

HOW CAN BLOCKCHAIN CONTRIBUTE TO DEVELOPING COUNTRY ECONOMIES? A LITERATURE REVIEW ON APPLICATION AREAS

Tom Gillpatrick¹, Semra Boğa², Oncel Aldanmaz³

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¹ Portland State University, USA

² Beykent University, Turkey

³ Independent Researcher, Turkey

Corresponding Author:

Tom Gillpatrick

Email: tomg@pdx.edu

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ABSTRACT

Blockchain technology originally finding applications in Fintech and supply chain management is rapidly expanding applications to other industries as well as the public sector. "Blockchain has been compared to the invention of the internet and its comprehensive impact on almost every industry." R. Beck and B. Markey-Towler (2017) A recent study by PWC (2020) found that, "Blockchain technology has the potential to boost global gross domestic product by \$1.76 trillion USD over this decade." It has been argued that the digital revolution has favored more developed nations and that has helped create a "digital divide" with less developed nations. Business and governmental infrastructure in developing nations have lagged that of more developed nations. Some of these challenges faced by developing nations include the registration of property ownership, financial systems, modern efficient supply chains often accompanied by a lack of trust and the ability to verify and audit organizational processes rapidly and economically. Blockchain technology has the promise to address many of the critical needs of developing countries internally and in external trade relationships to help enable them to be more competitive. This paper will review the literature and examine the impact of Blockchain technology on how its adoption may ameliorate many of these critical challenges for developing nations helping to improve governance and economic benefits that are shared more equitably. Potential for both positive and negative impacts will be discussed along with policy implications for public policy makers and private enterprises.

Keywords: Blockchain, Macro Economics, Competitiveness, Innovation, Developing Countries, Corruption, Financial Inclusion, Property Rights, Supply Chain, NFT.

1. INTRODUCTION

The process that started with the Fourth Industrial Revolution, which integrated the connection between the physical and virtual world into production through equipment and sensors, has created tremendous changes in industry with technological developments progressing in exponential dimensions. One of the innovations offered by this new digital transformation is the blockchain. Blockchain, which was first used with the distributed ledger behind bitcoin transactions in 2008, is mainly used in areas such as finance, banking, logistics, insurance etc., has recently started to take place on the agenda of businesses with the potential to affect the general economy. Achieving the expected benefit from this technology, which has the potential to transform economies, is closely related to the readiness of the enterprises and countries for this technology in terms of both mentality and infrastructure. Therefore, it is still an important question to what extent the small-scale companies or less developed countries that currently have difficulties in accessing finance and do not have sufficient technological experience can benefit from this technology. The fact that

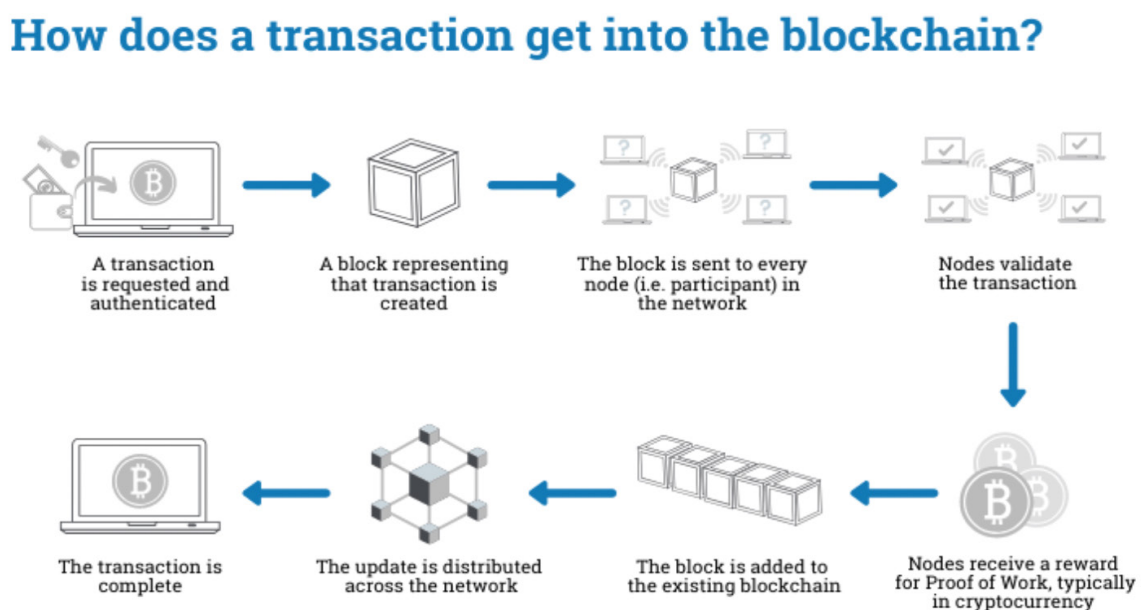
innovation and technological product exports, which are an important determinant of economic development, widen the gap between small and medium-sized companies and large companies, and on the other hand, widening the development differences between developing and developed countries are among the important risks related to blockchain technology. With this study, we examine some of the ways that blockchain technology may contribute to the civic infrastructure and economies of developing countries.

2. UNDERSTANDING BLOCKCHAIN TECHNOLOGY AND ITS APPLICATIONS

Blockchain, “a shared, immutable ledger that facilitates the recording of transactions in a network,” first gained popularity as the backbone of the first cryptocurrency, Bitcoin. Although the technology has both centralized and decentralized applications, the main and most popular idea behind today’s blockchain systems is removing central authority in monetary transactions to reduce the costs, speed, and the efficiency by forming a peer-to-peer network. The transactions in the modern-day blockchains are not limited to digital currencies: many kinds of assets, from cash and gold to intellectual property rights and copyrights, can now be efficiently recorded and utilized in the blockchain, with each transaction, no matter the form of assets, being verified and confirmed to be recorded in the blockchain ledger (Hammer, 2018).

Technically, the overall structure of blockchain is arranged in blocks that are connected in a chain, so as data is added, the blockchain links increase. “Each block contains a hash, or digital fingerprint or unique identifier, a timestamped batch of recent valid transactions, and the hash of the previous block in the chain” (Hammer, 2018). This constant connection between blocks and the storage of past transactions makes the information stored nearly impossible to alter, as one has to change every block before the block, he/she wants to change (Figure 1). This is why blockchain is called immutable and makes the system resistant to cyber threats and not require any intermediaries involved in its network of users. It also offers transparency in the data it stores since the same copy of the information can be found in each block (Iyengar et al., 2020).

Figure 1. How Does a Transaction Get Into the Blockchain?



Source: Pipe & Piper, 2021.

Blockchain has a similar evolution timeline as the Web evolutions, from 1.0 to 3.0. Blockchain 1.0 is the initiation of the technology, and its focus is mainly Bitcoin and other cryptocurrencies. 2.0 evolution is about “registering, confirming, and transferring contracts and properties,” and thus this version of blockchain heavily makes use of smart contracts, “programs stored on a blockchain that run when predetermined conditions are met” (Gatteschi et al., 2018) (IBM). By setting the ground for decentralized autonomous organizations (DAOs), which are “systems that enable people to coordinate and govern themselves mediated by a set of self-executing rules deployed on a public blockchain,” these contracts could give rise to many modern, more efficient blockchain-based procedures without a centralized authority (Hassan, De Flippi, 2021). Finally, in Blockchain 3.0, the technology shifts its focus from the finance industry and expands on sectors like government and healthcare (Gatteschi et al., 2018) (Table 1).

Table 1. Application Areas of Blockchain Technology.

Areas	Applications of Blockchain Technology
Internet of Things (IoT)	<ul style="list-style-type: none"> -Enhanced security of interconnected devices -Maintaining anonymity -Smart contract provisions -Device management -Secure updates
Energy	<ul style="list-style-type: none"> -Controlling the electricity market between machines -Facilitating energy trade -Increasing energy grid security -Green energy assistance
Finance	<ul style="list-style-type: none"> -Better transaction processing -Sustainable banking and financial transactions -Enhanced financial security and data privacy -Automating financial contracts -Remittances -Venture capital -Anti money-laundering processes -Trade finance
Healthcare	<ul style="list-style-type: none"> -Easier access to medical data -Medical data sharing -Unifying medical records
Government	<ul style="list-style-type: none"> -eGovernment -Creating a true digital identity -eVoting -Improving measuring instruments regulation -Record and identity management
Business	<ul style="list-style-type: none"> -Supply chain management

Source: Insider, 2022; Yavuz, 2019; Jaoude & Saade, 2019.

3. HOW BLOCKCHAIN TECHNOLOGY CAN CONTRIBUTE TO DEVELOPING COUNTRIES' ECONOMIES?

3.1. SECURING PROPERTY RIGHTS

Securing both real estate property and intellectual property rights is of great importance for economic development and welfare. In cases where property rights are not secured, it causes especially small businesses to carry out informal activities which cause their incomes and outputs to be well below their potential (Miller, 1997: 1). In addition, the protection of property rights is an important factor that determines the location of foreign direct investments (FDI). Attracting FDI, which is an important engine of growth and development in developing countries, can be directly related to the assurance of property rights, together with the improvement of some other institutional elements (Dixit, 2009). In a study conducted by Haydaroglu (2015) using the international property rights index, a positive relationship was found between the degree of protection of property rights and FDI inflows in EU and OECD countries. The panel data analysis conducted by Adams (2010) with the data of 75 developing countries for the years 1985-2003 also showed that intellectual property rights have a positive effect on FDI. On the other hand, in the analysis made by Maskus (2000) on Brazil and China, it has been seen that despite the weak property rights in these countries, countries have intense FDI inflows, so it has been revealed that the protection of strong property rights alone is not a sufficient factor to encourage firms to invest. In the study, it was emphasized that property rights and other institutional qualities should be combined for FDI inflows. On the other hand, in the study of Canals and Şener (2014), it was found that guaranteeing intellectual property rights is an important determinant in investments to be made especially in high-tech industries.

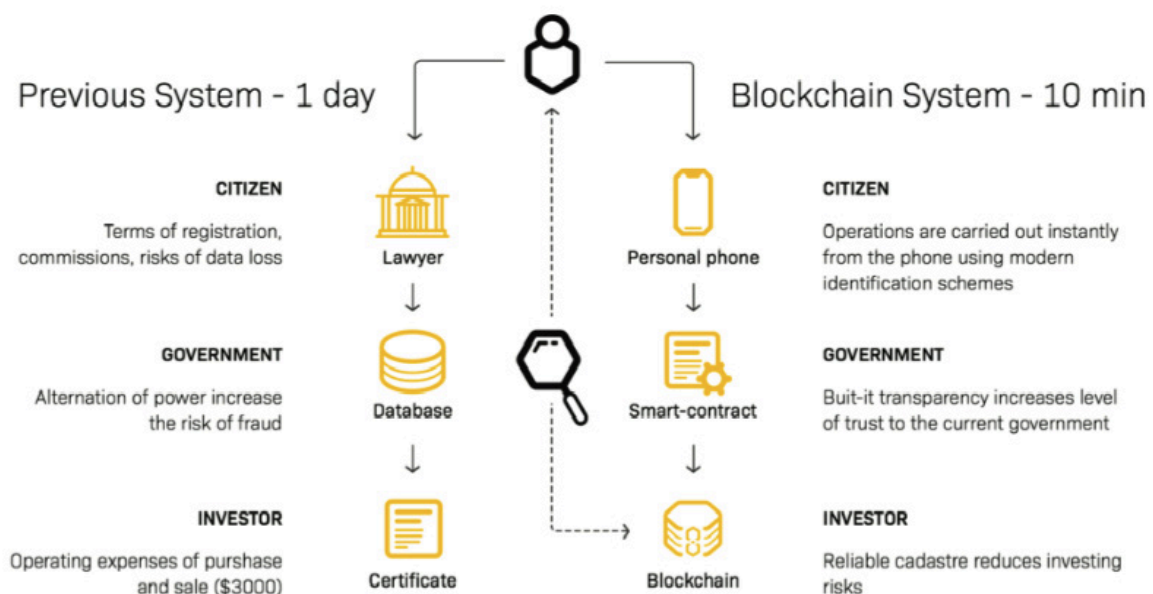
In underdeveloped regions of the world, the lack of ownership of lands is one of the biggest obstacles to entrepreneurship and economic development. About 90% of land in rural Africa is unregistered. Similarly, more than 20 million families farming in rural areas of India are not registered as landowners (Kshetri & Voas, 2018: 11). In addition, according to the report of the United States Agency for International Development (USAID), only 14% of Hondurans legally own their property (USAID, 2016). In Brazil there is no central land registration system which causes corruptions and double allocations. With the earthquake in Haiti in 2010, the building where the land was registered was demolished, which destroyed the evidence that many small farmers were landowners, and they had to struggle for many years to regain ownership of their land (Theconversation.com, 2018).

It is expected that blockchain will play an important role in the registration of property, especially in underdeveloped and developing countries. Again, transparency, accountability in property matters and consistency in land registry records in government offices in these countries will be ensured by blockchain applications. In addition, blockchain can play a vital role in ensuring the property records of individuals displaced by forced migrations such as natural disasters, wars, and climate change (J. Thomason et al., 2018).

Giving individuals legal status and security in the deed will also ensure that the property is used as collateral. Worldwide, \$20 trillion in capital is thought to have been lost due to incomplete land registry records. Bringing this capital to the economy will provide significant economic improvements, especially for poor people and SMEs. Registration of title deeds is of course possible without blockchain, but blockchain-based applications are capable of solving many problems in the current system. The lack of control panels, especially in underdeveloped countries, has a vulnerability in the way of interfering with the records. However, it does not allow intermediaries to make changes in records in blockchain-based registration transactions. In this system, only the owner has the authority to transfer the property with his private key (Schmidt & Sandner, 2017: 6). Blockchain includes technical features that can minimize disputes and conflict as well as reducing the costs associated with property registration. It is possible to perform all or most of the operations

using smartphones. Considering these advantages of blockchain, initiatives related to property registration have been started all over the world (Kshetri & Voas, 2018: 12). For example, US-based real estate registration platform Bitland announced the introduction of a blockchain-based land registry system in Ghana, where 78 percent of the land is unregistered. There is an enormous backlog of cases with land disputes in Ghana's courts. In the Bitland system, land registration processes are securely recorded with GPS coordinates, written explanations and satellite photos. These and similar processes are expected to guarantee property rights and reduce corruption practices (Ogundeji, 2016). Bitland also plans to expand the project to Nigeria in collaboration with the OPEC Fund for International Development (Econotimes, 2016). Another initiative to register land titles with the blockchain system has started in Georgia. With the agreement signed between the BitFury company and the Georgian government, it is planned to move the land purchase and sale transactions to the blockchain (Higgins, 2016). The cost, which is currently between \$50 and \$200 for notarized land purchase and sale records, is expected to drop to \$0.05-0.10 with blockchain. Figure 2 illustrates how the blockchain-based land registration system works in Georgia. Similarly, India also announced its plan to implement blockchain for land registry records in two states in 2017. The pilot project, which started in the government capital, Hyderabad, in cooperation with the Swedish start-up company ChromaWay, is planned to expand to other cities (Higgins, 2016b). In Honduras, where land records are manipulated or even stolen by government bureaucrats, it is aimed to guarantee the land registration system with the blockchain system, and partnership negotiations have started in 2015 with the United States-based Factom and Epigraph companies. However, the project, which was envisaged to be supported by the World Bank, could not be started due to political reasons (Eder, 2019).

Figure 2. Blockchain-Based Land Titling System in the Republic of Georgia.



Source: Shang & Price, 2019: 76.

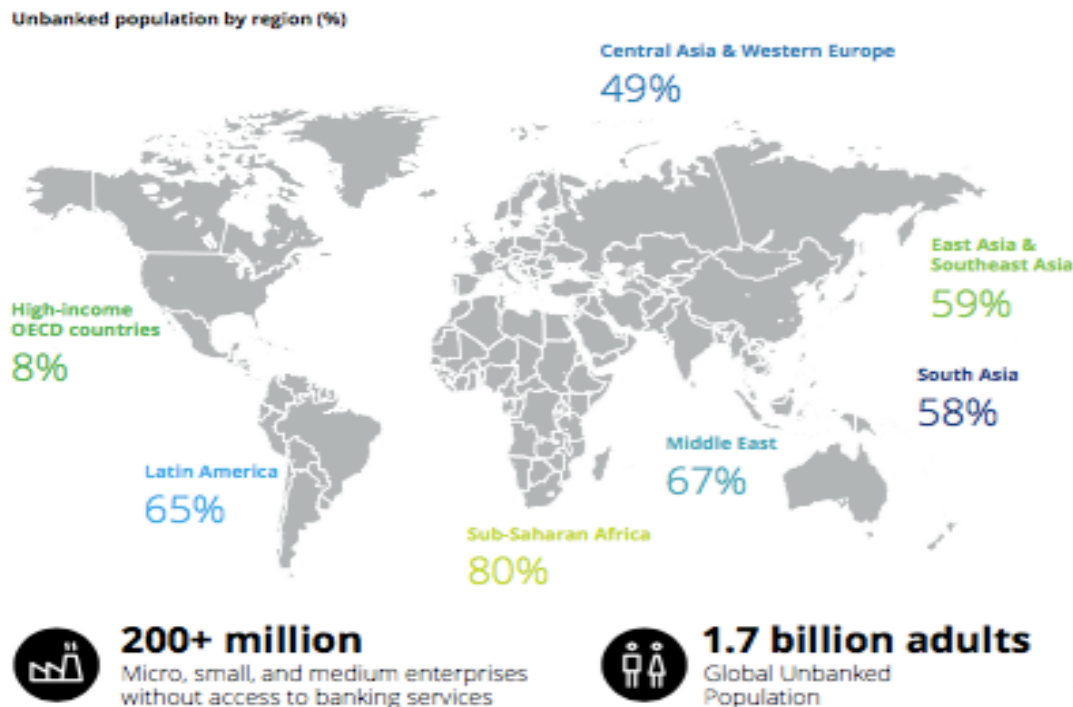
One of the first attempts to protect intellectual property rights with the blockchain system came from China. With the Blockchain Open Platform of Records (BROP), announced by Hangzhou Blockchain Research Institute at the Global Financial Science and Technology Summit in March 2018, a blockchain-based property protection system is used to securely record corporate users' identities, certificate data and digital identity information. Partnerships have been announced. With this system, it is planned to provide information about verifiable and auditable property records and public services (Mann, 2019: 63).

3.2. FINANCIAL INCLUSION

Financial inclusion (FI) can be defined as the process by which individuals and businesses in a country gain adequate and sustainable access to economic transactions, credit cards, payments, savings and official financial services and products. Financial inclusion has become a critical area that has been included in the agendas of both monetary and macroeconomic policies in recent years (Singh & Singh Kondan, 2011). It was also included in the United Nations' Sustainable Development Goals Agenda emphasizing that it is vital for both individuals and companies to have wide access to financial resources so that especially developing countries can complete their development processes (UNSGA, 2018). The spread of financial access to broad bases of society has the potential to increase economic activity by facilitating access to resources required for consumption and investment. Increased participation in investment activities of economic agents can reduce the cost of capital, thus increase efficiency in the economy by enabling productive resources to be allocated efficiently. There is also empirical evidence that financial access reduces poverty and income inequality. Omar and Inaba (2020)'s analysis for the economies of 116 developing countries consisting of Asia, Africa, Latin America and the Caribbean showed that financial inclusion significantly reduced poverty and income inequality in these countries. In another recent analysis conducted by Cicchiello et al. (2021), for the least developed 42 countries in Asia and Africa, findings were obtained that low financial access reduces economic development.

Although there is sufficient scientific evidence that financial inclusion will positively affect economic development and solve many of the basic socioeconomic problems of developing countries, more than 1.7 billion people in the world still do not have access to basic financial services. Figure 3 shows the inadequacy of financial access by regions in the world, where it is obvious that especially underdeveloped and developing countries are far behind developed countries.

Figure 3. Unbanked population by region (%).

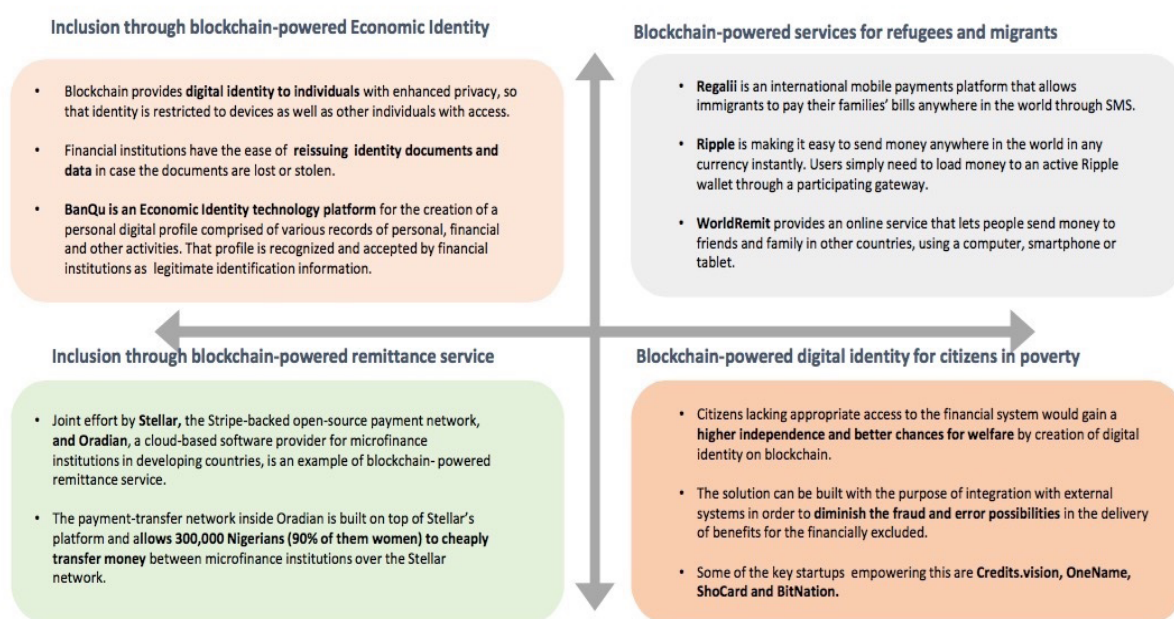


Source: The Global Findex Database, 2017.

According to the convergence theory developed by Abramovitz (1986), if poor countries grow

faster than developed and rich countries, they can catch up with developed countries in terms of per capita income. However, this assumption will be valid if the methods and technologies used in developed countries are copied (Lee, 2017). In this context, blockchain technology is seen as an important tool by developing countries and financial institutions to contribute to the development of countries by increasing financial participation. Blockchain has the potential to provide financial services to the unbanked, facilitate access to micro-credits, peer-to-peer banking services and significantly increase financial inclusion with the use of cryptocurrencies, with its transparent structure and distributed non-mediated transactions (Karnouskos, 2021: 559). Figure 4 shows the channels blockchain can contribute to financial inclusion.

Figure 4. How Banks/Financial Institutions are using Blockchain to Foster Financial Inclusion.



Source: Baruri, 2016.

The fact that blockchain reduces the costs of high-fee banking transactions is considered as an important advantage of the system. In many countries, even domestic money transfers are subject to high fees and long transaction times. Blockchain technology makes both national and international money transfers free by eliminating all third intermediaries, unlike traditional money transfers (Ohnesorge, 2018). Another feature of blockchain that will contribute to facilitating financial inclusion is the convenience it brings to account opening processes. The fact that 2.4 billion people worldwide do not have a digital identity is one of the main problems preventing them from accessing financial institutions. Thanks to the profile creation feature of the blockchain based on biometric data such as face and voice recognition, it is possible for users to create an account without the need for a passport or e-mail account (Lichtfous et al., 2018: 14).

Among the important reasons for exclusion from credit markets in underdeveloped and developing countries are issues such as identity verification in loan applications, asset status and creditworthiness of customers. Considering that banks have asymmetric information about the customer to whom they will lend, access to loans will be more efficient, especially with the transparent and secure environment provided by blockchain. With a shared credit ledger application, multiple microcredit institutions will provide a complete display of all information about borrowers and lenders without the need for a central authority or intermediary. The use of blockchain technology instead of intermediaries in the credit market will enable cheaper and faster provision of credit services. However, an important factor for this system to be accepted is that borrowers agree to have their

information monitored (Schmidt&Sandner, 2017: 11-13).

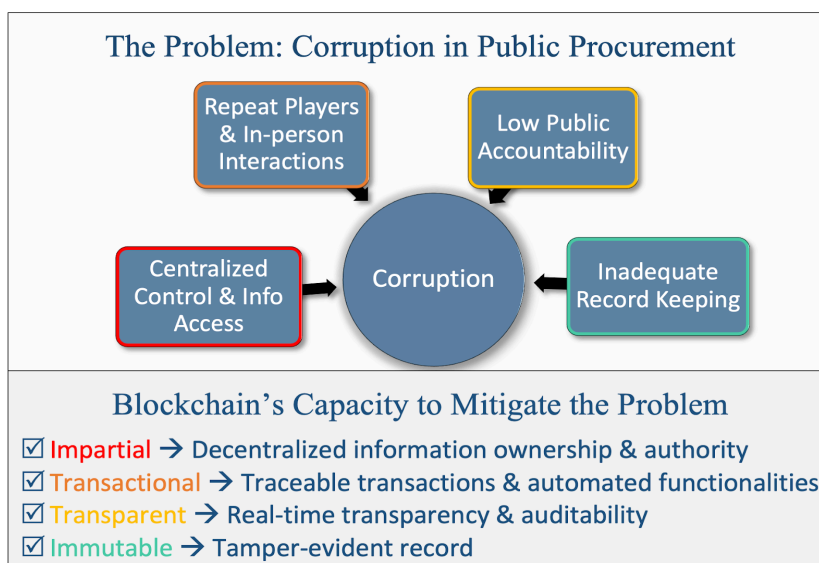
Chinaka (2016) emphasizes that the biggest problem of small-scale farmers in Africa is access to finance. Since the farmers do not have the assets that the banks deem to be minimum risk, they cannot show them as collateral, so they cannot escape from poverty. The model proposed by Chinaka (2016) has shown that in the blockchain-based system, farmers will facilitate the presentation of assets such as livestock, land, harvest, which are not normally accepted as collateral which facilitate the financial access of farmers. London-based fintech company Humaniq aims to include those who do not have access to banks and financially disadvantaged groups, especially in developing countries, into the financial system with a blockchain-based system. If the system, which consists of the combination of blockchain technology, biometrics, and mobile application is successful, it is estimated that 4.2 trillion dollars of capital will be released with the investment and market growth that will occur in the poorest countries of the world (Prnewswire, 2017).

3.3. CONTROLLING CORRUPTION

Despite many precautions, not all individuals and/or organizations in today's business, financial, and government sectors abide by ethical standards: they engage in corrupt behavior. According to Investopedia, "corruption is dishonest behavior by those in positions of power, such as managers or government officials. Corruption can include giving or accepting bribes or inappropriate gifts, double-dealing, under-the-table transactions, manipulating elections, diverting funds, laundering money, and defrauding investors." The cost of corruption, if detected, could be substantial, as five well-known investment banks have been fined by \$5.5 billion for manipulating the foreign exchange market by sending constant misinformation in the past years (Investopedia, 2021). Corruption is one of the biggest obstacles to attracting investment by developing countries. According to some views, reducing bureaucratic work through bribery can facilitate foreign investment inflows (Hilding Ohlsson, 2007). However, according to the generally accepted view, reducing corruption positively affects the investments and growth of developing countries. Seeing corruption as the most important obstacle to the transformation of the South African development community countries, Chamisa (2020), in his empirical analysis for 15 countries that make up the community, revealed that corruption negatively affects foreign direct investments. Applying dynamic panel data analysis to 42 developing and 28 developed countries, Freckleton et al. (2012) also found that foreign direct investment has a significant contribution to economic growth in these countries both in the short and long term. Increasing foreign direct investment due to lower levels of corruption has proven to boost growth in especially developing countries.

Since the main problem of corruption comes from manipulation, ambiguity, and uncertainty of information processed, blockchain technology, with its decentralized, immutable, and transparent nature, could especially be useful in reducing corrupt behavior in different settings. As mentioned in the previous sections, blockchain serves as a digital ledger that records every transaction, so all information regarding the interactions between users are recorded and visible by other nodes in the network. Blockchain systems also maintain data integrity, as interaction between different nodes, as well as information like "customer's background, financial records, source of income, wealth and assets can only be placed on a blockchain once there is consensus across the whole network that all the information is accurate" (Deloitte, 2019). By "timestamping groups of transactions and then broadcasting them to all of the nodes in the bitcoin network," blockchains also prevent double spending, a notable aspect of corruption. Moreover, since users must change all the pervious blocks before changing a certain block in the network, the information processed in the ledger becomes nearly unalterable, leaving nearly no space for corrupt behavior like money laundering, bribery, etc. to occur (Medium, 2018) (Figure 5).

Figure 5. The Problem: Corruption in Public Procurement.



Source: World Economic Forum, 2021.

According to the theoretical model proposed by Davis et al., blockchain can enable the subsidiaries of multinational enterprises (MNEs) in developing countries to fight corruption in the host country. According to the researchers, the processes of controlling corruption in developing countries can occur through three different channels: headquarters-subsidiary relationships, MNE-supply chain relationships, and MNE-government relationships. Schmidt and Sandner (2017) also identified three main strategic areas to identify possible application areas of DLTs in the fight against corruption. A summary of the applications suggested by the researchers is given in Table 2.

Table 2. Strategic areas and applications of DLTs in government.

Strategic Areas	Applications		
Weak Institutions	Property Registries	Legal Identity Documents	Budget Tracking
Financial inclusion	Shared Microcredit Ledger	Peer-to-peer bank	Crypto currencies
Empowerment	Sharing Economy	Escrow mechanisms	Distributed governance

Source: Schmidt&Sandner, 2017.

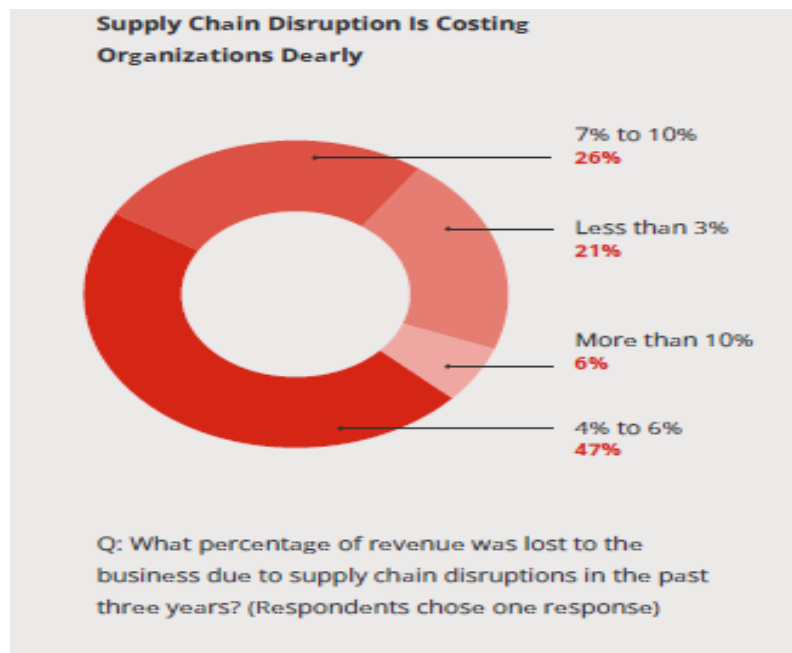
According to Aarvik (2020), a blockchain ledger to be used in government procurement systems can record and secure key events in the procurement process. This system, which will ensure the control of purchasing processes and reduce corruption, will also increase the trust between citizens and the state. Sanka and Cheung (2019) also examined blockchain technology as a solution for Nigeria, one of the countries with the highest corruption in Africa. Corruption in Nigeria mainly occurs in the form of embezzlement of public funds, bribery, paying salaries to non-existing employees in government offices (ghost employees), and election corruption. Proposing the use of

a consortium (permissioned) blockchain due to the confidentiality of records to the general public, the researchers argue that this system can be particularly effective in preventing embezzlement of public funds. In Mexico, where corruption is high and trust in government institutions and civil servants is extremely low, the areas in which DLTs are applicable were also questioned by [Natarén and Herran \(2019\)](#). The results of the study showed that DLTs, if implemented correctly, can contribute to reducing corruption in Mexico in areas such as the transparency of public funds records and the property registration system. Similarly, [Garcia \(2021\)](#) attributes the success of blockchain applications in preventing corruption in Mexico to the fact that those who set up the system can work independently and do not cooperate with government institutions to avoid conflicts of interest. According to Transparency International, in Turkey, which ranks 96th out of 180 countries, public tenders are an important area where corruption takes place ([Al-Monitor, 2022](#)). In the research conducted by [Öngel et al. \(2021\)](#) to evaluate the possibility of using blockchain technologies in public tenders in Turkey, it has been revealed that public procurement through smart contracts will enable scarce public resources to be managed more effectively.

3.4. SUPPLY CHAIN

Covid-19 had a devastating impact on supply chains (SC) globally critically disrupting flows of goods and services globally. In a recent study by ([Riskmethods, 2022](#)) 79% of firms surveyed said SC disruptions had a significant impact on revenue of their business. Figure 6 reports the prevalence of lost revenue due to SC disruption.

Figure 6. Percentage of Companies Reporting Lost Revenue Due to Supply Chain Disruption.



Source: Riskmethods, 2022.

Over the last decades the supply chains management (SCM) has emphasized lean management strategies including JIT (reduced inventories), outsourcing of production and distribution, arm's length relationships, cost-focused decision-making that has led to more complex supply chains where often participants in the chain are unknown to all parties. ([Lafrogne-Joussier et al., 2022](#)) While optimizing for cost has greatly reduced the costs of SCM, it has come at a trade-off with that system's resiliency to disruption ([Lehman and Cordon, 2020](#)). [Ellyatt \(2021\)](#) notes that, "But the pandemic has highlighted deep fragilities in these networks, with disruption in one part of the

chain having a ripple-down effect on all parts of the chain, from manufacturers to suppliers and distributors with disruptions ultimately affecting consumers and economic growth”. In a recent study by (GEP, 2021) it was estimated that the global cost of Covid-19 SC disruption at \$4 trillion USD. Additionally, it has been widely reported that Covid-19 SC disruption has led to increased inflationary effects around the world which may represent an added hidden-cost of Covid-19 SC disruption.

It has been reported by analysts at the WTO (Barraud, 2022) that Covid supply chain disruptions may be hitting poorer countries and small businesses even harder than major corporations in the more developed world. Viera (2021) reports that Covid mitigation efforts are having an adverse impact on developing nations, because of price volatility, food insecurity issues, and increased poverty. Added to these disruptions, many firms’ efforts to reduce SC risks such as onshoring or near shoring may have negative effects, along with production disruption across industries, lack of necessary health care supplies, and changes in consumer demand driven by the pandemic.

PriceWaterhouseCoopers (PWC, 2020) report the impact of Covid-19 on the economy of Nigeria was examined. The negative GDP impact of Covid on the Nigerian economy was estimated to be nearly 8% of GDP. In that research it was reported that supply-chain resilience would be key the economic recovery in Nigeria. PWC reports three major ways to improve Nigeria’s supply-chain resiliency, better supply-chain transparency, smart logistics, and AI driven SCM. Key technologies described in that research is BC along with IoT and robotics use in process automation. These technologies are felt to be synergistic in improving SC efficiency and effectiveness. For BC use of distributed ledger offers advantages of providing transparency & immutability important in building trust among SC partners. For example, traceability can reduce problems of counterfeit goods and the use of BC enabled smart contracts can significantly speed to process of payments. Exhibit 1 below describes some technology solutions that may improve supply-chain resiliency (PWC 2020).

Exhibit 1. Technology Solutions for Supply-Chain Resiliency.

Beyond COVID-19: Supply-chain resilience holds key to economic recovery in Nigeria

4.1 Solutions

Addressing the current disruption in the supply chain industry in Nigeria requires sustainable and emerging solutions. Some of these are proposed below.

Supply-Chain Transparency

Supply chain transparency, an issue many Nigerian companies face, sets the stage and is a key catalyst for greater sustainability and resilience within a supply chain. Supply chain transparency isn’t a new concept, but advanced capabilities are making an entirely new level of visibility possible.

Smart Logistics

Every company aims to minimise costs and maximise profits; smart logistics is the key savings driver and a growth lever in the connected supply chain ecosystem. Managing and executing the physical flow of goods from the point of origin to the point of consumption is an essential part of the supply chain. Smart logistics — the next level of this coordination — connects the physical shipment and information flow between suppliers, manufacturers, distributors and customers interactively and in near-real-time, building on supply chain transparency.

AI-Driven Supply Chain Management

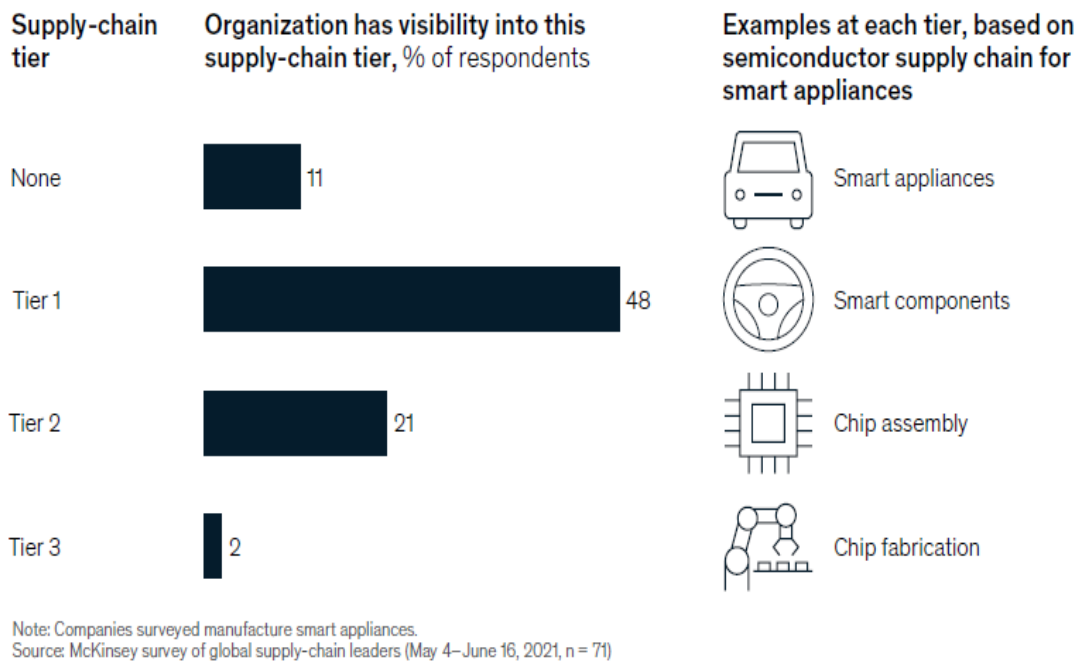
Artificial intelligence is accelerating supply chain improvements and will become the new norm as companies work towards improving supply-chain management. AI can be an enormously powerful accelerator of key supply chain capabilities, with the potential to drive efficient decision-making and build systems that can autonomously adapt to changing conditions. By applying sophisticated AI methods, such as machine learning and natural language processing, to supply chain capabilities, companies can increase transparency, improve planning and enhance logistics flows.

Source: PWC, 2020.

A key benefit of BC technology in SCM is the possibility of visibility of transactions across the SC. McKinsey found in a large global survey that very few companies had visibility into SC beyond very close or second tier connections (Köhler et al. 2021). Figure 7 shows example of visibility across supply chain.

Figure 7. Supply Chain Visibility.

Only 2 percent of companies have visibility into their supply base beyond the second tier.



Source: Author's creation.

Kshetri (2021) has reported that two key SC challenges for developing countries are the ability to trace across the SC and verification of origin and ownership. He reports that for a number of reasons, including asymmetries in bargaining power between SMEs in developing countries with much larger international buyers, poorly enforced legal systems, lack of visibility beyond tier one SC partners, SC actors who engage in cheating and misrepresentation has led to major trust issues regarding developing nation supply chains. Examples of SC problems leading to lack of trust buy consuming countries include the use of child or slave labor, sustainable production practices (coffee, palm oil, cacao, rice) and commodities that are mislabeled with respect to the country of origin (Cobalt, diamonds). Increasingly, firms are working to promote carbon neutral environmental impact which requires SC traceability and verification (Casey, 2022). Today, methods of certifying the integrity of developing world supply chains can be expensive and diverts economic value to middlemen rather than producers (Kshetri, 2021; Abebe et al., 2016). Increasingly firms are looking to deploy BC solutions to help ensure SC integrity and verification. Hirtenstein (2022) reports that Russia despite widespread sanctions has increased its exports of oil in April of 2022 with a large percentage of the shipments being shipped to unknown destinations, demonstrating the difficulty of supply chain verification even under world-wide scrutiny. Table 3 describes examples of BC projects being used for better SC traceability and verification (Kshetri, 2021).

Table 3. Examples of Blockchain Application for Ensuring Supply-chain Integrity in Developing Nations.

Blockchain solution	Implemented in	Commodities traced/tracked	Cost performance in relation to available alternatives
Circular's platform	The DRC	Cobalt	ASMs do not pay for traceability
Bext360	Ethiopia and Uganda	Coffee	Because of automated processes, costs are lower than those of certification agencies
BlocRice	Cambodia	Rice	Lower costs compared to FairTrade

Source: Kshetri, 2021.

Kshetri (2021) further describes benefits of using Blockchain, in Table 4.

Table 4. Benefits of Using Blockchain to Measure Supply Chain Integrity.

Effect	Explanation	Examples
Facilitating measurements	Measure the attributes of goods and services/performance of agents that otherwise cannot be measured	Circular's system captures data related to cobalt's origin, attributes, and supply chain participants' actions
Lowering costs of measurement	By automating, costs of measuring can be reduced	In the solutions of Circular, Bext360, and BlocRice, costs to small commodity producers are lower than the alternatives
Increasing accuracy of measurement	In many cases, compared to humans, machines can provide more accurate and objective measurements of the attributes of goods and services or the performance of agents	Bextmachines use machine vision and AI to analyze coffee cherries and coffee parchment
Strengthening contract enforcement with transparency and documentary evidence	A higher degree of authenticity can be achieved in documentary evidence, such as contract documents, which can make contract enforcement more effective and less costly	eMin tool to benefit migrant workers in the seafood industry Parties in BlocRice's contract include organic farmers and rice exporters in Cambodia and buyers in The Netherlands.

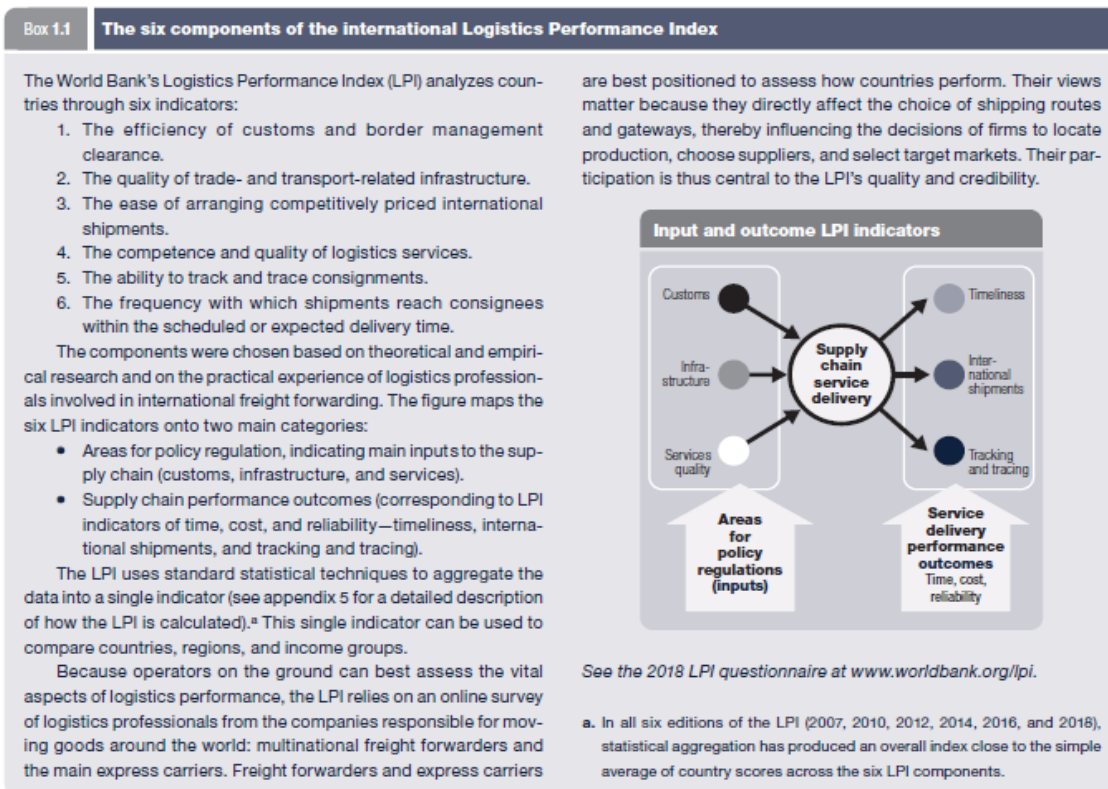
Source: Author's creation.

In response to Covid-19 disruptions many organizations are rethinking their supply-chain strategies. SC systems designed to be cost efficient and designed with a focus of exploited labor arbitrage in developing nations may be less relevant in today's world. Labor costs have escalated in many parts of the world and today supply chain resilience has taken on a new urgency along with strategies of near shoring and the use of multiple suppliers. Additionally, sustainability concerns continue to grow in importance for many buyers and new technology promises greater efficiencies through disintermediation and potential lower transaction costs. These changes offer both opportunities and challenges for developing country supply chains. Industry value-chains are being reengineered for greater resilience, increased focus on sustainability assurance and use of new technologies such

as block chain, AI, IoT, and robotic (automated decision-making).

The World Bank (World Bank, 2018) conducts research on a range of aspects of SC performance measures as part of its Logistics Performance Index (LPI) study. Its research of logistics performance in 160 countries clearly shows that logistics efficiency is lower in the developing world as compared to the more developed countries. This logistics inefficiencies in the developing world hinders trade performance, economic growth, and consumer welfare in those countries. Exhibit 2 describes the six components used by the World Bank in measuring logistics performance.

Exhibit 2. World Bank Logistics Performance Index (LPI) Measures.



Source: The World Bank, 2018.

The challenge is for organizations in the developing world to invest into these new technologies and the management systems and practices needed to utilize these technologies. For example, mobile technology along with 5G and IoT can vastly increase the availability of SC data that can be used to better analyze and manage industry value chains. However, currently access to these technologies is uneven in many parts of the developing world. The process of evolving a SC to digital process can create management resource and talent challenges. Firms established using traditional SC processes may be uncomfortable sharing information, control, and the cost of developing new systems can be a barrier (Köhler et al., 2021).

The potential benefits of block chain address many of the challenges of global distribution channels, particularly traceability, immutability of a distributed record of transactions, potential for SC partners who are unknown to each other to experience a more comfortable level of trust in the process, speedier transactions, and more secure transfer of funds. The potential for disintermediation can lower system cost and potentially shift bargaining power to producers and away from middlemen and large consumers. This would be a boon for many small producers of commodities who receive only a fraction of the delivered value of their products to end-consumers.

Developing nations have special exposure to supply chain challenges, many large customers are reassessing SC risk due to disruptions from the pandemic. Key to strategies to mitigate risk are to increase onshoring and nearshoring, invest into digital technology- including blockchain,

increase and diversify suppliers, and design greater resiliency and flexibility into supply chains while maintaining a cost focus. These strategies create both an opportunity and a challenge for developing nations.

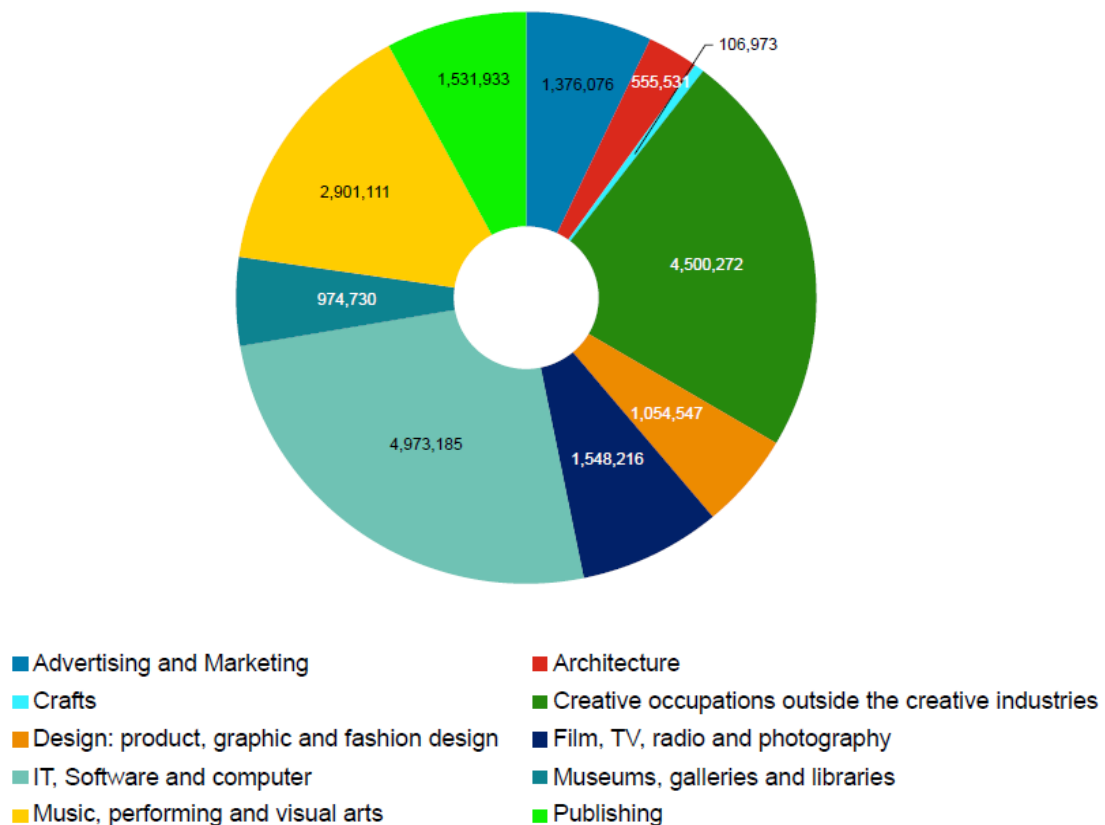
3.5. EXPLORING NEW SOURCES OF VALUE CREATION WITH NON-FUNGIBLE TOKENS (NFTS)

Creative Industries have been estimated to comprise about 10% of global GDP by the year 2030, however the Covid-19 pandemic has hit this sector hard (Avogadro et al. 2021). That report states that much of the creative sector is driven by micro, small and medium-sized enterprises (MSMEs) In developing countries, the artisan creative economy was estimated to account for estimated 300 million jobs and projected impact of nearly a trillion USD by 2023. Table 5 provides an example of the growth of employment in the creative economy for selected countries. Table 5 displays the relative levels of employment by industry for the creative industry sector across the nine nations in its study. Approximately 7% of total employment in these nine nations is linked to the creative industry sector.

Table 5. Growth of Creative Economy Employment for Selected Countries.

Country	Creative Economy 2011 jobs	Creative Economy 2018 Jobs	Share of Employment 2011	Share of Employment 2018	Estimated Jobs in 2030
Japan	6,203	7,893	9.9	11.9	10,519
U.K.	2,309	3,107	7.9	9.5	4,344
Germany	2,432	2,915	6.3	7.0	3,970
France	981	1,155	3.8	4.3	1,600
S Korea	842	1,093	3.4	4.1	1,725
Australia	796	987	7.1	7.8	1,344
Spain	750	889	4.1	4.6	1,041
Italy	518	586	2.3	2.5	626
Turkey	392	604	1.6	2.1	1,047

Source: Deloitte, 2021.

Figure 8. The Creative Industry study by Employment by Industry Sector Across Nine Selected Countries.

Source: Deloitte, 2021.

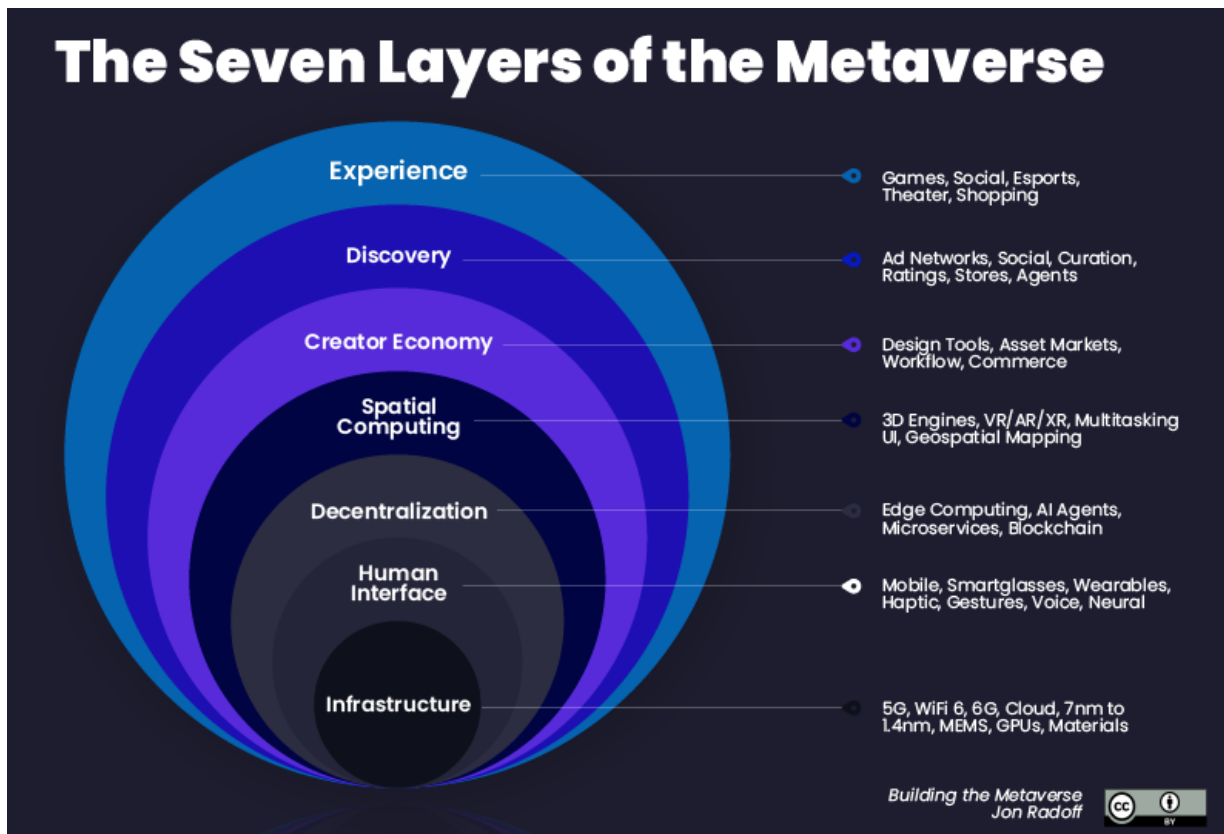
The Covid-19 pandemic hit service industries and the creative industry sector hard. Live creative events such as concerts were hit particularly hard by the pandemic. But the (Deloitte, 2021) report reports a positive recovery post pandemic for the industry. One promising area exploit new technology for intellectual property. One area of potential growth includes new revenue streams that exploit Intellectual property (IP) enabled by non-fungible tokens (NFTs). These unique digital assets are generating much interest as a way to connect creators with consumers with unique digital product offerings (Xie et al., 2021).

Recently much attention has been given to the use of NFT's as token of unique digital value. For example, many of the large consumer product companies (Ad Age, 2022) have found these useful as a tool to provide consumers an authentic, unique digital product that has value. Examples of NFT's include the use of digital clothing, art, celebrity memorabilia, loyalty reward tokens and more famously digital currency. In the marketing literature authenticity and its relationship to perceived consumer value has received much interest by both academics and by practitioners. Recently (Nunes et al., 2021) explored this linkage and concluded that authenticity is a key driver of consumer value.

Marketing is rapidly embracing the digital transformation of business in developing new ways for firms to create, deliver and capture customer value (Gillpatrick, 2019). More firms today view NFTs as part of a cultural, creative community are a new way may be a new way to create value to a broader global audience. This may open opportunities for culturally rich developing nations to create unique, authentic digital offerings (Boğa and Topcu, 2020). Recently digital apparel and art item have sold for hundreds of thousands of USDs (Ad Age 2022). It has been reported that Jack Dorsey's' original tweet was sold for over \$2.9 million USDs. How can a digital product obtain such high values- by being unique? By being the world's first tweet and by being verifiably authentic.

Among the first NFT offerings include unique famous brands be it a celebrity or and luxury brand (Gray & De Luce, 2021). Under Amour sold nearly 3000 Steph Curry shoe NFTs for an average of \$333 USD each and Adidas first NFT sold \$23 million in a few hours (Lee, 2022). Some imagine a whole new virtual world where people can experience a myriad of digital content that provides them economic value. This virtual world has been called the Metaverse. Figure 9 describes an overview of what different layers of this Metaverse might be and its relationship to the creative economy (Radoff, 2021).

Figure 9. An Overview of the Creative Economy as a Layer within the Metaverse (Radoff, 2021).



Source: Radoff, 2021.

The economic value perceived by consumers for NFTs is in the NFTs perceived uniqueness, as related to something important to those consumers. Thus, individual consumer values drive those consumers perceived economic value and motivation for digital products. Characteristics of those digital products to have value include perceived uniqueness, authenticity, verifiability of that authenticity is critically important as well. These value drivers relate closely to the promise of blockchain distributed records that are immutable, verifiable, easily shared and communicated and traded. Blockchain NFTs used for creative industry may be a method of creating, delivering, and capturing economic value for the creative culture industry for developing economies. NFTs can also be offered in combination with physical products as an added benefit that offers additional consumer value.

The United Nations has identified creative and cultural industries as a key driver of economic growth in the developing world. The rich cultural heritage of many of the developing nations may be more difficult to market because of the cost of distance to wealthier economies and the high cost of middleman in the arts, film, music, and media among others. Blockchain and the use of NFTs potentially offers these developing nation creative economies new ways to connect to consumers while capturing a greater portion of consumers demand for creative industry products by the process of disintermediation (Chen, 2018).

4. CONCLUSION

Many have proposed that the global pandemic has accelerated to digital transformation of business, government and how society in general functions. Blockchain technology has been heralded as one of the promising technologies of the digital revolution that is fueling economic development around the world. The potential benefits of blockchain have drawn attention from both business and governments around the world. Advanced economies see adoption of new digital technologies to fuel economic growth and improve business and governmental processes. Blockchain technology offers promising solutions especially for transactions where trust is prominent, with its transparency, auditability, and accountability features.

In this study, we tried to understand whether the current and potential usage areas of blockchain applications a remedy to the problems of developing countries. Although blockchain technology is used in many different fields such as health, travel, and copyright, in this study, the fields of supply chain, land registry, financial inclusion, and corruption, which have the highest potential to be applied in developing countries, are examined. Although the country examples examined in the study show that Blockchain technology has the potential to greatly affect developing countries, there are still difficulties and obstacles in front of its actual implementation. The findings of this study show that the success of blockchain applications and their contribution to the development of countries depend on the level of development of countries, the attitudes of politicians towards transparency and the country's technological infrastructure. For example, the high level of political instability in many African countries may prevents blockchain projects to be implemented. Another challenge is the necessary level of technological infrastructure needed to implement blockchain solutions. In many developing countries there exists inadequate digital infrastructure and capital needed to develop that digital infrastructure. However, infrastructure challenges can be opportunities as well. As seen two decades again a lack of telephone infrastructure led to more rapid adoption of mobile technology.

Some of the biggest challenges of developing nations a lack of secure property registration, access to financial resources, supply-chain trust and traceability and economic friction caused by inadequate and inefficient value chains can be addressed by blockchain technology. In addition, decentralized and shared access to verifiable information exchanged more rapidly at a lower cost offers the promise of shifting power away from intermediaries to decision-makers in these developing nations. When the applications to increase financial inclusion are examined, it is seen that blockchain-based digital wallets and mobile payment applications come to the fore especially in less developed countries. For blockchain to increase financial inclusion, an environment that regulates the development of the technological ecosystem, the willingness of innovators to mobilize capital, and the promotion of public-private collaboration to solve problems is required. Blockchain offer the promise of new ways to create digital products and services that may be able to leverage the culture and resources of these nations in innovative ways.

More secure property registration, supply-chain flows, financial transactions conducted faster and at a lower cost reduces risk. Reduction in risk is critical for attracting investment, retaining talent, and helping to create or more stable environment. But another risk for developing economies is not to adopt blockchain technologies particularly if the more developed world is moving to use these. A critical risk here is moving too slowly and not exploiting critical technologies which underpin what has been called the fourth industrial revolution.

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