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Unlocking New Business Models: How Blockchain is Shaping Digital Entrepreneurship in Iringa Municipal

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ABSTRACT

This study explored the impact of blockchain technology on digital entrepreneurship in Iringa Municipal, focusing on its potential to unlock new business models, enhance the entrepreneurial ecosystem, and identify challenges and opportunities associated with its adoption. A mixed-method approach was employed, involving a survey of 100 local entrepreneurs, which provided insights into their perceptions and experiences with blockchain. The findings revealed that a significant proportion of respondents viewed blockchain as a catalyst for innovation, with a majority recognizing its potential for market expansion and collaboration. However, challenges such as regulatory barriers, technical constraints, and financial limitations were also identified as impediments to widespread adoption. The study concluded that while blockchain holds promise for transforming the entrepreneurial landscape, concerted efforts are needed to educate stakeholders and create a supportive environment that facilitates its integration. Recommendations were made to enhance awareness, promote collaboration, and develop innovative funding mechanisms to fully leverage the benefits of blockchain technology in driving economic growth and innovation in the region.

INTRODUCTION

The emergence of blockchain technology is revolutionizing digital entrepreneurship across the globe. As a decentralized, secure, and transparent system, blockchain provides a foundation for new business models that break away from traditional structures. In Iringa Municipal, Tanzania, this disruptive technology is starting to shape digital entrepreneurship by fostering innovation and creating new pathways for entrepreneurs to engage in economic activities. The focus of this study is to explore how blockchain is unlocking new business models in Iringa, driving economic empowerment, and enhancing trust within local digital ecosystems. Blockchain has gained prominence due to its ability to facilitate peer-to-peer transactions without intermediaries, reducing costs and increasing efficiency. This presents an opportunity for local entrepreneurs in Iringa, especially in areas such as finance, supply chain management, and digital identity verification. Given its potential to reduce fraud and corruption while ensuring secure transactions, blockchain is seen as a game-changer in underdeveloped regions with infrastructural and financial challenges.

Blockchain technology offers significant potential for transforming entrepreneurship and startup financing. It can enhance the efficiency, transparency, and accessibility of funding for university-based entrepreneurial projects (Dai, 2024). By leveraging blockchain's decentralized architecture and transparent ledger system, startups can overcome traditional financing challenges such as information asymmetry and high transaction costs (Ahluwalia et al., 2020). The technology enables more effective matching between entrepreneurs and investors, leading to a more decentralized and streamlined financing process. Blockchain also presents opportunities for process optimization and modernization in various aspects of entrepreneurship (Todorova, 2023). However, its adoption comes with challenges, including regulatory, scalability, and governance issues that require careful consideration (Dai, 2024). Despite these risks, successful implementations of blockchain technology in various companies demonstrate its potential to revolutionize entrepreneurial practices and financing models (Todorova, 2023).

In the context of startup financing, blockchain can reduce information asymmetry and transaction costs, leading to more effective and decentralized entrepreneurial funding (Ahluwalia et al., 2020). The technology enables independent verification of data without central control, enhancing precision and operational oversight for businesses (Marikyan et al., 2022). For born-global startups utilizing blockchain, rapid internationalization can be attributed to network effects, solving the chicken-and-egg problem, and building ecosystems around the evolving technology (Zalan, 2018). While blockchain presents numerous benefits, including streamlined institutional functions and increased transparency, entrepreneurs must also consider potential risks and challenges in its adaptation (Ahluwalia et al., 2020; Todorova, 2023).

Blockchain technology disrupted traditional business models by enabling decentralization, reducing transaction costs, and enhancing trust ((Nowiński & Kozma, 2017). It impacted existing models by improving efficiency and security, while also creating opportunities for entirely new

businesses (Behrendt & Scheiner, 2023). The technology affected various dimensions of business models, particularly through authentication of traded goods, disintermediation, and lowered transaction costs (Nowiński & Kozma, 2017). Large companies like Walmart, IBM, and Microsoft adopted blockchain to gain competitive advantages ((Raisinghani et al., 2019). In the financial sector, blockchain facilitated the rise of decentralized financial services, which were more innovative, interoperable, and transparent (Chen & Bellavitis, 2019). These developments broadened financial inclusion and created new opportunities for entrepreneurs. However, implementing blockchain technology also presented risks and challenges that businesses needed to consider (Raisinghani et al., 2019). Overall, blockchain technology reshaped business structures and created a new landscape for innovation across various industries. Blockchain technology has emerged as a disruptive force with the potential to transform traditional business models across various sectors in Tanzania. It offers enhanced security, transparency, and reduced transaction costs ((Nkwabi, 2021; Nowiński & Kozma, 2017). In healthcare, blockchain could improve patient record management, while in land registration, it could increase transparency and reduce conflicts (Nkwabi, 2021). The banking sector could benefit from improved security and fraud prevention (Nkwabi, 2021). In education, blockchain-based solutions were proposed to address certificate verification challenges, enhancing credibility and reducing forgeries (Said et al., 2023). Despite its potential, blockchain adoption in Tanzania was still lagging, necessitating increased investment and implementation across various sectors (Nkwabi, 2021).

Recent studies have explored the potential of blockchain technology in various sectors across Sub-Saharan Africa, including agriculture, healthcare, and finance. In Tanzania, digital entrepreneurs have been developing applications to address challenges in crop production and agricultural services (Tossou & Thoto, 2020). The adoption of blockchain in healthcare systems has been proposed to tackle issues such as patient privacy, secure data sharing, and data integrity (Kombe et al., 2019). Blockchain technology offers opportunities for creating new markets and products in emerging economies, particularly in financial services and sustainable business practices (Miller et al., 2019). However, the success of these innovations depends on overcoming technical and economic limitations in rural areas, where ICT infrastructure and access remain challenging (Toivanen et al., 2012). Despite these obstacles, blockchain has the potential to drive inclusive growth and transform various sectors in African countries, including agriculture, healthcare, and finance.

Blockchain technology has developed as a transformative force in supply chain management (SCM), offering benefits such as decentralization, persistency, and auditability (Zheng et al., 2018). Various blockchain-based business models have been explored, including applications in the electric power industry using smart contracts (Queiroz et al., 2020). Permissioned blockchains have shown potential for enhancing supply chain trackability, enabling secure and transparent communication among various actors in the logistics process (Khanna et al., 2020). The technology has been applied to

tracking and tracing goods, verifying product authenticity, and automating supply chain processes (Hassan et al., 2020). Despite its potential to increase transparency, improve efficiency, and reduce costs, blockchain integration in SCM is still in its infancy, with scholars and practitioners not fully aware of its capacity to disrupt traditional business models (Queiroz et al., 2020). Future research directions include the integration of AI and ML, expanded use of smart contracts, and development of new blockchain-based business models (Hassan et al., 2020).

Blockchain technology faced numerous challenges for startups and established companies alike. Technical complexity, scalability issues, and regulatory hurdles were among the primary obstacles (Garcia Saez, 2020). Scalability problems, including throughput and latency, remained largely unstudied(Yli-Huumo et al., 2016). Security and privacy concerns were prevalent, with many proposed solutions lacking concrete evaluation (Yli-Huumo et al., 2016). The technology's immaturity made it difficult to recommend for most projects, although it showed potential for Internet of Things applications (Fournier & Petrillo, 2020). Startups struggled to impact incumbents' market shares significantly, and less than 10% of blockchain-enabled platforms survived their first year (Garcia Saez, 2020). To overcome these challenges, experts recommended starting in controlled markets and managing growth, rather than rushing to global markets (Garcia Saez, 2020). Future research directions were suggested to address these limitations and improve blockchain's effectiveness (Ademi, 2018).

In Tanzania, blockchain technology faced several challenges in startup ecosystem, including technical complexity, regulatory hurdles, and scalability issues. A major obstacle was the low awareness and understanding of blockchain among practitioners, with 74.7% of respondents in one study unaware of its applications in supply chain operations (Maagi, 2023). Technical issues and lack of knowledge were identified as primary challenges affecting blockchain adoption (Maagi, 2023). In the healthcare sector, difficulties in protecting patient privacy, securely sharing medical information, and maintaining data integrity were significant concerns (Kombe et al., 2019). Despite these challenges, blockchain showed potential for improving various sectors in Tanzania, including healthcare, land registration, and banking (Nkwabi, 2021). To address these issues, researchers proposed blockchain-based solutions, such as self-sovereign identity and secure data storage using blockchain ledgers and interplanetary file systems (Kombe et al., 2019; Said et al., 2023).

The blockchain startup ecosystem has shown significant potential for growth and innovation across various industries. Research indicated that blockchain technology enabled new business models, ventures, and cross-industrial offerings (Semenova, 2021). Startups played a crucial role in seizing profit opportunities and creating high value-added solutions (Semenova, 2021). The blockchain ecosystem encompassed eleven generic roles, with implications for governance, trust, and openness (Riasanow et al., 2018). Blockchain applications extended beyond cryptocurrencies to areas such as legal services,

supply chain management, and finance (Zhao et al., 2016). The technology facilitated open innovation and disrupted traditional business models (Bhattarai et al., 2022). As blockchain adoption increased, it attracted attention from banks, governments, and corporations, leading to numerous business innovations (Zhao et al., 2016). The emergence of blockchain ecosystems in various countries, such as Hungary, demonstrated the technology's potential to transform industry structures and create new market opportunities (Semenova, 2021).

The entrepreneurial landscape in Iringa Municipal faced significant challenges, including limited access to financing, inefficient regulatory frameworks, and a lack of trust between business entities and customers. Traditional business models struggled to cope with these issues, stifling innovation and limiting the growth potential of local entrepreneurs. Moreover, the rapid shift toward a digital economy created a demand for more efficient, transparent, and scalable systems. Although blockchain technology held the potential to address these problems by offering decentralized, secure, and transparent solutions, its adoption remained limited. This gap in understanding how blockchain could transform business models in the region necessitated an exploration of its role in shaping digital entrepreneurship in Iringa.

The study aimed to investigate the role of blockchain technology in transforming digital entrepreneurship in Iringa Municipal. Specifically, it sought to explore how blockchain is enabling the creation of new business models, assess its impact on the local entrepreneurial ecosystem, and identify the challenges and opportunities associated with blockchain adoption among local entrepreneurs.

The main contribution of this study was to provide insights into how blockchain technology reshaped digital entrepreneurship in Iringa Municipal by unlocking innovative business models. It highlighted the tangible impact of blockchain on the local entrepreneurial ecosystem, offering a deeper understanding of both the challenges and opportunities entrepreneurs faced in adopting this technology. The study contributed to the growing body of knowledge by demonstrating how blockchain could enhance financial inclusion, improve operational efficiency, and foster trust in business transactions, thereby promoting sustainable digital entrepreneurship in the region.

METHODOLOGY

The study employed a mixed-methods approach, combining quantitative and qualitative research methodologies to gather comprehensive insights into the role of blockchain in shaping digital entrepreneurship in Iringa Municipal.

A cross-sectional survey design was utilized to collect quantitative data, while in-depth interviews provided qualitative insights. This design allowed for a holistic understanding of the phenomenon under investigation.

A total sample size of 100 respondents was selected for the quantitative phase of the study. The participants were local entrepreneurs operating within Iringa Municipal, chosen through stratified random sampling to ensure representation across various sectors, including agriculture, retail, and technology. This approach facilitated a diverse perspective on the impact of blockchain on different business models.

Quantitative data were collected using a structured questionnaire designed to assess awareness, attitudes, and perceptions of blockchain technology among entrepreneurs. The questionnaire included closed-ended questions and different scale items to gauge the respondents' experiences and opinions regarding blockchain adoption.

RESEARCH RESULTS AND DISCUSSIONS

This section presented the findings from the study based on data collected from 100 local entrepreneurs in Iringa Municipal. The results were analyzed in relation to the study's objectives, which explored how blockchain technology enabled the creation of new business models, assessed its impact on the digital entrepreneurship ecosystem, and identified the challenges and opportunities for blockchain adoption. The quantitative data, derived from structured questionnaires, provided statistical insights, while the qualitative data from in-depth interviews offered a slightly different understanding of the respondents' experiences and perceptions. Together, these findings illuminated the transformative role of blockchain in the local entrepreneurial landscape and highlighted both the potential benefits and barriers to its widespread adoption.

Enabling New Business Models

The analysis focused on how blockchain technology had influenced the creation of new business models in the region. It revealed that various types of business models had emerged, driven by innovative approaches to products and services. Additionally, businesses had experienced varying levels of revenue generation, with many reporting significant financial growth as a result of integrating blockchain solutions.

Table 1: Showing the enabling new business models sub-indicators

Sub-Indicator	**Very Low**	**Moderate**	**Very High**
Types of Business Models Developed	15	35	50
Innovation in Products/Services	25	30	45
Revenue Generation	25	40	35

Types of Business Models Developed

In examining the types of business models developed through blockchain technology, a significant variation in responses was noted, indicating a diverse range of experiences among local entrepreneurs. As per

table 1, out of 100 respondents, 50 indicated that the development of new business models through blockchain was "very high," suggesting that the technology had a substantial impact on their ability to innovate and establish unique market approaches. These individuals expressed that blockchain allowed them to reimagine their business structures in ways that were previously unattainable, particularly through decentralized systems and smart contracts. One respondent shared:

"*…before blockchain, we relied heavily on third-party platforms and intermediaries, which slowed down our operations and added unnecessary costs. Now, with blockchain, we have direct control over transactions and can engage with clients more efficiently. This shift fundamentally changed how we structured our business, making it more agile and scalable...*"

In contrast, 35 respondents described the development of new business models as "moderate," reflecting a more cautious or gradual approach to integrating blockchain into their operations. These entrepreneurs acknowledged the potential of blockchain but noted that the transition required careful planning and adaptation. One interviewee mentioned:

"*…while we see the benefits of blockchain, especially in reducing transaction costs and enhancing transparency, it's not something we could fully implement overnight. We had to test various models to see what worked best for our business and our customers…*"

This awareness highlights the learning curve associated with adopting new technologies and the strategic adjustments required to optimize their use in a business context.

Lastly, 15 respondents rated the development of new business models through blockchain as "very low." These individuals often cited technical and financial barriers that hindered their ability to fully embrace blockchain-based business models. One entrepreneur explained:

"*…for us, the cost of implementing blockchain was simply too high, and the expertise required was beyond our reach. We understand the potential, but without the necessary resources and support, it's difficult to create a completely new business model around it…*"

This comment underlines the challenges faced by smaller enterprises in adopting cutting-edge technology and reflects the uneven distribution of blockchain's benefits across different segments of the entrepreneurial ecosystem.

In general, while many respondents reported a high impact of blockchain on business model development, others faced barriers that limited their ability to fully harness the technology's potential.

3.1.2 Impact of Blockchain Technology on Innovation in Products/Services

When exploring the impact of blockchain technology on innovation in products and services, the responses from entrepreneurs highlighted varied experiences, reflecting both significant progress and ongoing challenges. Of the 100 respondents, 45 respondents stated that the innovation in products and services driven by blockchain was "very high," emphasizing that blockchain

enabled them to introduce unique offerings and enhance existing services. One respondent elaborated:
"*…blockchain has allowed us to offer something entirely new in the market a service that guarantees transparency and trust. Our clients are now able to track every step of the supply chain in real time, which has become a huge selling point. Without blockchain, this level of visibility and assurance would have been impossible to provide...*"
This opinion was common among those who had fully integrated blockchain into their operations, with many seeing it as a game-changer that set them apart from competitors by enabling novel product features and services.

At the same time, 30 respondents categorized their experience with blockchain-driven innovation as "moderate," indicating that while they had made advancements, the process was gradual and required time to fully realize the potential of blockchain technology. These entrepreneurs acknowledged the promise of blockchain but noted that the integration of new features into their products and services was an evolving process. One interviewee mentioned:
"*…we've started using blockchain to offer more secure digital transactions, which has definitely improved customer confidence. However, we're still in the early stages of exploring how it can further enhance our service offerings. We see the possibilities, but it takes time to adjust our systems and align with market demand…*"
This moderate level of innovation reflects a more measured approach, where businesses are still testing the waters but remain optimistic about future developments.

Conversely, 25 respondents reported "very low" levels of innovation in products and services related to blockchain, often due to limited resources or technical challenges. Many in this group felt that while blockchain had theoretical benefits, practical implementation was difficult in their specific context. As one respondent expressed:
"*…we've heard about how blockchain can transform products, but in reality, it's been hard for us to apply it in a meaningful way. The technology is complex, and we just don't have the technical expertise or financial capacity to use it to its full potential…*"
This group highlighted the gap between the perceived potential of blockchain and the actual ability to innovate using the technology, underscoring the need for more support and accessible solutions for small-scale businesses.

In summary, while nearly half of the entrepreneurs experienced significant innovation in their products and services due to blockchain, a sizable portion either encountered moderate progress or struggled to implement the technology in ways that meaningfully enhanced their offerings. The differing levels of innovation reflect both the opportunities and challenges associated with blockchain, depending largely on factors like resource availability, technical expertise, and market readiness.

Revenue Generation

The study as shown on table 1, revealed varied experiences among entrepreneurs regarding revenue generation after adopting blockchain technology. Of the 100 respondents, 35 respondents indicated that their revenue generation had been "very high" since integrating blockchain into their business

operations. These respondents spoke of blockchain as a powerful tool that enhanced trust, efficiency, and overall business performance, directly impacting their bottom line. One entrepreneur explained:

"*…since we adopted blockchain, our revenue has increased significantly. Clients are more confident in our services because of the transparency it provides. We've cut down on transaction costs, eliminated fraud risks, and can offer services at competitive prices. This has drawn in more customers, and the returns have been remarkable…*"

This group highlighted how blockchain's unique features, such as secure transactions and smart contracts, allowed them to streamline operations and boost profits.

Meanwhile, 40 respondents rated their revenue generation as "moderate," suggesting that while blockchain had contributed positively, the impact on income was not as dramatic or immediate. Many in this group noted that the technology had opened up new revenue streams but that the growth process was gradual. One respondent shared:

"*…we've seen some growth in revenue since integrating blockchain, but it's been steady rather than explosive. We're able to offer new services, and customers appreciate the security aspect, but it takes time to build up trust and awareness. Blockchain is still new to a lot of people here, so while the potential is there, it's not an overnight success...*"

This feedback reflects a tempered optimism, where entrepreneurs saw blockchain's benefits but recognized the time required to fully capitalize on its capabilities in their specific market.

On the other hand, 25 respondents reported "very low" revenue generation following the adoption of blockchain. These individuals pointed to challenges such as high implementation costs, technical difficulties, or slow market uptake that hampered their ability to realize substantial financial gains. One respondent remarked:

"*…honestly, we haven't seen much of a difference in our revenue. The cost of implementing blockchain was high, and it hasn't yet translated into higher earnings. We're still trying to figure out how to make it work for us, but right now, the returns don't justify the investment...*"

This group underlined the financial risks associated with early-stage adoption of blockchain technology, particularly for smaller businesses with limited resources to absorb the initial costs and technical complexities.

In general, while a significant portion of the respondents experienced notable revenue growth due to blockchain, a large group saw moderate improvement, and a smaller segment struggled to see substantial returns. The varying levels of revenue generation highlight both the opportunities and challenges blockchain presents, depending on factors such as business size, market readiness, and the ability to manage the costs associated with integrating the technology.

Impact on the Digital Entrepreneurship Ecosystem

The investigation focused on how blockchain technology had influenced the digital entrepreneurship ecosystem in the region. It was found that the technology significantly enhanced entrepreneurial competitiveness, improved ecosystem support structures, and contributed to the development of new skills among entrepreneurs. Respondents noted that blockchain allowed them to gain a competitive edge, while the broader ecosystem adapted to provide more resources and opportunities for skill-building and innovation.

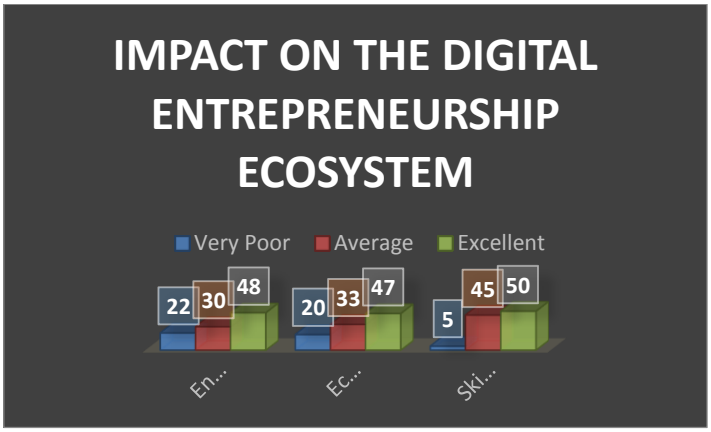

Figure 1: Showing the impact of blockchain technology on digital entrepreneurship ecosystem

Impact on Entrepreneurial Competitiveness

The study as indicated in figure 1, revealed a varied impact of blockchain technology on entrepreneurial competitiveness, as reflected in the responses of local entrepreneurs. Among the 100 respondents, 48 respondents reported that the technology had an "excellent" impact on their competitiveness, allowing them to differentiate themselves in the market and gain a significant advantage over their peers. These respondents noted that blockchain's ability to increase transparency, reduce transaction costs, and facilitate faster, more secure dealings gave them a distinct edge. One entrepreneur shared:

"*…blockchain has revolutionized how we operate. The trust and efficiency it brings have made us stand out in a crowded market. Customers value the security and reliability we offer, and that has positioned us far ahead of competitors who are still relying on traditional systems...*"

This perception highlights how businesses using blockchain could attract more clients, enhance their brand reputation, and streamline their operations, leading to improved competitiveness.

Meanwhile, 30 respondents rated the impact of blockchain on their entrepreneurial competitiveness as "average." These entrepreneurs acknowledged the benefits but noted that they were not yet fully leveraging blockchain's potential. For some, the technology had improved aspects of their business, such as customer service or operational efficiency, but the gains were more modest and gradual. One respondent explained:

"*…blockchain has helped us in certain areas, especially with automating transactions and reducing errors, but I wouldn't say it has completely transformed our competitive*

position just yet. We're still in the process of integrating it into all parts of our business, and that takes time…"

This moderate view reflects the reality that while blockchain offers significant advantages, the full benefits may take time to materialize, particularly for businesses still adapting to its use.

On the other hand, 22 respondents indicated that the impact of blockchain on their competitiveness was "very poor." These individuals often pointed to barriers such as high implementation costs, a lack of technical expertise, or a limited market understanding of the technology. As a result, they struggled to translate blockchain's potential into a competitive advantage. One entrepreneur remarked:

"*…for us, blockchain hasn't really made a difference in our competitiveness. The cost of getting everything set up was high, and we haven't seen the return on investment yet. Most of our customers don't even understand what blockchain is, so it's been hard to use it as a selling point…*"

This response reflects the challenges that smaller or less-resourced businesses face in adopting cutting-edge technology, where the initial costs and complexity may outweigh immediate competitive benefits.

Generally, while nearly half of the respondents experienced significant boosts in their entrepreneurial competitiveness due to blockchain, a notable portion encountered only moderate improvements, and a smaller group struggled to see tangible benefits. The mixed responses highlight how blockchain's impact on competitiveness can vary depending on factors such as business size, resource availability, and market readiness.

Impact on Ecosystem Support Structures

The study revealed that blockchain technology had a varying impact on ecosystem support structures for digital entrepreneurship in Iringa Municipal. According to data presented in figure 1, among the 100 respondents, 47 respondents rated the impact as "excellent," noting that blockchain had contributed to the strengthening of networks, partnerships, and resources that support entrepreneurs in the region. Many highlighted how blockchain's transparency and decentralized nature fostered more collaboration among businesses, financial institutions, and government agencies. One respondent explained:

"*…blockchain has opened up new channels of support for us. We now have access to platforms that allow us to partner with other businesses in ways that weren't possible before. The system encourages trust, which makes it easier to collaborate and share resources. We've also seen more government interest in supporting blockchain-related ventures, which is a big shift from before…*"

This shows how the ecosystem has evolved, with new structures emerging to facilitate the growth of blockchain-powered businesses.

Meanwhile, 33 respondents described the impact of blockchain on ecosystem support structures as "average." These entrepreneurs acknowledged some improvements, particularly in terms of access to technical expertise and

financial support, but felt that the overall support system was still developing. One interviewee remarked:
"*…we've definitely seen more support structures popping up, especially in terms of technical advice and networking opportunities. But at the same time, the system is still maturing. There's still a lack of cohesive support that would help more businesses, like ours, transition fully into blockchain…*"
This suggests that while some progress has been made, more comprehensive support systems are needed to help entrepreneurs navigate the complexities of blockchain adoption.

On the other hand, 20 respondents rated the impact of blockchain on ecosystem support structures as "very poor." These individuals cited a lack of accessible resources, financial constraints, and limited institutional backing as major barriers to their success. One respondent expressed frustration, saying:
"*…honestly, the support structures just aren't there for businesses like ours. We've tried to adopt blockchain, but without proper financial or technical backing, it's been nearly impossible. There's talk of blockchain support, but in practice, we've found very little that we can actually access or benefit from...*"
This group reflects the reality that not all businesses have access to the necessary support structures to take advantage of blockchain's potential, particularly in regions where institutional frameworks are still in their infancy.

In general, while blockchain technology has driven significant improvements in ecosystem support structures for some, others remain constrained by limited access to resources and institutional support. These findings highlight the importance of developing more robust and inclusive ecosystems to support the widespread adoption of blockchain technology among entrepreneurs.

Impact on Skill Development

The study revealed that blockchain technology had a substantial impact on skill development among entrepreneurs in the region, with a significant number of respondents as illustrated in figure 1, recognizing its role in enhancing their abilities. Of the 100 respondents, 50 respondents rated the impact on skill development as "excellent," emphasizing that the adoption of blockchain had pushed them to acquire new, advanced technical and business skills. Many explained that learning to integrate blockchain into their operations required them to understand decentralized systems, cryptographic security, and digital finance, which helped elevate their overall expertise. One respondent shared:
"*…before we started using blockchain, I had very little understanding of how these systems worked. But now, I've learned so much about how to securely manage transactions, set up smart contracts, and even navigate the regulatory landscape. It's been a game-changer not just for our business but for my personal growth as well…*"
This group found that blockchain not only improved their businesses but also significantly enhanced their technical and managerial skills, allowing them to operate more confidently in the digital economy.

Meanwhile, 45 respondents described the impact on skill development as "average," indicating that while they had gained new knowledge, the learning

curve was steep, and the process was still ongoing. These entrepreneurs acknowledged that blockchain had introduced them to new concepts, but many felt that more training and support were necessary to fully develop the skills required to leverage the technology effectively. One interviewee noted:

"*…we've definitely had to learn new things to use blockchain, especially around digital transactions and cybersecurity. But it's been challenging, and we're still in the process of acquiring the skills we need. It's not something you can master overnight, and the resources for learning are still somewhat limited here…*"

This group highlighted the need for continuous learning and development, as the complexity of blockchain required them to build their skill sets over time rather than achieving proficiency immediately.

In contrast, 5 respondents rated the impact on skill development as "very poor." These individuals often cited barriers such as a lack of access to training, insufficient technical knowledge, or the overwhelming complexity of blockchain systems, which hindered their ability to develop new skills. One entrepreneur expressed frustration, stating:

"*…I haven't really been able to develop the skills needed for blockchain. The technology is too complicated, and there's no proper training available. Without guidance, it's been difficult to even get started, let alone become skilled in using it…*"

This group reflected the challenges faced by those without the resources or support to engage meaningfully with blockchain technology, leaving them unable to take advantage of the opportunities it could provide for skill development.

In short, while half of the respondents experienced significant skill development through blockchain adoption, a large portion saw moderate progress, and a small percentage struggled to acquire the necessary skills. These findings underscore the importance of accessible training programs and educational resources to help entrepreneurs fully harness the potential of blockchain and elevate their capabilities.

Challenges of Blockchain Adoption

The study examined the challenges entrepreneurs faced in adopting blockchain technology, focusing on technical barriers, regulatory and compliance issues, and financial constraints. It was found that these factors significantly influenced the ability of businesses to fully integrate blockchain into their operations. Many respondents encountered difficulties in understanding and implementing the technology, navigating regulatory frameworks, and securing the necessary funding to support adoption efforts. These challenges created hurdles that slowed down or limited the extent to which blockchain could be effectively utilized.

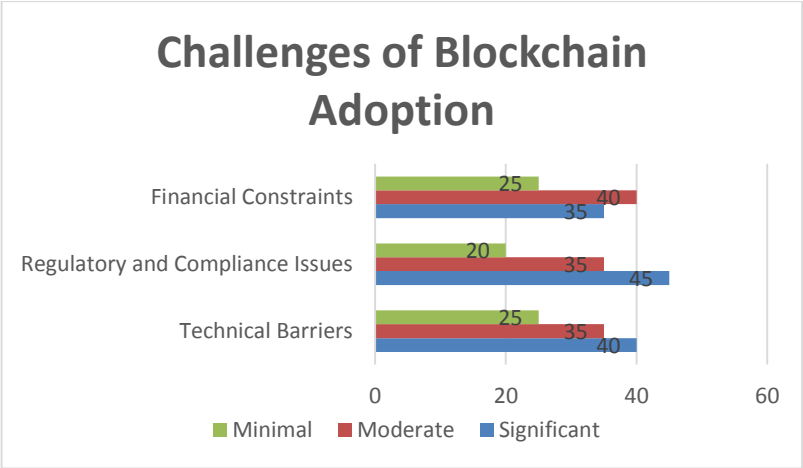

Figure 2: Showing the challenges of blockchain adoption sub-indicators

Technical Barriers

The study revealed that technical barriers posed a significant challenge to many entrepreneurs attempting to adopt blockchain technology. As per figure 2, of the 100 respondents, 40respondents described these barriers as "significant," highlighting difficulties in understanding the complex nature of blockchain and the technical expertise required to implement it effectively. Entrepreneurs often pointed out that the learning curve was steep and that accessing the necessary tools and knowledge was a major obstacle. One respondent explained:

"*…blockchain is highly technical, and for small businesses like ours, we simply don't have the in-house expertise to manage it. Hiring external consultants is expensive, and trying to learn it on our own has been overwhelming. It's a powerful tool, but the technical aspects are too difficult for us to handle without proper support…*"

This observation was echoed by many, who felt that the intricate and decentralized nature of blockchain technology made it difficult to integrate into their existing business models without facing significant challenges.

Meanwhile, 35 respondents rated the technical barriers as "moderate," indicating that while they had encountered challenges, they were not insurmountable. These entrepreneurs had begun to overcome some of the technical issues through a combination of self-learning, external support, and gradual integration of blockchain into their systems. One entrepreneur shared:

"*…It wasn't easy at first, but we've been able to work through the technical issues by taking it step by step. We've attended workshops and sought help from experts in the field. While there's still a lot to learn, we've made progress in understanding how to apply blockchain to improve our operations...*"

This group viewed the technical barriers as challenges that could be addressed with time and effort, though they acknowledged that ongoing support and education were crucial to their continued success with the technology.

In contrast, 25 respondents reported that the technical barriers to blockchain adoption were "minimal." These individuals, often from more tech-savvy backgrounds or larger organizations, had the resources and expertise needed to navigate the complexities of blockchain without significant difficulties. For them, the adoption process was smoother, as they were better

equipped to integrate the technology into their operations. One respondent noted:

"*…we had some initial challenges, but overall, the technical side wasn't too difficult for us. Our team already had experience with digital systems, so adopting blockchain was more of an extension of what we were already doing. We had the right tools and people in place, which made the process much easier...*"

This group's experience reflected the advantages that come with having access to specialized knowledge and resources, allowing them to bypass many of the hurdles that smaller, less resourced businesses faced.

In summary, technical barriers to blockchain adoption varied greatly among respondents, with a significant portion finding the challenges overwhelming, while others were able to manage them with moderate effort. A smaller group, benefiting from prior expertise or resources, experienced minimal difficulties. These findings emphasize the importance of technical support and accessible training programs to help businesses of all sizes overcome the complexities of blockchain technology.

Regulatory and Compliance Issues

The study as per figure 2, revealed that regulatory and compliance issues were a significant challenge for many entrepreneurs seeking to adopt blockchain technology. Among the 100 respondents, 45respondents reported that these issues posed "significant" barriers, often citing the lack of clear regulations and the complexity of navigating compliance requirements. Many felt that the legal framework surrounding blockchain was either insufficient or overly complicated, creating uncertainty and risk for businesses trying to integrate the technology. One respondent shared:

"*…the regulatory landscape is a real challenge for us. There are no clear guidelines on how to implement blockchain in our industry, and we're constantly worried about violating some unknown law. Without proper regulations, it feels like we're walking a tightrope, trying to innovate while staying on the right side of the law…*"

This concern was echoed by others, who found that the absence of well-defined rules created confusion and slowed down their adoption efforts, as they hesitated to fully embrace blockchain without understanding the legal implications.

Meanwhile, 35 respondents described the impact of regulatory and compliance issues as "moderate." These entrepreneurs acknowledged that while there were challenges, they were able to work through them with some effort, often by seeking legal counsel or collaborating with industry experts. One entrepreneur noted:

"*…it's not that there aren't any regulatory challenges, but we've managed to navigate them by consulting with lawyers who specialize in blockchain and tech. It's an extra cost and time-consuming, but with the right support, we've been able to stay compliant and move forward…*"

This group recognized that the regulatory environment was complex, but they were willing to invest in the resources needed to understand and comply with

the laws. While they still faced hurdles, they saw these as manageable with the right guidance and effort.

On the other hand, 20 respondents viewed regulatory and compliance issues as "minimal," often because their businesses operated in less regulated sectors or because they had the internal expertise to deal with compliance effectively. These entrepreneurs felt that blockchain, being a new and evolving technology, offered them more flexibility in areas where regulations were still catching up. One respondent explained:

"*…for us, the regulatory side hasn't been a big issue. We've been proactive in understanding the few regulations that exist, and because we're in a sector that's not heavily regulated, we've had more freedom to experiment with blockchain. We've also made sure to keep our operations transparent and secure, which has helped us avoid any major compliance problems…*"

This group tended to experience fewer regulatory challenges, either because they were better equipped to handle them or because the nature of their business allowed them to operate more freely within existing legal frameworks.

In short, the study showed that regulatory and compliance issues were a considerable barrier to blockchain adoption for many entrepreneurs, with nearly half of the respondents citing significant difficulties. While some were able to mitigate these challenges through legal consultation and strategic planning, a smaller group experienced minimal disruption. These findings highlight the need for clearer and more supportive regulatory frameworks that can guide businesses in adopting blockchain technology while ensuring compliance with legal standards.

Financial Constraints

The study indicated that financial constraints represented a considerable challenge for many entrepreneurs attempting to adopt blockchain technology. As shown in figure 2, among the 100 respondents, 35 respondents categorized these constraints as "significant," expressing that the costs associated with implementing blockchain were prohibitively high for their businesses. Many entrepreneurs highlighted the initial investment required for technology infrastructure, training, and potential consultancy fees as significant barriers to entry. One respondent articulated:

"*…we are genuinely interested in blockchain, but the financial burden is just too heavy for us. We would need to invest in new systems, training, and possibly hire experts, and that kind of money is simply not available for a small business like ours. It feels like we're being left out of a revolutionary technology because we can't afford to get on board...*"

This sentiment resonated with many respondents who felt that while blockchain offered exciting opportunities, the financial realities often overshadowed those prospects.

Additionally, 40 respondents described their financial constraints as "moderate." These entrepreneurs acknowledged that while they faced some financial challenges in adopting blockchain, they were actively seeking solutions to overcome them. Many mentioned that they were exploring

partnerships, grants, or funding opportunities that could alleviate the financial burden associated with blockchain implementation. One interviewee noted:
"*…yes, the costs are definitely a concern for us, but we've been looking at ways to manage them. We've reached out to potential investors and applied for grants that focus on technology innovation. It's not easy, but we are determined to find the resources to make this work…*"
This group demonstrated resilience and resourcefulness, showing that while financial constraints posed obstacles, they were willing to seek alternative funding avenues to facilitate blockchain adoption.

Conversely, 25 respondents rated their financial constraints as "minimal." These individuals often came from larger organizations or had better access to funding, which allowed them to navigate the costs of blockchain adoption more comfortably. For them, financial considerations did not significantly impede their ability to implement blockchain solutions. One respondent reflected:
"*…we are fortunate enough to have the resources to invest in blockchain without it being a huge strain. Our company is well-capitalized, and we see blockchain as a long-term investment that will pay off. We've budgeted for training and development as part of our strategy, so for us, financial constraints are not really an issue…*"
This perspective illustrated that access to capital and a strategic approach to investment allowed some businesses to move forward with blockchain adoption more smoothly.

In summary, financial constraints emerged as a significant challenge for many entrepreneurs in the study, with a notable percentage highlighting substantial barriers to adopting blockchain technology. While a significant portion faced considerable financial obstacles, others were finding ways to manage their constraints or reported minimal impacts. These findings underscore the need for increased financial support mechanisms, such as grants or partnerships, to help entrepreneurs overcome the financial hurdles associated with blockchain implementation and fully leverage its potential.

Opportunities for Blockchain Integration

The study examined the opportunities presented by blockchain integration, focusing on market expansion potential, collaboration and partnerships, and innovative funding mechanisms. Respondents identified these areas as critical for leveraging blockchain technology to enhance their business operations and reach new markets. Many entrepreneurs recognized that blockchain offered unique advantages, such as increased transparency and efficiency, which could facilitate partnerships and access to new customer bases. Additionally, they noted that innovative funding mechanisms, enabled by blockchain, could provide essential capital for growth and development, thereby positioning their businesses for future success.

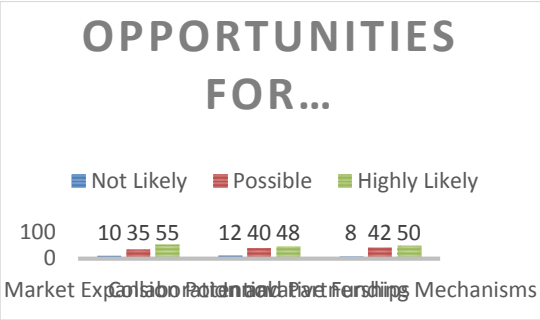

Figure 3: Showing the opportunities for blockchain integration sub indicators

Market Expansion Potential

The study revealed that the market expansion potential offered by blockchain technology was as shown in figure 3, viewed favorably by many entrepreneurs, with 55 respondents considering it "highly likely" that blockchain would enable them to reach new markets and broaden their customer base. These entrepreneurs expressed a strong belief that the unique attributes of blockchain, such as transparency, security, and efficiency, would allow them to enhance their offerings and attract more customers. One respondent articulated this sentiment by stating:

"*…blockchain has opened up a whole new world for us. We can now assure our customers that every transaction is secure and transparent, which has built trust. With these qualities, we're not just retaining our current customers but also attracting new ones who are looking for businesses that prioritize integrity and security…*"

This perception accentuated the confidence that many entrepreneurs had in blockchain's potential to drive growth and facilitate market entry.

Conversely, 35 respondents deemed market expansion potential as "possible." While they acknowledged the advantages of blockchain, they also pointed out that significant challenges remained that could hinder their ability to capitalize on this opportunity. Many expressed concerns about the competitive landscape and the need for more extensive market education. One entrepreneur explained:

"*…I believe there is potential for market expansion, but we must first educate our target audience about what blockchain can do. People are still wary of new technologies, and unless we can convey the benefits effectively, it may take longer to penetrate new markets...*"

This group recognized that while the opportunity was there, it would require concerted efforts in marketing and education to truly leverage blockchain's capabilities for market expansion.

A smaller number of 10 respondents, regarded the market expansion potential as "not likely." These entrepreneurs cited factors such as limited market understanding and existing competition as significant deterrents. They felt that blockchain, while innovative, might not provide them with a substantial competitive edge in their respective markets. One respondent shared their skepticism, saying:

"*…honestly, I'm not convinced that blockchain will help us expand our market. Our customers are quite traditional, and I worry that introducing blockchain could confuse*

them more than attract them. Until there is a clearer demand for such technology from our consumers, I don't see how it would benefit us significantly…"
This view highlighted a cautionary stance, suggesting that not all businesses felt poised to take advantage of blockchain for market expansion.

The study indicated that while a majority of respondents were optimistic about the market expansion potential of blockchain technology, there remained a range of opinions regarding its feasibility. Many entrepreneurs recognized the opportunity to reach new markets, but some emphasized the importance of addressing market education and competition. These findings suggest that, while blockchain holds promise for facilitating market growth, strategic planning and customer engagement will be crucial to realizing this potential.

Collaboration and Partnerships

The study as per figure 3, highlighted that collaboration and partnerships stemming from blockchain integration were viewed positively by many entrepreneurs, with 48 respondents believing such opportunities to be "highly likely." These individuals emphasized that blockchain's decentralized and transparent nature fosters trust and collaboration among businesses, making it easier to form partnerships. One respondent shared:
"*…blockchain has changed the way we think about partnerships. In the past, we would have to go through so many layers of verification and trust-building. Now, with blockchain, we can share data in a secure and transparent way, which means we can establish collaborations much faster and with more confidence. It feels like the barriers to entry have been significantly lowered…*"
This opinion illustrated how blockchain could facilitate a new landscape of partnerships, where businesses could come together to leverage shared resources and data more effectively.

In contrast, 40 respondents rated collaboration and partnerships as "possible." While they recognized the potential benefits of blockchain for enhancing partnerships, they also pointed out that several factors could influence the likelihood of successful collaborations. Many entrepreneurs expressed concerns regarding the existing competition and the need for clear alignment of goals between partners. One entrepreneur remarked:
"*…I can see how blockchain could help us collaborate more effectively, but it's not as simple as just using the technology. We still have to find partners who share our vision and values. That alignment is crucial, and it's not always easy to achieve, especially when companies have different objectives…*"
This sentiment echoed the apprehension that while the technology could facilitate collaboration, it would not automatically result in successful partnerships without careful consideration and alignment of interests.

A smaller segment of 12 respondents, considered the potential for collaboration and partnerships as "not likely." These entrepreneurs often cited a lack of familiarity with blockchain among their potential partners and concerns about the willingness of others to adopt such innovative technologies. One respondent conveyed their skepticism, stating:

"…honestly, I don't think many of our partners are ready to embrace blockchain. They are quite traditional in their operations, and introducing something as new and disruptive as blockchain could create more friction than collaboration. Until there is more widespread acceptance of the technology, I don't see us forming many partnerships through it..."

This perception highlighted a cautious view regarding collaboration, indicating that the prevailing attitudes toward blockchain among potential partners could significantly influence its success in fostering new alliances.

In summary, the study revealed a generally optimistic outlook among respondents regarding the potential for collaboration and partnerships through blockchain integration. While a significant portion believed that blockchain would greatly enhance collaborative efforts, some highlighted the need for alignment among partners and expressed concerns about the readiness of others to adopt the technology. These findings emphasize the importance of building trust and understanding in establishing successful collaborations, particularly in an evolving technological landscape.

Innovative Funding Mechanisms

The study as per figure 3, indicated that innovative funding mechanisms associated with blockchain integration were seen as a promising opportunity by many entrepreneurs, with 50 respondents considering such mechanisms to be "highly likely." These entrepreneurs recognized that blockchain technology offered novel ways to raise capital, such as through tokenization, Initial Coin Offerings (ICOs), and decentralized finance (DeFi) platforms. One respondent enthusiastically explained:

"…blockchain has completely transformed how we think about funding our projects. With tokenization, we can turn our ideas into digital assets that people can invest in directly, cutting out the traditional gatekeepers. This allows us to reach a broader audience and secure funding more efficiently…"

This enthusiasm underlined the belief that blockchain could democratize access to funding, making it easier for startups and small businesses to attract investment without relying solely on conventional financing methods.

Conversely, 42 respondents viewed the potential for innovative funding mechanisms as "possible." While they acknowledged the advantages that blockchain could provide, they also highlighted the uncertainties and risks associated with new funding models. Concerns regarding regulatory compliance, market volatility, and the perceived complexity of blockchain-based funding were prevalent. One entrepreneur reflected on these challenges, saying:

"…I think there's definitely potential for innovative funding through blockchain, but it's not without its risks. The market for cryptocurrencies is incredibly volatile, and there's still a lot of regulatory gray area. We have to tread carefully and ensure we're compliant, or we could end up in hot water…"

This observation illustrated a cautious optimism, suggesting that while the opportunities were promising, entrepreneurs remained vigilant about the associated risks and the need for thorough planning and legal considerations.

A smaller group, comprising 8 respondents, considered the prospects for innovative funding mechanisms as "not likely." These entrepreneurs often expressed skepticism about the reliability and sustainability of blockchain-based funding methods. They noted that traditional funding routes had a proven track record, and they were hesitant to divert their focus towards less familiar alternatives. One respondent shared:

"*…to be honest, I'm not sure that blockchain funding is the way to go for us. We've had success with traditional funding sources, and there's something to be said about the stability and security they offer. I worry that venturing into blockchain could expose us to unnecessary risks without a clear payoff…*"

This viewpoint reflected a desire for stability and predictability, indicating that not all entrepreneurs felt ready or willing to explore the innovative funding options that blockchain could provide.

In general, the study highlighted a generally favorable outlook regarding innovative funding mechanisms enabled by blockchain, with a substantial portion of respondents believing that these opportunities were highly likely to materialize. However, varying degrees of optimism were evident, with some entrepreneurs expressing caution about the risks and uncertainties involved. These findings emphasize the need for further education and support for businesses looking to navigate the evolving landscape of blockchain funding, ensuring that they can make informed decisions as they explore these innovative financial avenues.

CONCLUSIONS AND RECOMMENDATIONS

The study underscored the transformative potential of blockchain technology in reshaping digital entrepreneurship within Iringa Municipal. Through a comprehensive analysis of various indicators such as enabling new business models, assessing impacts on the digital entrepreneurship ecosystem, and identifying challenges and opportunities for blockchain adoption, it became clear that blockchain is more than just a technological advancement; it is a catalyst for innovation and growth. The findings revealed that while many entrepreneurs recognized the significant benefits of blockchain, including enhanced market expansion potential, improved collaboration, and innovative funding mechanisms, they also faced notable challenges such as financial constraints and regulatory uncertainties. This duality emphasizes the necessity for a supportive ecosystem that facilitates the adoption and integration of blockchain technology, thereby empowering local entrepreneurs to harness its full potential. Moreover, the insights gathered from respondents highlighted the importance of building awareness and understanding of blockchain within the community. As many entrepreneurs expressed optimism about the opportunities blockchain could create, there remains a pressing need for educational initiatives and resources to address concerns about the technology's complexity and associated risks. Ultimately, the successful integration of blockchain technology in Iringa Municipal holds the promise of driving economic growth and innovation, making it essential for local entrepreneurs,

policymakers, and industry leaders to work together toward realizing this vision.

Based on the findings of the study, it is recommended that stakeholders in Iringa Municipal, including local government, educational institutions, and business organizations, collaboratively develop and implement comprehensive educational programs focused on blockchain technology. These initiatives should aim to enhance understanding and awareness among entrepreneurs regarding the benefits, applications, and best practices of blockchain integration in their businesses. Additionally, creating a supportive ecosystem that fosters networking and collaboration between blockchain experts and local entrepreneurs will be crucial in addressing the identified challenges, such as regulatory concerns and financial constraints. Lastly, promoting innovative funding mechanisms, including partnerships with fintech companies and exploring decentralized finance options, could provide essential capital to drive blockchain adoption and spur economic growth in the region.

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