The indicator assessing the role of blockchain in driving innovation within startups focused on several key aspects, including the creation of new business models and revenue streams, the development of innovative products and services, and the fostering of collaboration and partnerships. Respondents highlighted how blockchain technology facilitated a shift in their operational

paradigms, enabling them to explore novel approaches to business that were previously unattainable. By leveraging blockchain, many startups not only transformed their existing offerings but also opened avenues for collaboration that enhanced their competitive edge in the market.

Table 3: Showing Role in Driving Innovation within Startups

Sub-indicator	Category	Frequency (n=95)	Percentage (%)
Creation of new business models and revenue streams	Significant Creation	40	42.1
	Moderate Creation	35	36.8
	No Creation	20	21.1
Development of innovative products and services	High Development	50	52.6
	Moderate Development	30	31.6
	Low Development	15	15.8
Fostering collaboration and partnerships	High Collaboration	55	57.9
	Moderate Collaboration	30	31.6
	Low Collaboration	10	10.5

3.4.1 Creation of New Business Models and Revenue Streams

The creation of new business models and revenue streams through blockchain technology as table 3, illustrates emerged as a significant theme among the interviewed respondents. Of the participants, 40 reported significant creation, indicating that blockchain provided them with unique opportunities to innovate beyond traditional business practices. One founder noted:

"...we were able to pivot our entire business model to incorporate tokenization, which opened up new revenue channels we never considered before. This shift has been pivotal for our growth..."

This sentiment was echoed by others who also reported substantial changes in how they approached their markets.

While a majority indicated significant creation, 35 respondents acknowledged moderate impact, suggesting that blockchain's influence was more incremental. One interviewee shared:

"...we implemented blockchain to enhance our service delivery, and while it did create some new revenue streams, the extent was not as extensive as we initially anticipated..."

These insights highlight a nuanced understanding of blockchain's potential, where some startups experienced transformative change, while others found the integration process to be more gradual.

Conversely, 20 respondents indicated that they experienced no creation of new business models. One interviewee remarked:

"...we explored blockchain but ultimately decided it wasn't the right fit for our current operations, and thus, we didn't pursue it further..."

This reflects a realistic appraisal of technology adoption, underscoring the varying degrees of effectiveness and the importance of strategic alignment in harnessing blockchain's potential for innovation.

The responses illustrated a range of experiences, reinforcing the idea that while blockchain can significantly reshape business models, the outcomes depend heavily on how it is implemented and integrated into existing frameworks.

3.4.2 Development of Innovative Products and Services

The study explored the extent to which blockchain technology had enabled digital startups to develop innovative products and services. The development of innovative products and services as a result of blockchain technology was a prominent theme highlighted by the respondents. According to data on table 3, a total of 50 participants reported high levels of development, emphasizing that blockchain had significantly influenced their ability to create cutting-edge solutions. One product manager explained:

"...with blockchain, we were able to enhance our product's security and transparency, which directly appealed to our customers. This technology allowed us to introduce features that were previously impossible, like real-time tracking of product authenticity..."

This insight illustrated how blockchain not only facilitated innovation but also strengthened customer trust and engagement.

In contrast, 30 respondents noted moderate development of new products and services. These participants recognized the potential of blockchain but described their outcomes as more iterative rather than revolutionary. As one entrepreneur stated:

"...we integrated blockchain into our existing services, which improved certain features, but it didn't result in entirely new offerings. It's more of an enhancement rather than a complete overhaul..."

This observation emphasized a pragmatic approach to technology adoption, where the innovation process involved adapting rather than creating entirely new products.

On the other hand, 15 respondents indicated low levels of development, reflecting challenges in leveraging blockchain for innovation. One startup founder remarked:

"...we initially thought blockchain would help us develop a groundbreaking product, but we found it difficult to translate the technology into something that the market wanted. Ultimately, we had to shift our focus elsewhere..."

This comment illustrated the complexities and risks associated with adopting new technologies, highlighting that while blockchain holds great promise, its successful implementation requires a clear understanding of market needs and strategic fit.

The varied experiences of the respondents showcased the diverse impacts of blockchain on product and service innovation, revealing both its transformative potential and the obstacles some startups faced in fully capitalizing on it.

3.4.3 Fostering Collaboration and Partnerships

The role of blockchain technology in fostering collaboration and partnerships among startups as per data presented on table 3, emerged as a significant theme in the study. A substantial number of respondents, 55 in total, reported high levels of collaboration facilitated by blockchain. These participants emphasized how the technology created new opportunities for cooperation and resource sharing. One respondent, a co-founder of a tech startup, articulated this point by stating:

"...blockchain enabled us to establish trust with other companies, which is essential when you're sharing sensitive data. We were able to form partnerships that were simply not possible before, leading to joint projects that expanded our capabilities and reach..."

This insight highlighted how the inherent transparency and security of blockchain fostered a collaborative environment, encouraging startups to work together towards common goals.

In contrast, 30 respondents indicated moderate collaboration, suggesting that while blockchain had positively influenced their ability to partner, the impact was not uniformly transformative. One marketing director explained:

"...we did find partners willing to work with us through blockchain, but the results were mixed. Some collaborations yielded great outcomes, while others felt more like experiments that didn't fully leverage the technology..."

This perspective emphasized the variability in how startups were able to harness blockchain for collaborative purposes, indicating that the success of partnerships often depended on factors beyond just the technology itself, such as alignment in vision and operational compatibility.

Additionally, 10 respondents reported low levels of collaboration, reflecting skepticism or challenges in using blockchain to foster partnerships. A respondent from a traditional industry remarked:

"...we were excited about the potential of blockchain, but when it came to collaboration, many companies were still hesitant to embrace it. There's a lot of reluctance in our sector to change established ways of doing business, and that made it difficult for us to initiate meaningful partnerships..."

This statement pointed to the barriers some startups faced in leveraging blockchain for collaboration, particularly in industries resistant to change.

The experiences shared by the respondents painted a nuanced picture of how blockchain technology could enhance collaboration, illustrating both its potential and the challenges that persisted in fully realizing that potential within the startup ecosystem.

3.5 Challenges and Barriers

The challenges and barriers faced by startups in adopting blockchain technology were crucial to understanding its overall impact. Respondents highlighted three primary areas of concern: technical challenges, security concerns, and cultural and organizational resistance.

Table 4: Showing the Challenges and Barriers

Sub-Indicator	Category	Frequency (n=95)	Percentage (%)
Technical challenges	Significant Challenges	50	52.7
	Moderate Challenges	35	36.8
	Minor Challenges	10	10.5
Cultural and Organizational Resistance	High Resistance	40	42.1
	Moderate Resistance	35	36.8
	Low Resistance	20	21.1
Security Concerns	High Security Concerns	60	63.2
	Moderate Security Concerns	25	26.3
	Low Security Concerns	10	10.5

3.5.1 Technical challenges

The technical challenges associated with blockchain adoption as per data on table 4, emerged as a significant concern among respondents in the study. Out of the 95 participants, 50 indicated they faced significant challenges, while 35 reported moderate challenges and 10 noted minor challenges. Many expressed that the complexities of integrating blockchain technology into existing systems were daunting. One respondent remarked:

"...we faced numerous issues trying to adapt our legacy systems to accommodate blockchain. It felt like trying to fit a square peg into a round hole..."

This sentiment was echoed by others, who described the steep learning curve that accompanied implementing such advanced technology.

Approximately 52.7% of respondents reported experiencing significant challenges, particularly regarding scalability and interoperability. A startup founder shared:

"...our team struggled with the scalability of blockchain solutions. Initially, we underestimated the resources required to scale effectively. It became a constant balancing act between meeting user demands and maintaining system efficiency..."

Such experiences highlighted that while blockchain technology held great potential, the pathway to effective implementation was fraught with obstacles.

Moreover, 36.8% of participants reported moderate challenges, indicating that integration issues significantly slowed their progress. A respondent emphasized:

"...we encountered several integration issues that slowed down our progress. The technical side was much more complicated than we anticipated, and it sometimes felt like we were taking two steps back for every step forward..."

These insights underlined the need for more comprehensive support and education around blockchain technology, as well as the importance of developing tailored solutions to address the unique challenges faced by startups in this rapidly evolving landscape.

3.5.2 Cultural and Organizational Resistance

Cultural and organizational resistance to adopting blockchain technology as per table 4, was identified as a notable barrier among the respondents in the study. Of the 95 participants, 40 indicated experiencing high levels of resistance, while 35 reported moderate resistance, and 20 noted low resistance. Many respondents attributed this resistance to a lack of understanding and fear of change within their organizations. One participant articulated this sentiment, stating:

"...there was a pervasive skepticism about blockchain among our team. Many employees were accustomed to traditional methods, and the thought of shifting to something so new was met with a lot of apprehension..."

This highlights how deeply entrenched organizational cultures can impede the adoption of innovative technologies.

The data revealed that 42.1% of respondents faced significant cultural resistance, reflecting concerns about the implications of blockchain on existing workflows and processes. A startup leader shared:

"...even though we recognized the potential benefits of blockchain, convincing our team to embrace it was a challenge. There was a significant worry that our current processes would be disrupted, leading to a decline in productivity..."

This illustrates the hesitance within organizations to move away from established practices, showcasing the need for effective change management strategies when introducing new technologies.

Additionally, 36.8% of participants reported moderate resistance, indicating a mixed response within their organizations. Some respondents mentioned attempts to address these concerns through training and workshops. One entrepreneur noted:

"...we tried to provide our team with more information about blockchain, but it was a slow process. People needed time to adapt, and many remained unconvinced of its practicality..."

This accentuates the importance of fostering a supportive environment that encourages learning and adaptation, as well as the critical role of leadership in championing technological change to mitigate resistance and facilitate smoother transitions.

3.5.3 Security Concerns

Security concerns regarding blockchain technology were a significant issue highlighted by the respondents in the study. According to table 4, out of the 95 participants, 60 expressed high levels of concern about security vulnerabilities associated with blockchain implementations. Many respondents pointed out

that, despite the perceived advantages of blockchain, the fear of potential breaches and cyber threats created a barrier to full adoption. One respondent, a startup founder, explained:

"...even though blockchain is touted as secure, we worried about the risks involved. Our data is our lifeblood, and any chance of a breach could be devastating..."

This reaction reflected a broader apprehension among participants regarding the adequacy of existing security measures in their blockchain systems.

In addition to the high security concerns, 25 respondents reported moderate security worries, indicating that while they recognized the benefits of blockchain, they remained cautious. A marketing specialist articulated this nuance, stating:

"...we were excited about what blockchain could do for us, but there was always this nagging feeling about how safe our data really was. We needed to be convinced that the security measures were robust enough to protect us..."

This highlights the dual nature of enthusiasm and skepticism that characterized many participants' attitudes toward blockchain technology.

Only 10 respondents indicated low security concerns, suggesting a relatively small group that felt confident in the technology's security capabilities. One of these respondents remarked:

"...in our experience, blockchain has been secure. We've implemented multiple layers of encryption, and our teams are well-trained in cybersecurity practices. I believe that with the right protocols in place, the risks can be managed effectively..."

This perspective, while valid, was in the minority, underscoring the need for the blockchain community to address these security fears through transparent communication, education, and the implementation of best practices to foster greater trust and confidence among potential users.

CONCLUSIONS AND RECOMMENDATIONS

The study underlined the transformative potential of blockchain technology in digital startups in Iringa Municipal, Tanzania, highlighting its role in enhancing operational efficiency, driving innovation, and reshaping funding mechanisms. Respondents emphasized the significant improvements in processes, transparency, and data security attributed to blockchain adoption. Many reported that the technology allowed for the creation of new business models and revenue streams, fostering collaboration and partnerships that were previously difficult to establish. However, while the eagerness for blockchain's benefits was evident, the study also revealed notable challenges, particularly concerning security concerns and cultural resistance within organizations. These barriers highlighted the need for a comprehensive approach to blockchain implementation that addresses both technological and human factors. The findings of the study indicated that while blockchain offers promising advancements for startups, a careful consideration of the associated challenges is essential for successful adoption. Participants expressed a strong desire for more education and support regarding blockchain's capabilities and security implications. By fostering an environment of trust and understanding, stakeholders can facilitate smoother transitions to blockchain technologies,

ultimately realizing the full potential of this innovative framework in driving growth and efficiency in the digital startup landscape.

The study recommends that digital startups prioritize comprehensive training and education on blockchain technology to address knowledge gaps and build confidence among team members. Additionally, fostering an organizational culture that embraces innovation and adaptability is crucial for overcoming resistance to change. Startups should also seek partnerships with experienced blockchain developers and consultants to navigate technical challenges and ensure secure implementations. Furthermore, engaging with regulatory bodies to clarify guidelines and enhance compliance can mitigate concerns related to security and legal frameworks, ultimately facilitating smoother adoption of blockchain solutions.

ACKNOWLEDGMENT

I would like to extend my appreciations to Juma Mdimu Rugina from Ruaha Catholic University (RUCU) for his support during the preparation of this manuscript, Ruaha Catholic University management and staff for encouragement they gave us during data collection, analysis and interpretation. Also I would like to thank my family especially my kids (Neema, Nelson, Nelvin, Nelvis and Angel Lusekelo Kibona) for being there when I needed them.

REFERENCES

- Ahluwalia, S., Mahto, R. V., & Guerrero, M. (2020). Blockchain technology and startup financing: A transaction cost economics perspective. *Technological Forecasting and Social Change*, 151, 119854.
- Ahram, T., Sargolzaei, A., Sargolzaei, S., Daniels, J., & Amaba, B. (2017). Blockchain technology innovations. 2017 IEEE technology & engineering management conference (TEMSCON),
- Aini, Q., Manongga, D., Rahardja, U., Sembiring, I., & Efendy, R. (2023). Innovation and key benefits of business models in blockchain companies. *Blockchain Frontier Technology*, 2(2), 24-35.
- Akbarpour, S. (2019). Blockchain start-ups to venture out from venture capital! are ICOs here to stay? *The Journal of Investing*, 28(3), 32-44.
- Almashaqbeh, G. (2021). Rethinking service systems: A path towards secure and equitable resource markets. *USENIX; login: Magazine*.
- Attaran, M., & Gunasekaran, A. (2019). Applications of blockchain technology in business: challenges and opportunities.
- Basu, P. (2020). Digital Transformation-Indian Startup Ecosystem and Blockchain Platform for Crowd Funding. *The Management Accountant Journal*, 55(11), 64-69.
- Bhattacharai, S., Fulgencio, H., & LeFever, H. (2022). Making Sense of Blockchain as a Digital Technology for Open Innovation: A Review Exploring Blockchain Business Applications, Start-Up Business Models, and Blockchain Services Ecosystem. *Transformation Dynamics in FinTech: An Open Innovation Ecosystem Outlook*, 281-313.
- Chen, Y., & Bellavitis, C. (2019). Decentralized finance: Blockchain technology and the quest for an open financial system. *Stevens Institute of Technology School of Business Research Paper*.
- Chen, Y., & Bellavitis, C. (2020). Blockchain disruption and decentralized finance: The rise of decentralized business models. *Journal of Business Venturing Insights*, 13, e00151.
- Ciupa, K. (2019). Decentralized Business Models: Impact of blockchain technology on business model generation. *Kwartalnik Nauk o Przedsiębiorstwie*, 53(4), 79-97.
- Friedlmaier, M., Tumasjan, A., & Welp, I. M. (2018). Disrupting industries with blockchain: The industry, venture capital funding, and regional distribution of blockchain ventures. Venture capital funding, and regional distribution of blockchain ventures (September 22, 2017). Proceedings of the 51st annual Hawaii international conference on system sciences (HICSS),

- Garcia Saez, M. I. (2020). Blockchain-enabled platforms: Challenges and recommendations.
- Goloseva, J., & Romanovs, A. (2018). The advantages and disadvantages of the blockchain technology. 2018 IEEE 6th workshop on advances in information, electronic and electrical engineering (AIEEE),
- Hilary, G. (2022). Blockchain and other Distributed Ledger Technologies, an advanced primer. *Innovative Technology at the Interface of Finance and Operations: Volume I*, 1-21.
- Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Khan, S. (2022). A review of Blockchain Technology applications for financial services. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, 2(3), 100073.
- Joel, O. S., Oyewole, A. T., Odunaiya, O. G., & Soyombo, O. T. (2024). Navigating the digital transformation journey: strategies for startup growth and innovation in the digital era. *International Journal of Management & Entrepreneurship Research*, 6(3), 697-706.
- Kigombola, A., Mbise, M., & Mafole, P. (2023). Dinari: A blockchain lab for supporting blockchain learning, research, and innovation in Tanzania. *Journal of ICT Systems*, 1(1), 19-31.
- Kogias, D. G., & Patrikakis, C. Z. (2024). Beyond Bitcoin: Exploring the Expanding Horizons of Blockchain Innovation. *IT professional*, 26(3), 4-8.
- Semenova, V. (2021). Entry Dynamics of Startup Companies and the Drivers of Their Growth in the Nascent Blockchain Industry.
- Semenova, V., Sebrek, S. S., Garrido, B. P., Katona, A., & Michalkó, G. (2023). The interaction of actor-independent and actor-dependent factors in new venture formation: The case of blockchain-enabled entrepreneurial firms. *Acta Oeconomica*, 73(4), 537-559.
- Shelke, V., Khakhkhar, S., & Jani, Y. (2022). Fundraising through blockchain. *International Journal of Computer Engineering in Research Trends*, 9(4), 73-78.
- Sheth, H., & Dattani, J. (2019). Overview of blockchain technology. *Asian Journal For Convergence In Technology (AJCT) ISSN-2350-1146*.
- Taherdoost, H., & Madanchian, M. (2023). Blockchain-based new business models: A systematic review. *Electronics*, 12(6), 1479.
- Zeggari, M., Lambiotte, R., Abadi, A., & Kassab, M. (2023). An Efficient and Decentralized Blockchain-based Commercial Alternative. 2023 IEEE 20th International Conference on Software Architecture Companion (ICSA-C),