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How Does the Blockchain Find Its Way in the UAE?

The Blockchain as a Sociotechnical System

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Abstract

Blockchain is emerging as a powerful technological force that promises to change society's status quo. The UAE has taken a proactive approach to blockchain innovation and development. With the framing of blockchain as a sociotechnical system, blockchain initiatives in the UAE are critically examined in terms of prospects, challenges, and implications for future digital societies. Blockchain developmental trajectories are analyzed from a sociotechnical lens, i.e., societal, technological, industrial, and economic trends that characterize the interfaces and interaction among people, organizations, technology, and society, eliciting underlying potential influences of cultural, ethical, and legal rhetoric. Despite strong initiatives, a series of challenges, such as trust, privacy, and transparency, have emerged as blockchain begins to develop its full potential. With these issues, sociotechnical concerns have increased regarding how to respond to the possible consequences that such a policy choice would entail, how to govern blockchains, and how to create a sustainable blockchain ecosystem. The sociopolitical ramifications of UAE blockchains are critically assessed to establish key features and conceptualize issues to unlock opportunities to guarantee a sociotechnical approach to blockchains.

Keywords: Blockchain; trust; sociotechnical perspective; sociotechnical blockchain

How Does the Blockchain Find Its Way in the UAE?

The Blockchain as a Sociotechnical System

Blockchains have flourished with an amazing growth across the globe (Duan et al., 2020). Blockchain technology is increasingly considered an innovative enabler for addressing social and technical challenges in today's society (Wamba & Queiroz, 2020). Blockchains have evolved as a vibrant and innovative technology, which proves to be effective and powerful in a number of critical services. Numerous leading industrial firms have been keenly investing in blockchain utilization in order to enhance their portfolio of products. A majority of practitioners believe that blockchain technology will drastically transform the manner we use online applications today (Yang, 2019).

The positive promises of a blockchain society are widely recognized, and there is mounting pressure to achieve the dream of a full blockchain-based era (Marsal-Llacuna, 2018). Blockchain will trigger a fundamental paradigm change to a wide range of products and will certainly influence the digital ecology in the world, but it also creates a series of challenges and issues that need to be considered when such a large-scale system is widely integrated into societies (Casino, Macrinici, Cartofeanu & Gao, 2018; Shin & Hwang, 2020). There are mounting concerns as to social, ethical and political concerns (Yeh et al., 2020). One concern is that both public and private sectors have faced glitches in determining justifiable governance and applicable management with regard to blockchain drives (Lim et al., 2021). In the UAE, for instance, while the technical capability of blockchains is rapidly progressing, the related social progress is sluggish, mainly due to complicated concerns and issues.

Blockchains have emerged as a new distributed ledger platform that securely saves transactions, and any other data, and confirms them without the need of any centralized

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mediation (Ghosh, 2019). The innovative features of blockchain, such as immutability, smart contract, security, consensus, and transparency, create negative side effects, namely, privacy, accountability, and fairness (Shin & Hwang, 2020). Security concerns are the most salient ones as most active blockchains are vulnerable to security attacks (Casino et al., 2018; Chang, Chen, & Lu, 2019). The key to sustainable development is tackling the security concerns in blockchains (Joshi, Han, & Wang, 2018). Addressing the privacy and security provision in blockchains has been a key task to make the technology everyday useable and familiarize users with the possibilities it offers (Shin & Hwang, 2020).

While these concerns continue to trigger further debates and actions, recent blockchain designs have been industry-leading and technology-driven, leaning toward technical performance at the expense of user rights and societal benefits (Upadhyay, 2020). Thus far, most blockchain development has focused on the supply aspect, or on the overly technical nitty-gritty implementation of distributed ledger systems and commercializing token-based processes (Du et al., 2019). Little effort has been spent on in-depth contextual considerations of the social, ethical, cultural, and legal aspects essential to blockchain design, deployment, and optimization (Shin & Ibrahim, 2020). The ongoing concerns over blockchains such as data integrity, privacy provisions, transparency, and governance have rarely been tackled, in contrast to the proactive technical focus (Duan et al., 2020). The question of how we operationally manage and strategically maneuver the evolution of blockchains will be key to its success and growth, both in the UAE and worldwide.

This study views blockchain as a sociotechnical artifact and contextually translates the technical attributes to its ongoing local context. This perspective is to critically assess the vital issue of whether blockchains are a society-wide innovation or a mere political slogan or

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marketing blurb. Blockchain technologies are a part of the human condition and the wider social realities, and so, their design and development process should be based on user-centered design principles and wider social impacts within a political, economic, and societal milieu (Shin, 2019). This point is consistent with the sociotechnical systems emphasizing the need for the integration of human and technical factors and concurrent design of their social and technical sub-systems (Shin & Bianco, 2020). Social issues regarding blockchains, such as trust, transparency, security, and accountability, have emerged, posing potential threats to blockchain deployment and ecosystem (De Domenico & Baronchelli, 2019; Lemieux, 2016). Such issues are *in situ* since they are not mechanically resolved with technical fixes, as the issues are inherently intertwined with the locality of a socio-political economy context (Macrinici, Cartofeanu, & Gao, 2018). These social issues become even more complicated in a large-scale system where numerous sub-systems interact and often clash, and there is no one-size-fits-all solution (Kumar, Liu, & Shan, 2019). Such issues can be further complicated by interactions with heterogeneous constituents in sociotechnical blockchain platforms and systems. A high level of complexity and a multitude of internal and external systems along with related social implications entail the idea of a blockchain ecosystem, in which firms, regulators, policy makers, and users converge with relevant roles in the distributed ledger technology (Yang, 2019).

The idea of a blockchain ecosystem has been applied to the UAE case of blockchain development, where the government has been proactively expanding infrastructure and investing significant capital and resources in technology deployment over recent years. The UAE's blockchain trajectories offer insightful models in regard to trustless platform development, regulatory systems, organizational innovation, and industry mobilization within the broader ecosystem that contribute to shaping outcomes, including the role of social, cultural, political,

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and technical artifacts. As the UAE takes on deploying a full-scale blockchain, the social ramifications of the blockchain could be considerable and challenging. It is socially meaningful and technologically relevant to frame the UAE initiatives with a sociotechnical perspective to develop strategic optimization of people and technology with each other. An examination of blockchains from a sociotechnical lens has brought up the following questions:

Research Question 1: What challenges and issues have been encountered with state initiatives to transform into a digital blockchain society?

Research Question 2: How do sociotechnical factors affect the development of blockchains in the UAE? What are the social, technical, and environmental factors associated with blockchain services in the country?

Research Question 3: What critical success factors for blockchain provisioning in the UAE or what factors associated with failure in service provisioning are inhibiting the successful deployment of a nationwide blockchain?

Blockchain technology promises to transform every sector and industry, but design of blockchain has focused on technical performance or isolated platforms whose stakeholders contribute mechanically by operating algorithmically automated transactions (Shin & Ibarahim, 2020). We highlight the significance of sociotechnical dimensions within a broader ecosystem that encompasses a wide range of technical and non-technical conditions. We argue that blockchain should be designed by the people, for the people, and of the people such that it develops in a user-oriented and socially sustainable way to contribute to a more visible and more trusted development, which leads to a significant, positive impact with clear responsibility.

2. Literature Review

Blockchain as a Sociotechnical System

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Contextualized design and assessment for the desired outcome are key in blockchain development (Casino et al., 2018). The idea of an ecosystem is quite useful for this task as the blockchain consists of ecological components: infrastructure, existing social relations, users, markets, and technological innovations (Kshetri, 2018). Performing a contextual evaluation is akin to sociotechnical assessment since it analyzes the mechanisms that each of these factors exert to contribute to forging a large-scale human system (Shin, 2019). Sociotechnical designs are a method and practice that consider human, societal, organizational, and cultural dimensions, as well as technological capability in the design of human organizations. The development of blockchain essentially involves a systematic consideration of sociotechnical factors because blockchains are sociotechnical systems that require social, organizational, and technological conditions to work properly (De Domenico & Baronchelli, 2019). From a network point of view, blockchain systems comprise a set of a distributed network of computers, appliances, and nodes linked through the internet (Lim et al., 2021). From a people's perspective, blockchains can be viewed as a trust-based cooperative platform including end-users, designers, providers, minders, and operators. From a functional perspective, it can be considered as an ecosystem involving a distributed ledger system on top of which operates highly integrated interconnected software and tools, each playing a separate but complementary function in the whole network (Casino et al., 2019).

What characterizes a blockchain as a sociotechnical innovation is that it is established by or related to a system that is adjusted and consumed by users in societies. Within a sociotechnical systems perspective, any institution, or part of it, is made up of a set of interacting sub-systems. Sociotechnical lenses to blockchain development address the connection and liaison between humans, technology, and the social milieu. A sociotechnical perspective helps us

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to consider blockchains, not only as technical artifacts, but also as humanizing devices that can help us to reconsider entrenched premises as to privacy, security, transparency, distributed decision, and integrity (Shin & Hwang, 2020). These are intertwined and complex, and differ in their relative focus based on design and operations. The transparency of personal data could put people at risk of abuse, while transparency of the demographic information, personal preferences, or other personal data could put a someone at risk for discrimination. In addition, the immutability of data saved on blockchains conflicts with the legal right to be forgotten. When a personal record is mistakenly stored within the blockchain, deleting or modifying it is almost impossible.

Concern has risen in recent years regarding the trust and robustness of blockchain systems (Shin, 2019). The user's blockchain account can be manipulated if the private key is obtained by criminals. Since there are no centralized controls that manage the blockchain, it is problematic to trace the criminal's behaviors and recover the rigged blockchain data. Ironically, blockchain's premise is to confirm trust but the biggest threat of blockchains is a lack of trust. If not addressed properly, these security and trust concerns can seriously weaken a blockchain society by generating a number of negative and even lethal problems in distributed environments (De Domenico & Baronchelli, 2019). Task on how to optimize and maximize the technical features in blockchains will affect the feasibility of its services and form potentially critical consequences on everyday lives.

The sociotechnical framework ensures that both social and technical dimensions are thoroughly considered. The social framework evaluates the context in which the system is designed, developed, and deployed; it is far-reaching in terms of the related players, which involve user groups, online communities, industrial firms, market players, and communities of

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practice. The social aspect considers how blockchain integrates into the real milieu, represents the social structure where benefits of blockchain implementation will occur, and characterizes the stakeholders who will benefit from and influence its development. The political aspect analyses the legal and regulatory issues regarding the introduction of blockchains in the UAE. The technical frame assesses the representation and materialization of the technical provisions and architecture of blockchains. Many technical configurations are mapped out and designed at this phase in the technology's development (e.g., infrastructure, hardware, middleware, software, applications, services, and content) and are likely to reappear over time with either updates of existing infrastructure or the development of new services. Hardware and software blockchain infrastructure refer to equipment and software used to power, support, and operate blockchain applications and services. The sociotechnical ensemble framework evaluates the alignment between the social context where transformation is carried out and the blockchain technology designed to improve the transformation, as well as the contextual impact – both between society and within – at organizational and individual levels.

These dimensions are not detached, linear, or independent, but rather are symbiotic and co-evolving concepts similar to structures of complex adaptive systems where a one-dimensional problem is frequently interrelated to other dimensions. When a technological change is introduced, system components find it complex to deal with the change mainly due to their symbiotically interdependent relations with the existing context. It is necessary to restructure them by engaging social components with the new context to decrease or minimize the inertia against the change.

Blockchain in the UAE

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The UAE's interest in blockchain technology shows how and why blockchain has a role to play in the future of society. In late 2015, a group of blockchain experts and policy makers met at the World Government Summit in Dubai to plan a new technology with potential to disrupt the digital landscape of the society. With government leadership, the Global Blockchain Council was formed, which then launched the Dubai Blockchain Strategy with the goal of fostering a local blockchain industry with global reach. The Smart Dubai Office manages and oversees Dubai's blockchain strategies, with the goal of making Dubai the blockchain capital of the world.

Abu Dhabi has positioned itself as the testbed for blockchain experiments. The Ministry of Artificial Intelligence has held an annual blockchain event since 2018. The minister has issued a challenge to move all viable government transactions to blockchain by 2025, effectively turning the government paperless. Meanwhile, the Abu Dhabi Blockchain Strategy aims to establish more than 2,000 new businesses and opportunities utilizing the technology, thereby cementing Abu Dhabi's status as a global hub. The UAE Government initiated the UAE Blockchain Strategy 2021 in 2018, which aims to move 60% of public transactions onto a blockchain platform by 2025, which will save 3 billion USD in transaction costs, 100 million paper documents, and 55 million operating hours annually.

-Blockchain in the financial sector

One of the country's largest banks, Abu Dhabi Commercial Bank runs an end-to-end blockchain trade transaction with automated tracking. The bank's internal network produces accurate credentials of the transaction cycle with reliable and fully digitized documents at every stage. Abu Dhabi Global Financing tokenizes traditional financial assets and enhances investor

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transparency, streamlines regulatory compliance, and improves liquidity by operating a simplified platform to purchase, trade, and transact startup equity.

-The blockchain-based smart identity system

The UAE Ministry of Finance has connected an identity card to individuals as a digital identification token. This system utilizes encryption and smart functions offered by the ID to validate information, including the individual's biometric data. This saves cost, effort, and time and facilitates the digital transformation.

- Blockchain in the media sector

Recently, blockchain technology has been applied in the media sector (Shin & Bianco, 2020). Blockchains help media and entertainment companies rethink their business models. The Gulf News, one of the largest newspapers in the country, has partnered with Civil, a blockchain startup, to provide new services. The proposed services attempt to uproot the long-standing advertising-reliant revenue mechanism and provide reporters/writers with rights to their articles. These blockchain services intend to improve reliability and reestablish trust in the journalism industry, in which fake news has been prevailing. The new services use a new platform built on Ethereum-enabled tokens that would support and fund worthy, independent newsrooms. Blockchains can establish a more efficient medium by which several completely anonymous or semi-anonymous parties can complete different sorts of transactions at a reasonably cheap price. Because blockchains are decentralized peer-to-peer networks, there is no single breakdown point and no single access point for malicious hackers. Hence, it enhances security and safety for data. This ability to keep a fully auditable and unchallengeable database that is available to all participants of the blockchain provides another level of enhanced

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transparency and trust that is not always available within traditional media and communication processes.

-Blockchain in the government sector

The public and government sectors overall have also shown significant interest in blockchain technology (Ølnes, Ubacht, & Janssen, 2017). Since 2017, the UAE government has started a series of blockchain strategies to spur exploration and adoption of the technology in the society. Numerous blockchain projects have emerged nationwide that have yielded many learning opportunities for participating stakeholders. The government aims to use blockchain systems as a tool to provide a secure and efficient platform that achieves the potential of transparent and fair e-government.

3. Methods

An in-depth case study was performed to analyze blockchain from a sociotechnical perspective. Blockchain systems are complicated and multifaceted, and approaches to understanding their essence can be diverse and multidimensional. The multimethod approach to blockchain evaluation is one which views first-hand data and second-hand data as complementary. This combination of methods allows exploration of the what, how, and why of a social phenomenon that first-hand data can address, and the impact, extent, or influence of blockchain phenomena that second-hand methods establish. As the data were collected with diverse methods from diverse sources, cross analysis and triangulation methods were used to analyze the data from multiple sources.

The main sociotechnical method is ethnographic and is based on interviews with people. Such an interpretative approach was useful as it allowed us to consider the interactions of diverse actors and their diverse interpretations. Using snowball sampling methods, relevant stakeholders

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in the development of blockchain in the UAE were interviewed by video meeting mode, face-to-face meeting, phone, and email. A total of 32 respondents were recruited (Table 1; 9 from the public sector, 10 from the blockchain industry, and 13 from research communities). These first-hand methods were used as a complementary tool to verify the archival data (such as industry reports, government white papers, public records, and newspapers regarding the planning, design, and deployment of cryptocurrency and blockchains). We used content analysis methods to probe the secondary data collected from the literature (print media, scholarly journals, technical reports, public documents, and databases). Since content analysis is context-sensitive, this enabled us to analyze the symbolic features of the blockchain era. With a triangulation method, we validated the qualitative data and refined the findings by mapping the sociotechnical trajectory in blockchain project development, the roles of governments and firms, the demand and supply roles in the ecology model, and player involvement in blockchain development.

Table 1. Interpretive Data Collected

Sectors	Venues		Participants
Government/public sector	Interviews	3	9
	Online meeting	3	
	Email	3	
Blockchain industry (Practitioners)	Meeting	3	10
	Online meeting	3	
	Email	4	
Blockchain researcher group	Focus group	5	13
	Online meeting	4	
	Email	5	
Total			32

4. The Blockchain as a Sociotechnical Ecosystem

A broad spectrum of technical and non-technical issues will need to be considered with the introduction of blockchain technology. From the perspective of blockchain as a sociotechnical ecosystem, it is important to scrutinize the interaction among ecosystem

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components: the features and functions that each of these core components exert in contributing to a system evolution. The functions of these components are closely related to a web of interdependent interactions, and these functions normally evolve over time. As per sociotechnical systems theory, blockchain development can be dismembered into parts of the systematic ecosystem, i.e. operating platforms, data repository, industry, governance, practice, and users. This perspective examines the ongoing dynamics within the wider ecology of societies, communities, institutions, markets and the practice and production of services. Framing blockchain with a sociotechnical lens is useful since it contextualizes blockchains within the scope of their ongoing practice in the society (Shin & Ibrahine, 2020).

Technological Dimension

-Technological factors in blockchain growth

Although a general high aspiration toward blockchain has been projected in the UAE, the country's blockchains bear inherent technological limitations that inhibit blockchain from evolving sociotechnical ensembles. First, one technological issue regarding the UAE blockchains is scalability, which remains a key hurdle for governments and companies. Creating scalable blockchain platforms that can adapt to the changing external dynamics of a government or firm can pose difficulties regarding operation, expenses, and change management. It was realized during early experiments with UAE blockchains that scalability is an essential technological challenge. With every transaction, the blockchain adds one more block to its ledger of transactions, and every block adds to the chain size with data since the chain keeps track of the blocks before it. As more users participate and the individual transaction histories increase, the system is at risk of collapsing. Numerous solutions are being examined and tested to solve this

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problem, such as off-chain transaction or Sharding, but they are realizing that scalability becomes an even more serious problem as the blockchain keeps growing.

Second, as different kinds of blockchains quickly develop in the UAE, concern about interoperability is rising. Thus far, there is no standard in blockchain services to ensure that different types of blockchains will be compatible with each other and work in harmony. There are more than 5000 active blockchain projects with different platforms and varied parameters such as different protocol schemes, different consensus models, and different smart contract functionality. As the blockchains have been developed for more autonomy and freedom, this causes interoperability and communication issues. The lack of interoperability between different blockchains has added to the confusion and uncertainty in development and diffusion of blockchains.

Third, the high complexity embedded in blockchains creates a number of problems. Blockchain transactions can take a longer time to process than traditional payment systems due to their complexity and the encrypted, distributed feature. Related to the complexity, users find it difficult to figure out, use, and fully adopt blockchain services. Most active blockchain services in the country are not user-friendly in that the mechanism of transporting tokens and coins in a decentralized manner is fairly complex and requires specialized knowledge. As blockchain uses encryption to warrant its security as well as create consensus over different networks, users need to write to the chain and run complex algorithms, which involves large amounts of computing power. This creates a huge environmental cost in that the computing power required to keep the system running is fairly high.

-The Technical Industry

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The UAE has long been a frontrunner in the development and deployment of digital innovations. Developing blockchain technology in the UAE has been no different. The country has a huge crypto market, which holds 29 percent of the global cryptocurrency exchange, as well as a very large financial market. The UAE accommodates resourceful and experienced industries that could take blockchain innovation to the next level of excellence. The UAE's establishment of its information technology (IT) and the competitive IT industry has led to its global recognition as a technology powerhouse. This momentum has continued in the initiatives of blockchains and digital transformations. Major firms are raising investments in their blockchain systems and commercializing services as they seek potential market opportunities. General views from the industry respondents consistently show high enthusiasm about blockchains. Many respondents saw blockchain can help solve specific business problems. One respondent from a financial firm stated, *"I think blockchain is transformative. The potential of blockchain in the financial industry as well as other overall industry could be transformative and technically innovative."*

One of the blockchain services that health industries are actively implementing is a blockchain-based digital health data storage platform. This platform will serve as a streamlined tool to improve the search for medical information, health facilities, licensed health practitioners, and health information. Health practitioners, pharmaceutical companies, and medical facilities will all benefit from the blockchain platform. The improvements can also help encourage medical tourism and supply information that can save and improve the well-being of UAE citizens.

Social Dimensions

-Social issues with blockchain development

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In many cases, social dimensions are more critical than technical ones in the process of sociotechnical system development. The social system and its' innovations in general have been underdeveloped in the UAE blockchain case as the country tends to consider blockchain as a magic wand, an all-powerful game changer that would bring some kind of benefit to the country. Under this rosy blueprint development, blockchain weaknesses have rarely been discussed or have been overridden by overhyped technical terminology. Critical social issues related to blockchain have been underestimated or overlooked. One respondent from an academic research group noted, *“Social issues related blockchain are seriously underdeveloped at present. Other than technical blockchains, the government and industry do not care or don't have understanding about such issues.”* Another respondent from a university agreed with this sentiment, stating *“The country traditionally has followed technology universalism. Due to the traditionally technology-driven nature of blockchain and cryptocurrency, which does not look at design from a user-centered perspective.”*

Ironically, one of the main social issues comes from the most salient technical features. By design, blockchain architectures are vulnerable to attacks. A blockchain has its solid security features from the decentralized system of its nodes. Since the trace of transactions is publicly open, no one can covertly make alterations. When a modification is recorded, the other nodes on the platform approve the change before the record is stored. Owing to the design of blockchain technology, all public blockchains are vulnerable to 51 percent attacks, which occur when hackers make up more than half of a blockchain's computing power (Pazaitis et al., 2017). They become the network majority and can manipulate the whole blockchain, permitting the hackers to prevent other users from producing blocks, double-spend coins, and blocking transactions entirely. The vulnerable security could be deteriorating in the UAE, considering rather

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vulnerable environments to security. Numerous security challenges have been identified in the UAE, such as online fraud, system hackers, and frequent mobile security issues. While the country has numerous prospects regarding its blockchain sector, a misuse of customer data from financial firms illustrates how the online environment in the UAE is vulnerable with regard to security. These incidents hurt the trustworthiness of the whole market and critically undermine blockchain technology development in the UAE.

Second, the weak privacy features and vague privacy regulations of the blockchain platform could be the weakest point for the UAE. Although privacy is another technical attribute of blockchain that is widely praised, it is also one of the key loopholes in blockchain. The way shared ledgers are designed makes it almost impossible to hide a transaction on blockchains. Every transaction ever stored on the blockchain is accessible for anyone to see. When personal information is available in the public domain, it poses challenges in the healthcare, financial, and legal sectors, where robust privacy requirements are necessary. One respondent from the technology industry expressed the concern over privacy, stating, *“I do not believe blockchain is good at privacy. I know it has critical privacy loopholes due to its design.”* Another respondent from a user group shared the concern, saying, *“I have a serious concern over privacy and security in general because the distributed nature of blockchains means that blockchain is publicly available and every transaction can be shared by anonymous public.”*

Every transaction that happens is verified publicly, logged publicly, and kept in an openly confirmable ledger maintained by public consensus, with an immutable digital certificate. This privacy concern may create conflicts within the UAE where there are no privacy guidelines for blockchains. While the UAE’s Data and Privacy Protection Act (Article 378) governs privacy and data protection, it does not specifically include blockchain. Also, as the privacy of a

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blockchain hinges on transparency, a lack of transparency in data collection and process may pose a challenge. The privacy governance needs to address the blockchain case.

Third, from a sociotechnical system perspective, a lack of awareness by the public can be significant obstacles to effective development. Many people in the country do not fundamentally understand how blockchain operates or the overarching effects blockchain can have in everyday life. One respondent from a user group said, *“I heard about blockchain, but most of my friends never heard about it. Even myself, I do not know specific details of blockchain. I think this is true to most people here in this country.”* This lack of awareness even extends to most policymakers and related stakeholders, which is problematic since blockchain as a disruptive technology needs flexible regulations to ensure that its capability is utilized in a constructive manner to build a sustainable society. Because blockchain is a new set of systems that change the rule of the game, only those who understand how it functions differentiate it from cryptocurrencies. There is a doubt of acceptance and diffusion in the blockchain as the lack of appropriate social structure and supporting programs. The growing doubt of acceptance and diffusion of blockchain is fueled by a lack of appropriate training and social awareness programs.

Political Dimensions

-The UAE's Blockchain Initiative

The UAE has been taking numerous measures to roll out blockchain into the nation's economy and governance. In 2017, the government introduced its Emirates Blockchain Strategy to strengthen blockchain adoption in government offices. It expects 50% of transactions to be completed using blockchain by 2021. Also, the Dubai Blockchain Strategy was launched in 2017 to explore and evaluate blockchain applications. Leveraging blockchain technology, the

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government can potentially reduce paperwork by 200 million and work hours by 60 million per year. It expects to save about 11 billion dirhams (\$3 billion) in transactions and document processing. *“These visions will also help UAE develop the correct governance for blockchain, based on the specific needs from those deploying the technology,”* said an official of the Dubai blockchain group.

Traditionally, the UAE has been highly innovative regarding new technology and initiatives in general. Blockchain has been a core national technology agenda. Since 2016, the UAE has spearheaded a large number of blockchain projects. The government formed a “Digital Transformation Committee” that directly reports to the President and is authorized to manage important policy issues pertaining to the design and development of blockchain technology. The UAE has taken its positive stand toward blockchains and the innovation it creates for financial technology by giving tariff reliefs and relaxing regulations for blockchain projects. While the government does not approve Bitcoin as an official form of payment, trading Bitcoin is widely accepted in the market. Considered the most liquid cryptocurrency, Bitcoin involves accessing a cryptocurrency exchange that allows trading and investing. The government has designated blockchains as a key strategic R&D area and has offered a stimulus and tax-relief measure. This support is an effort to boost awareness and drive in the blockchain field, while exploring possibilities for the future open innovation it could offer the financial sector as well as other vital sectors.

The UAE government holds a strategic assumption that blockchains will be one of the key enabling momentums in bringing about new growth engines and vitalizing existing industries. Blockchains have been chosen by the Ministry of Artificial Intelligence as a core field for the country to emphasize as a part of the digital transformation initiatives (Zhang, 2016). The

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Ministry of Industry and Advanced Technology has started to support blockchain by approving over 19 major blockchain companies and the development of up to 5,000 professionals in order to establish the UAE's strategic position as a spearhead in financial technologies. The ministry intends to capitalize 350 million USD in the emerging market through 2026. The government plans to establish a 10 billion USD blockchain subsidy to support new start-ups in blockchains. To advance the UAE's competitive edge in the blockchain sector, the ministry, with teamwork from the Ministry of Energy and Infrastructure, has been exploring blockchain platform architectures that incorporate different sources of data with feasible services (Zhang, 2016).

The government's proactive approach has led to increased industry involvement. Together, the government and firms have rapidly launched a series of blockchain programs to raise awareness, and a few blockchain firms have started to provide useful services accessible by users. The UAE's big firms (First Abu Dhabi Bank, Emirates Telecommunications Group, and ADNOC) have been actively developing blockchain services.

-Regulation: Governance and policy

Blockchain technology in the UAE has advanced way ahead of regulations. Despite the burgeoning blockchains, lack of consistent regulatory clarity and differences between jurisdictions pose a challenge for emerging blockchains.

Although the UAE presents blockchain as a government priority and has introduced various blockchain-related initiatives, regulation of cryptocurrencies in the onshore UAE and the Dubai International Financial Centre remains limited. Although coins and tokens are not prohibited, the Securities and Commodities Authority has issued circulars to caution investors on cryptocurrencies, without, however, taking a firm regulatory position. Both the onshore UAE and the Dubai International Financial Centre have adopted a wait-and-see approach; however, in

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October 2019, the Commission issued a draft regulation on virtual assets with a request for public commentary. As of 2021, no regulation has come into force.

Currently, there is no statute or guidance from the UAE regulatory bodies that provides coherent oversight on how blockchains should be regulated under the UAE law. One government official noted, *“Currently, no regulation regarding blockchain has come into place in the UAE. We adopt a wait-and-see posture and try to learn from other cases as they make the first mover’s lessons for us.”* Relevant regulators lack the necessary understanding of blockchain and cryptocurrencies and remain unprepared to apply a consistent approach towards coping with regulatory concerns. The present regulations over cryptocurrency are unsettled and confusing. Cryptocurrency in the UAE has yet to be defined as a currency or controlled by the Regulatory Framework for Electronic Payment System. In some places, cryptocurrencies are forbidden completely, while others regulate their use by regulating exchanges.

Owing to a lack of legislation at the federal level, there are no specific regulations in place for the misuse of virtual coins or tokens in the country. There are no unified international standards, and this will continue to be a challenge for the UAE case. There are additional concerns about how to best regulate data and data ownership, but there are no internationally endorsed standards or codes of conduct so far. The efforts of the UAE to establish global standards for blockchain are a positive move and signal how the technology is maturing. Yet, the government has not provided clear standards for domestic blockchain cases. This can be alarming considering the enthusiasm expressed by the government, but the UAE’s banking laws in 2019 do not explicitly include the state of cryptocurrency in the jurisdiction.

5. Discussion

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Currently, blockchain is a key agenda in the UAE as the digital transformation initiatives progress toward achieving development goals. The UAE has one of the most promising environments for blockchains to prosper due to its well-implemented network infrastructures and the tremendous volume of data produced, processed, and analyzed in real-time. The UAE continues to enhance the ICT momentum to blockchain initiatives with a vision that digital transformation through a token-based society can bring immense social benefits (through social-good applications) to emerging economies. Such vision, however, is not likely to be easily realized without careful and proactive sociotechnical provisions and preparations. With the extremely favorable conditions for the blockchain ecology, this enthusiasm comes at the price of intertwined sociotechnical complexity. Blockchain in the UAE has not yet realized a tangible service as it confronts a series of technical, social, political, and operational challenges. A lingering question in the technology-oriented initiatives is how to integrate or align the technical features of the blockchains to existing social progress as well as other ongoing technology projects, which is fundamentally related to sociotechnical issues. Blockchains, as a tool for securing privacy and offering even greater system performance, are undoubtedly a common interest that government and industry share in promoting digital transformation. With this shared interest, however, the ongoing implementation has faced substantial complications to appropriate and successful economic deployment, as attempts have been focused only to advance blockchain technical performance. The question lingers concerning how to carry on the momentum for social innovation and the future sustainability of blockchains over the long-term. With continued developments in overlapping projects, how can blockchain transformation be justified societally? Will blockchain technologies mature against the rising public concerns over security, privacy, transparency, and sustainability? These concerns warn against the old-fashioned belief that

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systems can be best developed from a centralized top-down approach in a sheer predetermined, deliberately planned, and entirely controlled manner. In fact, a centralized top-down design directly contradicts the core principles of decentralized and distributed contribution blockchains.

The development of blockchains should heavily include a sociotechnical dimension within which a blockchain is assessed and designed for its societal value rather than its technical utility, and it should be visible and transparent to the citizens, eventual benefactors of blockchain (Shin & Bianco, 2020). Related to this point, the real issues of blockchains in the UAE are less about technological advancement, but more about the way society is arranged and restructured with blockchain deployment and implementation. It also relates how blockchains and policy are harmoniously aligned and construed. There is currently a strategic misalignment between industry and government in the UAE as they have different perspectives about blockchain, particularly in security and privacy. From a sociotechnical viewpoint, this kind of misalignment is a big challenge for blockchain deployment in the UAE.

First, a lack of regulatory clarity can create a hazardous environment for blockchains. The absence of regulatory oversight has led to increasing data manipulation and scam. Financial sectors are facing challenges of transparency, accountability, privacy, and data security. An overarching governing framework is urgently needed to safeguard that fairness, accountability, and transparency requirements are ensured (Shin & Hwang, 2020). Related to this, a lack of industry standard for blockchain hinders the diffusion of such technologies into the wide society, resulting in the absence of interoperable system.

Second, since the beginning of its innovation, it has been criticized for the difficulties in using blockchain properly. The limited usability issues pose potential obstacles and hinder its wide-scale adoption. The findings reveal that blockchain in the UAE has been perceived as a

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highly complex technology and most users do not even understand what it is, much less how to use it. The concepts of distributed ledgering and encryption in blockchains are difficult to comprehend for end-users. In addition, users cannot immediately see the result of cryptocurrency transactions as they take several hours to finalize, which creates another level of uncertainty and inconvenience.

Third, security issues present critical sociotechnical questions to the UAE blockchains. People tend to consider blockchains as entirely safe and have a tendency to undervalue the key conditions for blockchain security. People tend to take security in blockchains for granted as they assume that blockchains are completely safe and secure. It may be a sociotechnical realization that blockchain can be highly vulnerable to risks, just as any other technical system no matter how robust. Recently, numerous security incidents have been occurred related to smart contracts and Ethereum.

Additionally, trust issues have become a key factor in UAE blockchains. If the blockchain is a mecca of transactions and file sharing, the question arises as to how we can trust this technology. For blockchain to be a socially acceptable technology in a wide society, it should be trustable and reliable for the users. At present, there is a low level of trust, which is due to a prevailing perception that cryptocurrency is a scam or online fraud. A recent series of security breaches in Bitcoin transactions have contributed to this perception.

6. Practical Suggestions: A Sociotechnical Approach to Blockchains

The results imply that the key questions of blockchain development remain tied to regulatory, societal, ethical, and legal questions. While government authorities, firms, and service providers share the concerns over blockchain, core questions involve developing society-wide beneficial blockchain programs, providing training and awareness for stakeholders

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involved, and onboarding stakeholders with the best governance practices and standards in place. The response to these key questions for the UAE can be that the government performs a key role in managing disruptive innovations and emphasizing the value of digital transformation, supporting both the private and public sectors in discussing, planning, and adjusting blockchain technologies. Thus, the government and industry work together for the formation of a cooperative setting and put in place processes for both sectors to stabilize blockchain technology at scale. It may be useful for the UAE to recognize that blockchain is not the magic cure-all some people believe it to be. It can be a beginning point of a sociotechnical transition to sustainable blockchains. From a sociotechnical systems perspective, practical suggestions can be made for ongoing blockchain initiatives in the country.

First, blockchain use and application in the UAE reveal notable obstacles: the social practices of technology adjustment, calibration, and integration. From a sociotechnical angle, how technology is adjusted to fit a new social milieu and how technology is integrated into everyday life are important questions to examine (Shin, 2014). The UAE blockchain case shows little trajectories of these technological adjustment and integration into society. There are a well-planned vision and technical roadmap, robust platforms for accommodating distributed ledgers, a strong network infrastructure, and well-funded blockchain firms. Currently, however, there is no single usable service or visible application that is used or even proposed in the near future for everyday life. The findings serve to raise awareness of the common challenges and inhibiting factors encountered in blockchain deployment. While both the federal and local governments have taken active roles in developing blockchain, the use of blockchain remains underdeveloped. Education and awareness of the related stakeholders have not done well and also identifying and understanding the most relevant applications of blockchain have been neglected. So far,

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blockchain use applies predominantly to limited applications in financial services or narrow commercial sectors (e.g., cryptocurrency trading) rather than to integration for wider societal usages and public services. The blockchain design process should constructively incorporate ethical considerations and societal issues as well as the cultural and contextual factors that can affect the deployment of technical blockchain (Shin & Bianco, 2020). Although the technical dimensions of blockchain obviously can be essential in developing initiatives, they also inherently carry critical risks that should be addressed before its full-fledged implementation (Marsal-Llacuna, 2018). In the due process of aligning blockchain with social values, it is key that fundamental user rights and human wellbeing/values should be considered in a meaningful way. Perhaps the most important strategy for the UAE is the proper usage, rather than a one-size-fits-all solution of blockchain systems, which are not a silver bullet capable of accomplishing any goal (Kumar et al., 2019). Although digitalization, encryption, transparency, and accessibility are underlying features in blockchain platforms, blockchain usability is perhaps the most important as it fosters the digital ecosystem. Although the government promotes blockchain applications and services, people should gladly accept blockchains and digital transformation as part of their lives. Citizens should be able to accept the innovations into the core of their social practices and the inclusion of blockchain technology in the different aspect of their lives. Users can apply blockchain services in such a way that it makes sense to them in their own frames of existing social practices. The success of integrating blockchain into the existing social system hinges on the trust and opinions of the public toward the blockchain system. The country is attempting this the other way around, trying to frame existing societies into the proposed blockchain scheme. This creates a lot of confusion as a new set of technical features of blockchain clashes with existing social values and user practices in the society. The

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government's plan of Digital Transformation should be reconsidered as the plan is to make a total overhaul of existing society into digital society without considering a smooth transition or sociotechnical adjustments.

Second, blockchain initiatives should be continued as a constant effort rather than a one-off event or one-time policy by political slogan. Interview respondents shared the key concern that the core challenges in blockchain implementation remain in the operational and regulatory domain rather than on the technical matter. Bringing stakeholders to the table, alignment of diverse interests, and coordination between different stakeholders were viewed as top challenges for blockchain projects in the UAE. The public sector considered public awareness and coordination of different players as the most urgent task, whereas the private sector's main issue was regulatory ambiguity. In the trajectory of technology development in the UAE, a government-driven top-down approach continues to play a dominant role. There has been a negative side effect of such technology-oriented plans, and blockchain development seems to follow the same track. Creating infrastructure and shaping an ecology normally involves considerable effort and cost. A blockchain is more than a set of ready-made encrypted codes; rather, it is a sophisticated social reengineering approach to model a contextually identified set of social factors that could contribute to ongoing social practices and embedded cultural values in the society. The government should additionally focus on the societal and ethical effects of blockchains and move away from technological determinism.

Third, as a sociotechnical evaluation method, the government may shift its current focus on technical mentality to cultural and ethical aspects of blockchains. Blockchain cannot replace all existing systems and the government must consider very carefully the pros and cons of a blockchain system. Although there are numerous blockchain initiatives nationwide, few

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entrepreneurs or academics have researched the ethical aspects of blockchains. Like the potential positive impacts of blockchain, the ethical consequences of blockchain can be just as diverse and wide ranging. The ethics of blockchain are essential for technology adoption and diffusion.

Blockchain's potential for social impact spans a wide spectrum, as it can disrupt different types of organizations and social systems across the country. Thus, policymakers need to understand the ethical approaches used in designing blockchain technology, especially how they influence marginalized and underserved social groups. A clear guideline or framework (something like blockchain ethical design framework) should be introduced as a tool to create a sociotechnical design that integrates key ethical issues for the design and use of blockchain. The main goals of the ethical guideline should provide user-centric tools to evaluate the context-specific consequences and ethical ramifications of their blockchain design and deployment options and to achieve better social outcomes. The design process should include anyone who is influencing a social-impact solution that may involve the design and implementation of a blockchain.

7. Conclusions

The promise that blockchain will have a significant impact on the UAE is genuine and has actually been happening. By enhancing the security, trust, and verifiability of the way organizations operate and how access to services is delivered, data are measured and processed, and transactions are traced, blockchain's possibilities can transform society and nation to a higher level of the digital era. Achieving this potential, however, requires a careful sociotechnical approach that aligns and integrates the relationship between design and human outcomes.

This study seeks to resolve blockchain problems and unlock opportunities in the country to guarantee a sociotechnical approach to blockchains and consider the needs of all players in the

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ecosystem. The findings of this study contribute to the theoretical principles and practical application of how to govern blockchain systems effectively, how to make sense of blockchains within a social setting, and how to design blockchains that are user-oriented and fulfill the needs of the society and its citizens. These sociotechnical insights will be constructive in transforming blockchain promise into a sociotechnical setting. The ability of blockchains to have an immense repercussion on the UAE is positive and promising. Its key features, platforms, and financial impact have the power to move ahead with momentum. Yet these revolutionary possibilities will not be realized unless governments strategically design systems to redistribute power from the elites to the users in the country who would take the form of public good provision. The realization of the potential depends on a thorough sociotechnical design that aligns technological blockchain systems with human meaning of the country. The government should purposefully align the social and technical elements of how societies are evolving to realize a national strategy based on both sociotechnical reflection and intervention.

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