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Blockchain in the Middle East and North Africa (MENA): Opportunities for Regional Integration and Economic Growth

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Abstract

Composed of an assortment of countries with vast differences in economic and political development, the Middle East and North Africa (MENA) region has historically been slow to embrace integration. The region consists of a diverse mix of countries with complex colonial legacies, ongoing warfare, tribal and religious enmity, and extreme wealth disparity. Recent advances in technology have the potential to enable greater cohesion and development. One such innovation is blockchain, an immutable distributed ledger technology that eliminates intermediaries and revolutionizes how transactions take place over the Internet. While originating as the technology underlying Bitcoin and other cryptocurrencies, blockchain has been applied in many other areas in which data integrity and transparency is vital and has been adopted around the world. This paper explores blockchain adoption in the MENA region, focusing on the financial systems, government policies, and innovation ecosystems within the member countries. Huge discrepancies in the levels of development and adoption of the technology in the MENA countries are revealed, with Israel and several of the oil-rich Gulf states being the most advanced. Examples of blockchain-related collaborations among MENA nations are presented and the future trajectory of blockchain adoption is explored.

Keywords: MENA, Blockchain, Cryptocurrency, Middle East, North Africa, Regional integration

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Introduction

A generally accepted principle is that regional integration leads to greater levels of economic development (Vamvakidis, 1998; Park and Claveria, 2018). Coordinated activities between nations in a geographic area facilitate the flow of goods, capital, energy, people and ideas. Such flows require cooperation in: (1) trade, investment and domestic regulation, (2) transportation, information technology and energy infrastructure, (3) financial and economic policy, and (4) provision of common public goods (The World Bank, 2021a). Economic and political integration may result in the reduction or abolishment of tariffs, relaxed border controls, and provide a favorable environment for financial flows. Entities such as free trade zones, custom unions, common markets, economic unions, and political unions enable such growth. Non-economic advantages of integration include greater international relations, enhanced security, peace-making, social inclusion, educational exchanges, increased tourism and humanitarian relief (Maupin, 2017, The World Bank, 2021a).

Despite the existence of formal multilateral trade agreements in MENA (e.g., the Gulf Cooperation Council, Pan Arab Free Trade Agreement, and the Arab Maghreb Union), the region is one of the least integrated areas in the world (Malpass, 2021; Karasapan, 2019). It is composed of

a heterogenous group of countries with extreme differences in terms of economic development, with Israel and the oil-rich Gulf countries on one end of the spectrum and countries such as Yemen, one of the poorest and least developed countries in the world, on the other end. There is no standard definition of MENA and inclusion of member nations varies depending on the agency defining it (e.g., United Nations, World Bank, International Monetary Fund). In this paper, the following nineteen countries are considered to compose the region: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, the United Arab Emirates, Palestine (West Bank and Gaza Strip), and Yemen.

The region faces many serious socioeconomic and institutional challenges that have stalled integration, among them: high dependence on petroleum and other raw material exports, the need to import much of its foodstuffs and industrial products, high unemployment levels particularly among the young, high tariffs, non-tariff barriers, corruption, gender discrimination, poor quality of education, poor infrastructure, multiple civil wars, ethnic and sectarian division, and religious extremism (Karasapan, 2019; Alshaikh et al., 2020; Dabrowski and Dominguez-Jimenez, 2021). Dealing with such difficult issues requires new and innovative approaches, many of which can be enabled by advances in information and communication technology (ICT). Application of ICT has been correlated with the accomplishment of economic and human developmental goals (Toader et al., 2018; Bilan et al., 2019). ICT is being applied to achieve the United Nations Sustainability Development Goals (SDG), which include eradication of poverty and economic integration as key objectives (Sachs, 2018; Huawei, 2018). International agencies and NGOs are leading the charge in accelerating the development of ICT in such areas as healthcare, education, gender equality, agriculture, commerce, e-banking, and the environment (Heeks, 2018; Sachs, 2018). The ultimate benefits of these efforts are the democratizing effect that access to information has in establishing equity and improved quality of life.

Believed by many to be the most revolutionary and innovative idea of the times, blockchain is an immutable distributed ledger technology (DLT) that eliminates intermediaries and revolutionizes how transactions take place over the Internet. While originating as the technology underlying Bitcoin, blockchain has been applied in many other areas in which data integrity and transparency is vital and has been adopted around the world, with MENA countries having some of the most and least developed blockchain environments in the world.

This paper is organized as follows: the first section provides an overview of blockchain technology and its potential to improve the economic, political and societal factors that are essential to regional integration and economic development. The next section introduces the MENA region, concentrating on the barriers that have slowed its integration as well as the status of blockchain development and adoption in its member countries. The final sections of the paper explore current collaborative initiatives involving MENA countries and reflect on future development.

Blockchain Technology for Regional Integration

First introduced in the famous white paper by the pseudonymous Satoshi Nakamoto in 2008 as a "new electronic cash system that's fully peer-to-peer, with no trusted third party" (Nakamoto, 2008), blockchain has become one of the most transformative technologies of our time. While there were earlier attempts at creating digital cash, it was Nakamoto's bitcoin blockchain that solved the 'double-spend problem' by providing a peer-to-peer approach to exchanging value in a trusted fashion. Blockchain allows transactions to be anonymous and secure by maintaining an immutable and tamperproof public ledger of value. Blockchains, unlike traditional databases, do not depend on intermediaries or central authorities to maintain and verify transactions, but rather on cryptographic techniques and computer code. Transactions are recorded in blocks and linked together in a chain across a distributed network of computers (nodes). Each block contains a cryptographically determined *hash* value of the transaction data along with the hash of the previous block. After consensus is reached among the nodes in the network, a new block is added to the chain. Consensus is reached via a 'proof of work' mechanism whereby special nodes in the network compete to solve a complex cryptographic puzzle to be rewarded with newly minted bitcoin and

transaction fees. Such 'mining' requires enormous computational power and electricity, but newer less energy-intensive consensus mechanisms are being introduced (Warburg et al., 2019).

Blockchain technology has qualities that make it a very compelling alternative to traditional centralized approaches, which are more prone to hacking and data leaks. Blockchain is tamper proof, transparent and decentralized; it has been referred to as the 'trust protocol' (Tapscott and Tapscott, 2016), because it can be used anywhere authentication of ownership of an asset is needed. The first generation of blockchain technology, underlying the bitcoin protocol, provided a mechanism for exchanging value. With the introduction of Ethereum in 2015, a new generation of blockchain was born, extending its functionality to include the execution of computer code, known as 'smart contracts'. The founders envisioned a world in which individuals could transact seamlessly across the planet, using a blockchain-enabled distributed global computer network. Since that time, we have seen an explosion of new decentralized applications (Dapps) in such areas as finance and entertainment, running on any number of different blockchain networks.

While blockchain technology is becoming an important disruptive force, there are still major obstacles to its mainstream adoption, particularly in the cryptocurrency sphere. With growing popularity, cryptocurrencies like Bitcoin and Ethereum, have become slow and expensive to use, preventing them from becoming a medium of exchange for mass adoption. Bitcoin, for example, can only process around 7 transactions per second, compared to a traditional financial platform such as Visa, which can handle many thousands (Warburg et al., 2019). As an asset of value, cryptocurrencies are volatile and speculative. Much has been made of Bitcoin's energy requirement, since massive amounts of electricity are required to validate the blocks containing transactions. The node (i.e., miner) that succeeds in solving a difficult cryptographic puzzle is allowed to add the block to the network. Alternative consensus mechanisms (e.g., Proof of Stake) are being introduced which eliminate the need for immense expenditures of electricity, thereby reducing the carbon footprint. New 'Layer 2' platforms, utilizing off-network approaches, will further allow for lower overhead on the main network and much greater speed and scalability. Despite its current limitations, blockchain technology is taking hold in many industries around the world.

Economic, political and social impacts of blockchain technology

Although blockchain is still an immature technology, we are seeing rapid adoption across a wide array of industries and governments and many examples of how it is impacting aspects of our economic, political and social lives.

Economic impacts - It is hardly a coincidence that Bitcoin came into the world shortly after the financial crisis of 2008, which ultimately caused the failure of several major financial institutions and triggered the worst economic downturn since the Great Depression. The fragility of our banking system became painfully obvious, and Bitcoin's vision of a decentralized, transparent, peer-to-peer alternative seemed to appear at the right moment.

As a store of value, cryptocurrency has the potential to enable economic growth by offering easier access to capital and financial services. Its value proposition is evident in many countries around the world in which untrustworthy institutions and high inflation rates have damaged national economies. Hyperinflation has resulted from the overprinting of fiat currencies by central banks, wreaking havoc with many economies in the developing world. In Venezuela, for example, inflation reached levels up to 80,000% in 2018 (Chaix, 2019).

To transfer money internationally in today's economic system, various middlemen are required to authenticate transactions and provide trust. These add costs and slow down the process. The use of blockchain technology allows for the elimination of intermediaries to manage the transfer of value and almost instantaneous transmission. The role of the intermediary is replaced by an algorithmic consensus mechanism secured by strong encryption in a distributed, peer-to-peer network.

The World Economic Forum projects that 10% of the global gross domestic product (GDP) will be stored on blockchain networks by 2027 (Kshetri, 2017). Cryptocurrencies, built on blockchain technology, have the potential to enable such economic growth. For the approximately 1.7 billion unbanked people on the planet who cannot afford the steep fees imposed by layers of intermediaries,

cryptocurrency offers a previously unavailable way to participate in the global economy. Global remittances reached over $550 billion in 2021 (The World Bank, 2021c). The process is bloated, requiring several layers of intermediaries (i.e., Western Union, banks, etc.) taking time and resulting in substantial fees for the individual. Cryptocurrency provides a solution, substantially reducing cost and increasing speed.

The idea of crypto assets poses a threat to traditional financial and governmental institutions and has been restricted or banned in countries around the world. The premise, in most cases, is that it can be used for illicit purposes. Indeed, cryptocurrency can be used for the purchase of all kinds of illegal goods and services, money laundering and other criminal activities. As of 2021, forty-two countries had implicit bans on certain cryptocurrency use, while 9 had absolute bans on all cryptocurrency activity (Bajpai, 2021). Despite this, we are seeing a steady and increasing level of acceptance internationally. Bitcoin, for example, has recently been accepted as legal tender in El Salvador, with countries such as Paraguay and Panama probable early followers. With cryptocurrencies, a decentralized form of digital payments is possible.

The current system for enabling cross-border transfers of money is the SWIFT network, first implemented in 1973. SWIFT establishes global standards for financial transactions and connects thousands of financial institutions throughout the world. International payments are expensive, as fees are collected both by SWIFT and by the associated banks who facilitate the transfer. According to Gupta (2018), the system is not keeping up with the demands of today's global e-commerce and is generally unreliable, inefficient, and subject to fraud. SWIFT international payments take three to five days to clear and 4% of payments on the SWIFT network fail. Cryptocurrency provides a remedy for some of these problems as direct transfers can occur instantly with minimal cost and without fear of manipulation by a central authority. The transaction takes place between parties that have entered into a agreement where trust is enforced, reducing costs and turnaround time (Ravishankar, 2018).

Blockchain can make a big impact on global trade, simplifying cross-border trade and reducing transaction costs. There are many stakeholders along the global supply chain including banks, freight forwarders, importers, exporters, customs and port authorities and regulatory bodies that introduce friction and slow down the process of traditional trade flows. At the heart of this is the lack of trust and asymmetric access to information that is inherent in traditional supply chains, and which necessitates intermediaries to verify and track movement through the various links up and downstream. Blockchain has the potential to modernize and transform global trade and can be effective in areas such as trade finance, customs and certification processes, transportation, logistics, insurance, distribution, intellectual property and government procurement (Ganne, 2018; Chatterjee et al., 2020).

Political impacts - Blockchain can help provide trust between nations, a critical component enabling political integration. Reinsberg (2018) suggests that blockchain can provide the governance necessary for credible commitments between countries via smart contracts that execute automatically when agreed conditions are met. Atzori (2015) explores how blockchain technology may make the nation-state less relevant in the future. Hegadekatti (2017) goes further in suggesting that integration needs to go beyond the nation-state to deal with the trust deficit, claiming that blockchain technology can be used to create networks to develop regional unions which would result in many advantages for the economy and society.

Blockchain technology provides a decentralized platform that has promising potential to foster greater cooperation between nations, mediating international conflicts and promoting peace-making (Cullell, 2018). The Toolkit Report of the United Nations' Peacemaker program (United Nations Peacemaker, 2019), for example, envisions a future in which blockchain will provide a more secure and trusted mediation process and implementation of peace agreements.

The right to vote is essential in all democracies and if trust is not present, we risk losing it. Blockchain can be useful to record and report votes and to reduce election fraud. Liebkind (2020) describes development of a new digital ballot that uses 'decision tokens' to cast votes (from a cell phone or PC) and to log them on a blockchain to verify the outcome of the election. Such blockchain-

based voting systems are being tested in other locations around the world, for example in Thailand, where the digital token ZCoin was used in the 2018 national election (Liebkind, 2020).

A recent World Economic Forum (WEF) suggests that blockchain technology may facilitate improved governance necessary to meet the United Nations Sustainable Development Goals (SDG) by 2030 (Prescott et al., 2021). Maupin (2017) advocates greater collaborative effort among the G20 countries in building a more inclusive and transparent digital economy, based on blockchain technology. The challenge is to coordinate the many involved stakeholders (e.g. governments, aid agencies, local people, local authorities and NGOs) using a decentralized platform.

Government corruption is a major problem around the world and blockchain technology can be an effective means of addressing it in such areas as public procurement, government contracting, land title registries, corporate ownership registries and grant disbursements (Zwitter and Boisse-Despiaux, 2018; Warburg et al., 2019). Alex Gladstein, activist and Chief Strategy Officer of the Human Rights Foundation, considers cryptocurrency a force that can be used against authoritarianism and the methods commonly used by despots, which include controlling the finances and freedoms of political opponents (Jilch, 2022).

Social impacts -The idea that blockchain can be employed for the social good has gained traction. Originally conceived as an alternative to the traditional financial system, blockchain has far more potential in the developing world to transform such areas as education, healthcare, gender equality and the environment (Domjan et al., 2021; Sachs, 2018; Cullel, 2018; Kshetri, 2017). As an example, the Eisenhower Fellowship has piloted a project with Accenture and a local NGO to help feed hungry school children in India. Using blockchain combined with artificial intelligence (AI) and Internet of Things (IoT), significant efficiency improvements in food preparation were realized. It is estimated that this project would save up to $500,000 annually if deployed on a wide scale (Podder and Venkat, 2018). Zwitter and Boisse-Despiaux (2018) cite many other blockchain use cases to fight corruption, validate property rights and create security digital identities. The problem of authenticating land ownership is a major problem in the developing world. Blockchain can help prove ownership and can also be applied in such areas as compliance, revenue collection, consumer protection, competition policy, safety and security (UNCTAD, 2020).

Blockchain is being applied to environmental problems in new and interesting ways. The United Nations Environment Programme (UNEP) and the Social Alpha Foundation (SAF) recently published a report entitled *Blockchain for Sustainable Energy and Climate in the Global South: Use Cases and Opportunities* which explores how blockchain technology can accelerate the transition to clean energy and mitigate climate change in the developing world. Blockchain, in this context, allows for more accurate load monitoring and more efficient generation and distribution of power. It can also support interconnections between climate markets at the transnational, regional and national levels. (UNEP, 2021). Tokenization of energy resources is starting to become a viable approach in the developed world as well. One example is the Brooklyn Microgrid which utilizes blockchain and smart meters to tokenize energy, enabling residents to sell and buy green energy to and from their neighbors. This peer-to-peer arrangement allows for shared ownership, lower rates and community financing for solar panels and other green technologies (Fernando, 2018). Other blockchain use cases within the energy sector are peer-to-peer energy trading, tracking carbon emissions and rewarding renewable adoption (Gnana, 2021).

Blockchain technology has become an important vehicle for humanitarian aid, a process that has significant overhead costs associated with moving donations across borders. Typically, there is little transparency or oversight, and it is difficult to know if and how money gets to its intended recipients and how it is applied. With blockchain technology, smart contracts can automate the funding process and reduce the friction caused by numerous intermediaries in traditional humanitarian aid efforts. Blockchain is being employed by international organizations, such as the World Food Program (WFP) and the United Nations Children's Fund to help refugees and enable food security as well as NGOs involved in gender equality, such as Women on the Block, who are helping women participate in the crypto-economy by investing in female-led startups (del Castillo, 2017; Chin, 2019).

Al-Subaei (2019) explores how the core principles of blockchain technology, i.e., decentralization, transparency and autonomy, are pertinent to human rights issues, including freedom of speech, privacy and online surveillance. Blockchain can be useful to combat human trafficking, corruption, and fraud while facilitating democratic participation and freedom of expression. In many countries, unauthorized immigrants live in deplorable conditions or are held in detention. As opposed to building physical walls to deal with illegal immigration, blockchain technology can be employed to maintain a digital history of citizens and to check illegal infiltration at the border. It can also be used as a tool to help curb the flow of black money and to aid in the fight against terrorism (Rathod, 2019).

Countries around the world have utilized blockchain technology in other non-financial areas such as supply chain management, agriculture and land management (Reiff, 2021). COVID-19 has been a catalyst accelerating the use of blockchain to deal with a variety of pandemic-related issues, such as monitoring vaccine distribution, providing transparency along the cold chain, securing medical data, and tracking the spread of the virus and its impact on citizens (Chawla and Ro, 2020). Developmental organizations, such as the Center for Global Development, USAID and the International Development Research Center, are exploring how blockchain can be applied in new ways to solve critical problems affecting the developing world (Hernandez, 2017; Pisa and Juden, 2017; Zambrano, 2017).

Implementation of blockchain technology is not without it challenges. However most of the obstacles regarding blockchain execution are less related to the technology itself and more with the process, which requires coordination between governments and development organizations (Pisa and Juden, 2017).

Barriers to Integration in the MENA Region

The MENA region accounts for only 3.9 percent of global GDP and is one of the least integrated areas in the world (Karasapan, 2019). A recent report by the World Economic Forum indicates that the region's international economic environment has deteriorated over the last few years with ongoing risks in the economic, political and societal arenas (Kastner, 2019). The barriers to integration in the MENA region are complex and have become even more substantial post-Covid. According to a World Bank report, the combined effects of the pandemic and the collapse in oil prices have resulted in significant contraction in economies across the region, resulting in increased poverty and food insecurity (Arezki et al., 2019).

The region has a long history of conflict, including the anti-colonial struggles of the 1950s. In recent years, it has been plagued with internal and external conflicts that have divided the region, hindered trade, and slowed economic growth and integration. Among these are the civil wars in Yemen, Syria, Algeria and Lebanon, the Iran-Iraq war, terrorist entities (e.g., ISIS, Al Queda), the U.S-led wars against Iraq and the continuing Arab-Israeli conflict (Karasapan, 2019; Aretzi et al., 2020; Dusek, 2019). Such struggles have caused mass displacement and a refugee crisis in many parts of the region.

The *Freedom in the World* report, annually published by Freedom House, ranks 210 countries and territories in the world as being 'free', 'partly free' or 'unfree' using various measures such as economic and political rights, civil liberties and freedom of the press. According to the 2021 report, only Israel and Tunisia were categorized as free countries. Kuwait, Morocco and Lebanon were categorized at partly free', with the rest of the MENA nations deemed 'not free'. As a whole, the MENA region had the worst civil liberties scores in the world (Slipowitz and Hawthorne, 2021).

The so-called Arab Spring in 2010, when anti-government demonstrations occurred across the region, revealed a strong demand for justice, security and transparency in an area rife with corruption and inequality (Yousef et al., 2020). The Arab Spring movement provided hope for greater human rights and more equity among its population. While it did lead to some leadership changes (Libya, Tunisia, Yemen and Egypt), it also ultimately led to more violence, repression and mass displacement in others (Robinson, 2020). In general, countries affected by conflict have some of the worst gender gaps in education, labor force and political participation, which also leads to slower long-term

development. Food price inflation, especially in Lebanon and Yemen, has led to further erosion. Agricultural prices have already increased by 30 percent over the past year and may further increase food insecurity (The World Bank, 2021b). The MENA region faces many challenges, including high unemployment levels, widespread corruption, lack of accountability and transparency, bureaucratic public sectors that impede private enterprise and investment, lack of entrepreneurship, and high dependence on food imports (O'Sullivan et al., 2011, Arezki et al., 2019).

With only 5% of global exports, integration into the global economy has lagged in the MENA region. Depending primarily on oil and other commodities for export markets, MENA countries have been slow to achieve greater economies of scale through production networks and global value chains (Saidi and Prasad, 2018). Trade integration in the MENA region has been a slow process due to inefficient legal and regulatory frameworks for investments. Tariffs in the MENA regions are high compared to other parts of the world. Non-tariff barrier measures such as unnecessary regulations, import authorization procedures and onerous customs border controls, also impede integration. Other challenges are poor logistics support and protectionist strategies.

The lack of a common currency in the MENA region is another factor slowing down integration efforts. With twenty-two separate currencies in the Arab world alone, economic integration has proven to be a daunting task. There have been recent attempts to address this issue, for example by the Arab Monetary Fund and the International Monetary Fund, but to date, they have not had much impact (Karasapan, 2019).

In some of the MENA countries, many enterprises are state-owned and an environment conducive to small business and entrepreneurship is nonexistent. Complex licensing processes and bidding procedures are examples of the kind of bureaucratic barriers that hinder innovation and investment (Karaspan, 2019). The exact opposite can be said of some of the other MENA countries, most notably Saudi Arabia, Jordan, Bahrain and Kuwait, who made the World Bank's top ten list of nations implementing the most reforms to help small and medium-sized enterprises in the *Ease of Doing Business* report (Sarkar, 2019).

There is endemic poverty in much of the MENA region and unemployment, particularly among the youth, is rampant. For the past 25 years, the rate of unemployment among young people has been the highest in the world, and in 2017, the rate was 30% (Kastner, 2019). The middle class is shrinking in the non-oil producing Arab states and the standard of living has decreased in many areas, such as Yemen, Libya and Syria (Khouri, 2019).

Infrastructure in such areas as transportation, energy and ICT, is critical to facilitate connectivity and integration. The MENA region has poor transport infrastructure (ports, roads, airports) which impacts logistics and raises the costs of trade. According to an OECD report, around 24% of manufacturing firms in MENA consider transport issues to be a major factor inhibiting business operations (OECD, 2021). The report also points to challenges in the ICT sector. In many MENA countries there is still limited access to the Internet. Only 8% of MENA SMEs have an online presence (compared to 80% in the United States) and only 1.5% of retailers are online. While these challenges occur in many of the non-oil producing MENA countries, it is not the case throughout the region; some of the most advanced and sophisticated 'smart city' infrastructure in the world is being deployed in the Emirates and Saudi Arabia, for example (Saidi and Prasad, 2018).

Blockchain Development and Adoption in MENA Countries

Predictably, there is much variance regarding the adoption of blockchain technology in the MENA nations. At one extreme, there are Israel and the oil-rich Gulf States, responsible for innovation, investment in new startups and progressive policies and communities around the technology. With absolute bans in six of the MENA countries and governmental warnings in most of the others, cryptocurrency has been used primarily to make remittances and donations, to mitigate rampant inflation, to bypass sanctions or to fund terrorist activity in most of the region (Papadaki and Karamitsos, 2021). However, there are changes on the horizon as more and more countries start experimenting with the technology. One positive development is the launch of the MenaPay system,

the first fully backed blockchain-based payment gateway in the region, providing a secure and transparent mechanism for digital money transfer (MenaPay, 2022).

The following sections outline how blockchain and cryptocurrency are being adopted in the MENA countries. Most of the progress has been in Israel, Bahrain, the UAE and Saudi Arabia, with the rest either banning it outright, cautioning the populace against it or moving slowly towards regulation and adoption. However, the underground use of cryptocurrency is widespread throughout the region.

Israel - Israel is an outlier, being the only non-Muslim state in MENA. Founded in 1948 as a nation for the Jewish people after WWII, Israel has evolved into a technological powerhouse. Dubbed the 'start-up nation' (Senor, 2016), Israel has produced more start-ups than all other developed nations, besides the U.S., and has attracted significantly more venture capital (Harel, 2016, Katz, 2018). Israel has the highest concentration of technical companies outside of Silicon Valley and the most NASDAQ-listed technology companies after the U.S. and China. Top global tech companies such as Microsoft, Intel, Google, IBM and Apple have all located operations in Israel (Harel, 2016). With Israel's lead in high tech areas such as cybersecurity and cryptography, it is not surprising that it has an advanced blockchain ecosystem with a plethora of startups in the blockchain space. Many of Israel's leading blockchain startups revolve around security and payment solutions that bridge fiat and cryptocurrencies (Rose and Yaakov, 2021). Private blockchain initiatives such as the Tel-Aviv-based fintech center, 'The Floor', are dedicated to expanding connections between cryptocurrencies and the nation's banks (Leichman, 2008). There is a vibrant blockchain community in Israel. The Israeli Blockchain Association (http://blockchainisrael.io), a robust entity with over a thousand members and dozens of experts on the advisory board, has as its mission the education, development, and empowerment of the Israeli blockchain community as well as the connection of the industry with global best practices. Blockchain Israel (https://blockchainisrael.org/) is the largest blockchain community in Israel with over 200 start-ups and 3,000 members.

Blockchain is also prominent in the Israeli academic community. Israel is home to world famous cryptographers and scientists, such as Adi Shamir, the inventor of the RSA encryption algorithm. In 2018, Tel Aviv University established the Hogeg Institute for Blockchain Applications, the first institute for applied blockchain research in Israel (Scott-Briggs, 2018).

Israel is open to exploring creation of a Central Bank Digital Currency (CBDC), a digital Shekel (Stub, 2021). The banking sector also seems to be warming up to crypto. Israel's Central Bank drafted regulations that spell out how banks might work with crypto companies (Nocamels Team, 2018) and recently, one of the largest banks in Israel, Bank Leumi, announced that it will offer cryptocurrency trading services to its clients, the first bank in Israel to do so (Crawley, 2022).

The oil-rich Gulf States - Perhaps the most notable development in the MENA region has been the enthusiastic embrace of blockchain and cryptocurrency technology in several of the Gulf States. Specifically, Bahrain, Saudi Arabia, and the United Arab Emirates (UAE), are becoming crypto hotspots and have made significant inroads in blockchain policy and legal frameworks. With the long-term prospects for oil production shrinking, the need to create a new economy and a sustainable future has become a priority. As such, there has been a major push among these countries to formulate regulations and governance structures around blockchain and cryptocurrency. Local governments are encouraging startups to pair up with bigger financial institutions and are attempting to make the region attractive to global investors through open and innovative financial regulation.

Historically, the Gulf states have been largely followers of innovation trends, not originators. This is starting to change in the arena of financial technology as these countries are formulating innovative policy that is leading to disruptive change globally. Reimagining themselves as pioneers promoting digital transformation and ushering in the 4th Industrial Revolution, these states are funding new entrepreneurial projects, providing physical workspaces and the opportunity to experiment with the technology via "sandboxes" (Buller, 2020). As the eco-system grows, foreign investors and entrepreneurs are starting to take note of these crypto-friendly locations. For example, the U.S.-based crypto payments company, Ripple Labs, is already working with Saudi and Emeriti banks to further develop and legitimize cryptocurrencies (Abdel-Qader, 2020).

Bahrain - The small island nation of Bahrain has been a leader in promoting new fintech and blockchain initiatives, striving to become the region's leading technology hub. The Central Bank of Bahrain has promoted a set of regulatory standards called the Crypto-Asset Module, which provides a framework for the regulation and licensing of crypto-asset operations. The government has also encouraged companies to experiment with crypto-related products and services within government-endorsed sandboxes. This progressive atmosphere is rare among the nations of the world and is considered a model for global crypto adoption (Buller, 2020).

United Arab Emirates (UAE) – The UAE is composed of a federation of seven emirates along the eastern coast of the Arabian Peninsula, Abu Dhabi and Dubai being the most populous and prominent. The UAE has emerged as one of the wealthiest and technologically advanced countries in the MENA region. Like Bahrain, the UAE government plans to implement blockchain technology across the country and to become a regional hub for business innovation in the region. Launched in 2018, the *Emirates Blockchain Strategy 2021,* articulated the goal of transferring 50 percent of government transactions to a blockchain infrastructure by 2021 (Al-Subaei, 2019). The strategy ultimately aims to save over billions of dollars in the routine processing of transactions and documents and millions of hours in labor (AlTaie, 2018). Also, in 2018, the *AI and Blockchain Guide Initiative* was unveiled with the aim of creating a standardized definition of these technologies at the federal level (Allen, 2019).

Abu Dhabi, UAE's capital and home to its government, has aggressively explored blockchain and crypto technology as a pathway to future economic development. The Abu Dhabi Global Marketplace (ADGM) was created to formulate regulations to support innovation and to help the country make the transition to a digital economy. ADGM's 'digital assets' framework aids in the development of standards on anti-money laundering, safe custody of assets and governance models. It has also initiated the RegLab sandbox, a controlled environment for companies to test out fintech solutions (Buller, 2020).

Non-financial use cases of blockchain technology are also evident in the country. The Abu Dhabi National Oil Company, the UAE's largest oil company, recently piloted a blockchain-based system in collaboration with IBM to automatically track quantities and transactions among its operating companies (Flinders, 2019; Benny, 2019).

Dubai has also made significant strides in advancing blockchain. The government recently launched the *Dubai Blockchain Strategy*, whose aim is to make Dubai the first city in the world to be fully powered by blockchain and to become the world's smartest and happiest city. Dubai recently approved the Dubai Virtual Regulatory Authority, the country's first effort to regulate the crypto sector (Helms, 2022).

The country's 'Smart Dubai' office is leading its transition and has identified twenty-four different current blockchain use cases in such industries as health, transportation and education (Lago, 2021). With the numerous blockchain projects and partnerships with such major players such as IBM, Dubai's blockchain ecosystem is rapidly developing. The country's support of blockchain extends to streamlining law enforcement and payment processes as well. For example, the world's first Court of the Blockchain was established in the Dubai International Finance Center (DIFC) which will foster greater efficiencies in cross-border enforcement by eliminating the need for duplicate papers (Hullet, 2018). Automated dispute resolution via smart contracts is also part of this system. An online payment portal, DubaiPay, which integrates blockchain and allows for real time settlement of transactions, was also recently implemented (Allen, 2019). Like Bahrain, Dubai is encouraging the private sector to experiment with the technology. Dubai Financial Services Authority (DFSA), the regulatory branch of DIFC, launched the 'Innovation Testing License', allowing companies to test their blockchain technologies. (Allen, 2019). An emerging blockchain community is growing in Dubai. The Dubai Future Foundation launched the Global Blockchain Council, which already has nearly 50 members from the public and private sector, including such companies as IBM, SAP and Cisco (https://www.dmcc.ae/about-us/global-blockchain-council).

Dubai is also leveraging blockchain technology to increase global trade. The *Digital Silk Road* project utilizes a private blockchain to modernize trade. The initiative aims to ease Dubai's trade with the rest of the world by creating a trusted secure real-time network for trade data and establishing its prominence as the world's best place to do business (HyperLedger Foundation, 2022).

Saudi Arabia - Like its neighbors UAE and Bahrain, Saudi Arabia understands the need to move away from total dependence on oil and is trying to reinvent itself as a blockchain-powered nation (Anthony, 2021). The *Saudi Arabia 2030* initiative provides a strategic framework to make this transition. New crypto-related partnerships are developing throughout the country. An example is the agreement between the country's monetary authority and central bank with Ripple Labs to improve the country's payment infrastructure (Papadaki and Karamitsos, 2020). Saudi Vision 2030 aims to diversify the economy and make the country an innovation hub to include the development of decentralized finance (DeFi) and blockchain applications (Lago, 2021). The Saudi Arabian Monetary Authority (SAMA) is experimenting with blockchain technology for banking services and has initiated the SAMA Regulatory Sandbox for testing and research (Hafiz, 2020).

The rest of MENA- The remaining MENA states are mixed with respect to blockchain/cryptocurrency regulation and adoption. Presented in alphabetical order, they are:

Algeria – As per the 2018 Financial Law of Algeria, the use, sale or possession of cryptocurrencies are prohibited. However, Bitcoin has emerged as a valuable alternative to fiat currencies as a way around the many economic and political problems facing the country (Georgiev. 2019).

Egypt - In 2018, the Grand Mufti of Egypt forbade the use of cryptocurrencies under Islamic Law, citing its use for such activities as tax evasion, money laundering and terrorist financing. The Egyptian Central Bank is slightly less harsh, allowing some licensed use of cryptocurrencies (Handagama, 2021). Despite restrictions, trading in cryptocurrency has become very popular among the citizenry, especially among the 67% of the adult population who are unbanked (Handagama, 2021). Egypt is starting to explore non-financial applications of blockchain. For example, it is piloting a blockchain-based online document platform for the country's Advance Cargo Information System which will provide real-time information to line and port operators (HKTDC, 2021).

Iran - The trading and possession of cryptocurrency was banned in Iran due to money laundering and terrorism financing concerns. However, Bitcoin and other cryptocurrencies are widely viewed as an effective way to bypass U.S. economic sanctions. Iran has started to explore crypto for international trade settlements and has agreed to allow local businesses to use cryptocurrency for their international trade deals (Sinclair, 2022).

Iraq – In 2017, the Iraqi Central Bank prohibited the use of cryptocurrencies. This restriction and the absence of any crypto regulatory framework has caused citizens to utilize black market sources for crypto activity (Bapir, 2021).

Jordan- Digital currencies are banned in Jordan, presumably to protect the public from loss due to fraud, hacking and theft. However, blockchain technology has been successfully deployed for digital identity management in Jordan's camps for Syrian refugees (Juskalian, 2018).

Kuwait - The Central Bank of Kuwait has issued warnings regarding crypto assets, such as Bitcoin, Ethereum and Dogecoin, citing their volatility and the risks of fraud (Faridi, 2021),

Lebanon – The Lebanese economy is one of the worst disasters in history. In recent years, the national currency of Lebanon has lost more than 90% of its value (Lautissier, 2021). Young people are increasingly looking to cryptocurrency as a ray of hope and are accelerating is usage (Azhari, 2021).

Libya - Cryptocurrency trading in Libya is illegal. However, due to cheap electricity, Libya leads the entire Arab world in bitcoin mining (El-Assay, 2021).

Morocco - Despite being banned in 2017, crypto trading has become very popular in Morocco, leading the entire region in volume (Hall, 2022).

Oman - The trading of cryptocurrency is discouraged in Oman, but allowed. It is evident that the Omani government is starting to consider it more seriously and it has recently invited bids from firms interested in creating a regulatory framework for digital assets (Zimwara, 2022).

Palestinian Territories – Israel's economic blockade has severely restricted the flow of goods and devastated the economy of Gaza, where unemployment is almost 50% (Saqan, 2021). Since there is no official Palestinian currency, commerce is transacted with the Israeli shekel, the U.S. dollar and Jordanian dinar. Cryptocurrency offers a viable alternative and is widely used throughout the country. The Prime Minister of Palestine has indicated the desire to abandon the Israeli shekel in favor of a digital currency (Gibbs, 2019).

Qatar –Due to its relations with neighboring Iran, there has been retaliation from Iran's rivals, led by Saudi Arabia, resulting in blockades. Cryptocurrency has gained popularity among the population to bypass associated sanctions. However, due to its potential for financing terrorism and money laundering, the government has banned all cryptocurrency-related activity including trading on exchanges. Broader acceptance of blockchain technology is evident in academia. Researchers at the Center for Law and Development at Qatari University, for example, have proposed a multi-layered governance approach to blockchain regulation, adopting international regulations, standards and best practices as well as applying sandbox regulations for blockchain products and services (Ibrahim and Trudy, 2021).

Syria – Civil war in Syria has caused grave damage to the economy, rule of law and political institutions. Many institutions are in disarray and there is great poverty and human suffering. As in other conflicted areas around the world, cryptocurrency is being used to fund warfare activities. A recent investigation by the U.S. Justice Department revealed a Syrian crypto exchange involved with terrorist related donations and other activities. Specifically, the exchange Bitcoin Transfer was linked to Al Qaeda and other jihadist groups in the region (Chainanalyis, 2022). There is no discernible policy regarding cryptocurrency and no explicit ban in Syria.

Tunisia - Like many other countries, Tunisia has taken a cautious view of cryptocurrency and has warned its citizens against its use. However, it is not banned. The recent arrest of a Tunisian boy who used cryptocurrency in an online transaction resulted in a public outcry. As a result, the laws surrounding the use of crypto currency are being revamped by the finance minister (Ligon, 2021). Tunisia surprised the world in 2019 by being the first country to issue a Central Bank Digital Currency, the *e-Dinar* (Wood, 2019).

Yemen –The civil war in this country has led to one of the worst humanitarian crises in the world with over 16 million Yeminis facing critical food shortages (Wright, 2021). Lack of government oversight has made adoption of cryptocurrency by the population slow and problematic, with much of the activity being centered around unlawful use and to fund violent attacks (Cuen, 2020).

Collaboration among MENA countries

Blockchain technology is still in its infancy and the industry has yet to consolidate around a dominant design. As previously noted, there are divergent standards and approaches to blockchain across the MENA region. We are beginning to see aggressive adoption in some parts of the MENA region and isolated examples of blockchain enabling collaboration and integration. For example, the UAE and Saudi Arabia have recently announced plans to launch a common digital currency, the 'Aber', and cross-border transaction systems which would serve both countries (Abdel-Qadar, 2020; **Papadaki** and **Karamitsos, 2021).**

Notwithstanding such positive signs, one of the most difficult impediments to integration is the ongoing hostility between Israel and the Arab states, the longest regional conflict in recent history. After five wars, a decades long boycott by Arab nations, and endless conflict with Iran, Israel is intact (Abdulla, 2021). Egypt and Jordan established diplomatic relations with Israel in 1979 and 1994 respectively. In 2020, the Abraham Accords were initiated to establish formal relations between Israel, Bahrain, and the UAE, with separate arrangements with Morocco and Sudan added shortly thereafter (Wilson Center, 2021). One year into the agreement, the Biden administration has committed to further normalization, expanding the Accords to include Oman and Saudi Arabia (Deutch, 2021).

The Abraham Accords will allow some of the MENA nations to benefit from collaborating with technologically advanced Israel, as they phase out petroleum and develop their own digital

economies. At the same time, they will open new export markets for high-tech products from Israel. The synergy between the Emirates and Israel is developing rapidly. The UAE recently announced the establishment of a $10 billion investment fund in Israel to focus on industries such as energy, water, space, healthcare, agricultural technology, AI and blockchain (Soliman, 2021). Other initiatives focusing specifically on blockchain are also being established. The Dubai Blockchain Center and Israeli Blockchain Association recently signed a memorandum of understanding (MoU), fostering collaboration on common blockchain-related areas of interest, such as investment strategies and best practices (The Israeli Blockchain Association, 2020).

While not explicitly addressed within the Accords, these new collaborative relationships could portend the easing of the Israeli-Palestinian conflict (Abdulla, 2021). Presently, there are isolated instances of collaboration between Israeli and Palestinian counterparts around emerging technology. The Tech2Peace program, for example, is a partnership between Israeli and Palestinian entrepreneurs sponsoring internships for young Palestinians to work at leading Israel-based companies (Rowley, 2019). Such grassroots attempts at Israeli-Palestinian collaboration are promising. In 2019, the Trump administration began talks with the Israeli crypto start-up Orbs, to develop new approaches to providing economic aid to Palestinians based on investment rather than donations (Cuen, 2019). While sporadic and inconclusive, such efforts provide hope for a more prosperous and integrated future for the area.

Going forward, the MENA countries would benefit from creating a common regional digital market. To do so, improvements in digital connectivity with other global markets are also needed to increase productivity, wide-ranging growth and job creation. One promising example is the collaboration between Swiss-based venture capital company, CV Labs, with both the Israeli Blockchain Association for knowledge sharing, testing, and development of blockchain applications and the Dubai Multi Commodities Centre (DMCC), the largest free zone in the UAE, to develop a Crypto Center to provide co-working space, advisory services and capital to entrepreneurs working in crypto and blockchain (Reinbold, 2021).

Research Limitations and Direction for Future Research

The current study was a snapshot of the current state of blockchain and cryptocurrency technology in the MENA region, derived primarily from the literature and web-based sources; no new empirical data was presented. Blockchain and cryptocurrency technology is still in a nascent stage and the landscape is changing at an exponential rate. As this disruptive technology matures and the industry consolidates around common standards, regional integration and economic development will become increasingly important use cases. More studies are needed that establish best practices and assess the value of these technologies to address the challenges facing the MENA region.

Conclusion

Gartner projects that the global market potential for blockchain will be around $3.2 billion in the MENA region by 2024 (Deimers et al., 2020). However, there is a substantial digital divide in the MENA region, a bimodal distribution in which some have wealth and access to the knowledge economy while others are steeped in poverty and human suffering. Thus, the potential benefits of blockchain technology are uneven and hard to realize across the entire region. There is a critical need for a cross-country framework that will foster development of the regional blockchain ecosystem. More education and government supported research is needed for this emerging technology to have a widescale impact on the region. (Papadaki and Karamitsos, 2021). Development of critical infrastructure to support regional connectivity and expanded digital trade is also needed, including digital payment solutions ((Arezki et al., 2020; Dusek, 2019).

Such issues are important discussion points among MENA's leaders as well as stakeholders from other parts of the world. The *17th World Economic Forum on the Middle East and North Africa* took place in Jordan in 2019, and attracted more than 1,000 high powered individuals from government, business and civil society. The primary topic of discussion was the building of new platforms for collaboration in MENA, with five transformational imperatives being emphasized: (1) new economic

and social models, (2) ushering in the Fourth Industrial Revolution, (3) entrepreneurship and innovation, (4) environmental stewardship, and (5) peace and reconciliation. The topic of blockchain technology is infused throughout the meeting's final report (Hinchberger et al. (2019). David Malpass, president of the World Bank Group, is optimistic about the future, citing recent initiatives that promise to increase gains in efficiency, greater diversification, trust building and sustainability. What's needed is a greater sense of urgency and commitment among MENA nations (Malpass, 2021).

The MENA region has amazing potential. It is a vast area rich in human and natural resources. Blockchain is an enabling technology that can help leverage these assets and confront the barriers that inhibit regional integration. The greatest challenges relate to education and governance, not the technology itself. The outlook is uncertain, but one thing is undeniable: blockchain technology and cryptocurrency will play a key role in the region's future.

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