



Review

A Review of Contemporary Governance Challenges in Oman: Can Blockchain Technology Be Part of Sustainable Solutions?

Leon Goldsmith ¹, Abdul Khaliq Shaikh ^{2,*}, Hacer Yildiz Tan ³ and Kaamran Raahemifar ^{4,5,6}¹ Politics Programme, University of Otago, Dunedin 9016, New Zealand² Department of Information Systems, Sultan Qaboos University, Muscat 123, Oman³ Institute of Social Sciences, University of Otago, Dunedin 9016, New Zealand⁴ Data Science and Artificial Intelligence Program, College of Information Sciences and Technology (IST), Penn State University, State College, PA 16801, USA⁵ School of Optometry and Vision Science, Faculty of Science, University of Waterloo, 200 University Ave. W, Waterloo, ON N2L 3G1, Canada⁶ Department of Chemical Engineering, Faculty of Engineering, University of Waterloo, 200 University Ave. W, Waterloo, ON N2L 3G1, Canada

* Correspondence: shaikh@squ.edu.om

Abstract: Oman is considering adopting the latest e-governance technology, including Blockchain-based. While much research was conducted into the benefits and risks of Blockchain-based in information systems and finance fields, fewer researchers investigated the opportunities and risks associated with adopting Blockchain-based frameworks for governance and public administration, especially in highly bureaucratic, centralized rentier states, such as Oman. As the first phase of an exploratory sequential mixed-methods study, our purpose was to identify key governance problems in contemporary Oman and analyze each problem against evidence drawn from the relevant parts of the Blockchain-based and e-governance literature to evaluate the potential utility, risks and limitations associated with adopting block-chained e-governance solutions in the Sultanate. Our initial results indicate that there are advantages for states, such as Oman, from being an early mover into block-chained e-governance systems, including greater cost efficiency, drastically improved accuracy and reliability of information systems, transparency and accountability of public services, and an upgrade in the overall level of legitimacy and public trust in the institutions of governance. However, more research into the risks related to reconciling block-chained systems with the dynamics of labor, tax reforms and centralized authority in a rentier social contract is required.

Keywords: e-government; governance; blockchain technology; social contract; development; rentier states; Oman



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1. Introduction

Oman is an oil-exporting rentier state undergoing significant economic and political transformation in the early 2020s. Oman's governance model, built on a large and frequently inefficient public sector, proved increasingly problematic in the context of an urgent need to diversify its economy and mitigate its exposure to volatile global oil prices. This imperative to reform the rentier model in Oman and in other similarly positioned Gulf states, such as Bahrain, touches upon the very nature of the rentier social contract, which since the 1970s resembled the Hobbesian 'Leviathan' where the centralized state mediates all aspects of a stable bargain between the rulers and the ruled. In this vein, the technology of blockchain envisaged by Satoshi Nakamoto as a platform for a stateless and fully decentralized cryptocurrency, bitcoin, seems antithetical to the rentier state. However, are the rentier 'Leviathan' and 'Nakamoto' really irreconcilable?

The main purpose of this study is to discover whether there is potential for centralized rentier states, such as Oman, to benefit from the latest blockchain technologies in terms

of enhancing, supplementing, or reforming their current governance systems. Towards this end, our objectives are fourfold: (1) to identify specific areas of Oman's public administration and governance that are considered challenging or problematic from a national perspective; (2) to contextualize each of these issues in relation to Omani conditions and requirements; (3) glean from international studies whether there may be advantages to Oman from adopting blockchain solutions to the identified governance problems; and (4) gain an impression of the Oman government's outlook on blockchain solutions to governance and public administration issues. First, it is necessary to provide some brief background to the quite unusual case of Oman.

In the late 1960s, the Sultanate of Oman, located in the southeast Arabian Peninsula, lacked any comprehensive governance systems across its territory. In fact, the ruling sultan, Saïd bin Taimûr al-Saïd, often struggled to extend effective governance beyond his palace walls [1]. Subsequently, oil wealth and stable, comprehensive governance under the next sultan, Qabûs bin Saïd al-Saïd (r.1970–2020), propelled human and infrastructural development projects forward at breakneck speed [2]. Oman came to represent a model oil-exporting rentier state with a highly centralized governance structure and a well-coopted polity [3]. Much like the other Gulf Cooperation Council (GCC) states, the nature of the social contract in Oman became based on citizens' expectations of abundant public sector employment, generous subsidies, cheap expatriate labor and zero income tax. In return, the task of governance was left to the discretion of the Sultan and his ministerial appointees. Whilst oil income remained sufficient, this social bargain between state and citizen was stable and, in fact, provided a somewhat efficient model for rapid decision-making in the development of a modern and unified state.

In the early 21st century, the Omani social contract started to buckle. In 2011 social unrest broke out over perceived uneven distribution of oil-wealth and a lack of transparency and accountability in governance. These social and political pressures were exacerbated by the collapse of global oil prices from mid-2014, which caused substantial budget deficits throughout the rest of the decade [4]. Most importantly, the long stable era under Sultan Qabûs came to an end with his death on 10 January 2020 and a transfer of power took place with Qabûs' paternal cousin, Haitham bin Tariq al-Saïd, appointed as the new sultan. Despite a smooth transition of power, the sustainability of the highly centralized rentier social contract remains in question. The main components of the old rentier bargain—public sector jobs, subsidies, and zero-taxation—are no longer viable options over the long run [5].

Oman, and similar rentier states, seek to pivot to a new post-oil social contract that can provide continuity of stable governance and development, the question is what options are available? This article explores the potential for Oman to shore up its governance systems by introducing state-of-the-art blockchain technology within new comprehensive, resilient, and efficient e-governance systems. For countries, such as Oman, that are searching for innovative solutions to pressing governance problems, a strategy involving blockchain holds significant potential in terms of efficiency, transparency, security, cost, and trust (legitimacy); however, there is also a magnitude of risk as it remains a little known and largely untested technology, especially in the context of an absolute rentier state.

The questions posed in the study are: what are the current governance issues facing Oman and what possible solutions are available within blockchain-based e-governance technologies? In addressing these questions, this paper presents an exploratory review of one critical case in an emerging broader question regarding the convergence of decentralizing digital technologies and their potential role in good governance, and the governance issues faced by highly centralized states with extensive (often inefficient) public sectors. As such, this paper seeks to highlight the types of governance issues such states face and to lay the groundwork for further targeted, quantitative enquiries into whether blockchain would, indeed, help address challenges to good governance in highly centralized states seeking reform.

The following sections will proceed as follows. Section 2 presents a review of the literature, Section 3 presents the research methodology, and Section 4 outlines the general

features of blockchain technology and its application to governance. Section 5 presents the results of our survey of the current governance issues facing the Sultanate of Oman. Section 6 discusses current perspectives towards blockchain solutions based on an interview with a top policymaker in Oman. Section 7 discusses possible blockchain solutions and some risks to the identified governance issues. The conclusion sums up the overall findings of the study.

2. Review of the Literature

Scholarly literature on the various applications, implications and impacts of blockchain technology is growing. Blockchain is often defined as a distributed public ledger, which forms a secure chain of 'blocks' to store and manage data and facilitate peer-to-peer transactions [6–11]. The various benefits of managing information and transactions via blockchain were widely studied, for instance, in terms of decentralization, anonymity, auditability, persistency and security [6,8,12,13].

Researchers argued that blockchain can upgrade government authority and governance by enhancing levels of public trust in governance systems [14–16] increasing efficiency and decreasing the costs [6,17,18]. Conversely, other studies examined the risks of blockchain as a challenge to state authority and legitimacy [19–23]. This aspect is especially important to explore in terms of developing countries with shorter histories of institutional and constitutional entrenchment, such as Oman and other Gulf states.

A highly relevant trend for us in current research is the study of 'smart cities', which explores the potential for blockchain technology to support sustainable, efficient, transparent, and democratic public administration for evolving 21st-century urban conglomerations, especially in the rapidly urbanizing and developing global south [24–26]. A significant aspect of the 'smart city' literature relevant to our study was the finding that blockchain and similar technologies, while tempting for policymakers as 'temporary solutions' to governance challenges, are not necessarily 'short term' quick fixes for addressing 'deep-seated structural issues' and cannot replace genuine 'governance transformation' where it is required [25]. In addition, Praharaj, Han, and Hawken [25] make another important point regarding the persistent gap between creating digital infrastructure in the hope that it will engage people in civic deliberation and genuine promotion of active political-participant populations (2018); something that Almond and Verba (1963) described in their seminal study, *The Civic Culture* as far back as the early 1960s [27]. In fact, new data show that greater access to ICT infrastructure does not necessarily correlate to increased levels of civic culture and that ICT technology is primarily being used for other purposes, such as entertainment [24].

However, much of the evidence presented in the 'smart city' literature focuses on municipal-level governance and in democracies, including the world's largest democracy India [24,25]. Fewer studies explored the feasibility of blockchain technology implementation at national level by central governments [28]. Fewer still explore blockchain potential in highly authoritarian or rentier-state settings, such as Russia [29], Dubai [30,31], and the wider Middle East [32].

To what extent Oman's governance issues can be solved by new technologies, such as blockchain, is not shown in the existing literature. Several studies focused on the quality of e-government services being offered in Oman, including the widespread adoption of mobile applications for public interactions with government agencies [33], and the overall challenges of adopting e-government solutions in the Sultanate [34]. To our knowledge, there were no studies broadly surveying the potential benefits of blockchain for governance and public administration in Oman, which we found surprising and motivated us to address this gap.

3. Research Methodology

The method for this study constitutes the first phase of an exploratory sequential mixed-methods design [35]. This social science method involves two research phases. The

first phase is an open-ended qualitative exploration to inductively identify key themes in a topic area. The second phase involves the extraction and analysis of data related to those themes in relation to a set hypothesis. In this review paper, we present results from the first exploratory phase of this method where we discovered those areas where further quantitative enquiry into blockchain solutions to Oman’s public governance problems is required.

Our primary source of data for this exploratory review was taken from contemporary international, regional (Gulf) and national news media. (These included Reuters, Al Jazeera, Arab News, Haaretz, Gulf News, Oman Observer, Muscat Daily, Times of Oman.) However, given Oman’s low profile in international and regional media outlets, it was necessary to derive most of our data from local Omani media in order to gain a sufficiently deep sample of specific governance issues in the Omani context. Moreover, the Omani media is reactionary; this means that while it is a ‘guided media’ and controlled by strict publication laws—Omani media tends to be cautious and self-censoring to ensure compliance with Royal Decree No. 49/84, which promulgated the Publications and Publishing Law (1984)—local media tends to respond to trends of public opinion to (1) test possible public reactions to upcoming policy changes (via social media), and (2) respond to those public reactions once policies are announced/implemented. This understudied media dynamic is partly due to the lack of open channels for political participation in Oman, something that the first author of this study observed over several years inside the country. As a result, Omani media, including privately owned outlets, tends to reflect the agenda and perspective of the government and reveals the policy issues important to the public, which allowed us to discover important issues from the public policy and governance points of view.

More specifically, we used local media over external international sources because the Omani media naturally provided more coverage of local affairs. We, therefore, used available regional and international news, and targeted the main private newspaper in Oman, *Times of Oman*, which publishes news in both English and Arabic, for the bulk of our data. (We also considered the Muscat Daily and Oman Observer newspapers; the latter is operated by Oman’s Ministry of Information.) A dataset of 450 news articles, broadly related to the public sector and governance, was compiled from 2018 to 2020, inclusive. This dataset was then filtered down to 149 articles that directly addressed current and potential problems in the execution of public governance in the Sultanate. From this filtered sample, we quantified several discrete themes relating to issues of public governance that are deemed problematic or require solutions. The results provided us with 10 categories ranked from the most frequently reported to the least. Of the filtered sample of 149 articles, 29% focused on the general area of economic, social, and political pressures in general. The most frequent specific issues related to the following: public sector reform and e-services (15%); issues of employment (15%); and taxation (12%). Other issues included public healthcare (8%); education (7%); elections and e-participation (5%) (see also Shaikh, Ahmad, Khan, and Ali, 2021); corruption, fraud and attestation of documents (5%); and reforms to public subsidies, such as energy and utilities (4%). In addition, one article mentioned land information (Table 1).

Table 1. Frequency of references to governance-related issues in news media, 2018–2020.

Rank	Governance Issue	<i>n</i>	Fraction of Full Sample (<i>n</i> 450)	Fraction Filtered Sample (<i>n</i> 149)
1	Economic/political/social pressures	43	0.10	0.29
2	Public sector reform and e-services	22	0.05	0.15
3	Employment: expatriate labor management, Omanization, automation	22	0.05	0.15
4	Taxation reforms	18	0.04	0.12
5	COVID -19 Pandemic and Healthcare	12	0.03	0.08
6	Educational Changes- online delivery (partly caused by Covid-19)	10	0.02	0.07

Table 1. Cont.

Rank	Governance Issue	<i>n</i>	Fraction of Full Sample (<i>n</i> 450)	Fraction Filtered Sample (<i>n</i> 149)
7	Elections and e-participation	8	0.02	0.05
8	Corruption, fraud and attestation of documents	7	0.02	0.05
9	Government subsidy reforms	6	0.01	0.04
10	Land information	1	0.002	0.007

Source: Dataset compiled by the authors, 2018–2020.

These results determined the specific governance issues upon which we would concentrate our study. We decided, however, to omit ‘economic/political/social pressures’ (ranked 1) due to its generality. We also left out ‘Educational changes’, (ranked 6) as it was an area subject to complex and fluid changes in 2020 because of the COVID-19 pandemic and, therefore, better addressed separately by later studies. We also omitted land information due to its limited impact on the media discourse in the period under observation. (The authors note, however, that land information, despite its lack of attention in media indicated in this study, is an area of interest for potential future blockchain solutions due to issues related to the government allocation of land parcels to Omani nationals and a decline in the availability of arable land [36]. We addressed the remaining seven specific governance issues in Oman in relation to the international literature connected to each specific issue in terms of potential blockchain solutions.

Finally, we managed to obtain permission to interview the senior Omani official broadly responsible for the implementation of e-governance systems, including blockchain technology in the Sultanate: the Undersecretary for Communications and Information Technology at the Ministry of Transport, Communications, and Information Technology, Dr Ali Al-Shidhani. The resulting high-level insights give a snapshot of how Oman is positioning itself regarding new information systems technology in e-governance. The resulting data provide a useful departure point for further quantitative and mixed-methods research into blockchain-based e-governance solutions in Oman, and further targeted interviews at the relevant ministries and agencies.

It is also important to note that the political and economic system in Oman is defined as an oil-exporting rentier state, which means that the generalization of our results is perhaps limited to other similar cases in the Arab Gulf, which have similar historical experiences and similar trajectories of socio-economic and political development, as well as a need for reform. This unique regime type and its convergence with new technology are discussed in the next section.

4. Blockchain Technology and Oman’s Social Contract: ‘Leviathan’ Meets ‘Nakamoto’

The idea of a stable social contract encompassing the entire territory of a nation-state was first articulated in the works of Thomas Hobbes (1588–1679) [37]. Hobbes’ pessimistic view of human nature concluded that escaping the ‘brutish state of nature’ required establishing an all-powerful sovereign—the *Leviathan*—which provided the bedrock for secure and stable governance [38]. Oman’s modern social contract, which dates from the mid-1970s until the present, resembles Hobbes’ *Leviathan*. Sultan Qabūs reflected the all-powerful, ‘benevolent leviathan’ around which political order and governance were constructed within a unitary and highly centralized national framework funded by oil revenue.

The rentier system and subsequent centralized governance structure of modern Oman would seem to be the antithesis of the ideas presented in the 2008 white paper by the mysterious figure known as ‘Satoshi Nakamoto’. Nakamoto imagined a fully decentralized, de-territorialized framework for exchange, asset protection, and the upholding of contracts via blockchain technology and bitcoin [39]. This obvious polarity would logically suggest that an absolute rentier state, such as Oman, should not be able to coexist with a fully decentralized technology based within a libertarian, almost anti-statist, philosophy. Hence Nakamoto would be perplexed by the enthusiastic adoption of blockchain by an authoritar-

ian state, such as the United Arab Emirates, for instance, who in April 2018 announced the Emirates Blockchain Strategy 2021, which involved moving fifty per cent of its government transactions onto blockchain [40].

There is an important convergence between Hobbes and Nakamoto, however. Both rested their ideas on an assumption that there is an essential lack of trust between individuals. For Hobbes, this necessitated surrendering individual autonomy to a ‘social contract’, that allowed individuals to escape the ‘state of nature’ by joining an all-powerful state (leviathan), which would serve as the intermediary between distrustful individuals, in terms of creating secure transactions in an orderly society. Nakamoto agrees with Hobbes regarding the essential lack of trust between individuals but goes a step further to also identify the flaws in the state, as it is ultimately made up of, or dominated by, self-interested individuals or the autonomous interests of the state [39]. Hence, there is a need to create an infallible technology (blockchain) that can govern peer-to-peer interactions without the need for a human third party. The lack of trust between nodes in a blockchain, which must be managed by consensus protocols, is referred to in the blockchain terminology as ‘byzantine behavior,’ [11], which perhaps underlines the ‘realist’ nature of blockchain as opposed to liberal ideals of cooperation in political terms. Essentially, ‘Leviathan’ and Nakamoto have different means to the same end, a socially or technologically constructed framework to create secure transactions in a world of trust scarcity. Hence, we should be less surprised by the interest of authoritarian states in blockchain, but it remains to be seen how the convergence (or divergence) of state-based and technology-based trust will develop.

5. What Is Blockchain and How Can It Be Used for Governance?

Comprehensive, up-to-date, and accessible surveys of the state of the art of blockchain technology are available [11,26], so it is unnecessary to include these details here. Instead, we provide a brief overview of the technology and how it can be used for governance. Blockchain consists of ‘blocks,’ or digital ledgers, that are ordered and contain the records of all transactions occurring in a blockchain network. These blocks contain a timestamp, hash, and record of transactions. The blocks are connected through the previous block’s hash. The cryptographic hash ensures the integrity of data stored in these blocks. However, the verification of a transaction is performed through a consensus algorithm by parties known as ‘miners’. New transactions are added to the block after verification. Every node of the blockchain network has a copy of that block. Moreover, every transaction is signed by its owner’s private key, which prevents the risk of duplication, or double spending in the case of cryptocurrency [41,42].

To illustrate via the cryptocurrency Bitcoin; when user A wants to send a transaction to user B, it is signed by user A’s private key and broadcast to every node in the network for verification. These nodes (miners) verify the transaction according to the rules of the consensus algorithm (proof of work). The miners provide authority to check the signatures on the transaction and account balance of user A. For this process, miners must solve the complex mathematical puzzle and create a new block. The created block is sent to each node in the network. These nodes check the validation of the created block and then add it to the chain of blocks. In the end, user B receives the transaction, as illustrated in Figure 1 [43,44]. The entire process may be complete in a matter of seconds, without being diverted through any central or mediating actor, such as a central bank, financial institution, or other regulatory body. Blockchain technology is already finding application in trading, supply chains, agriculture, real estate, health management and, increasingly, in e-government [15,16,42,45].

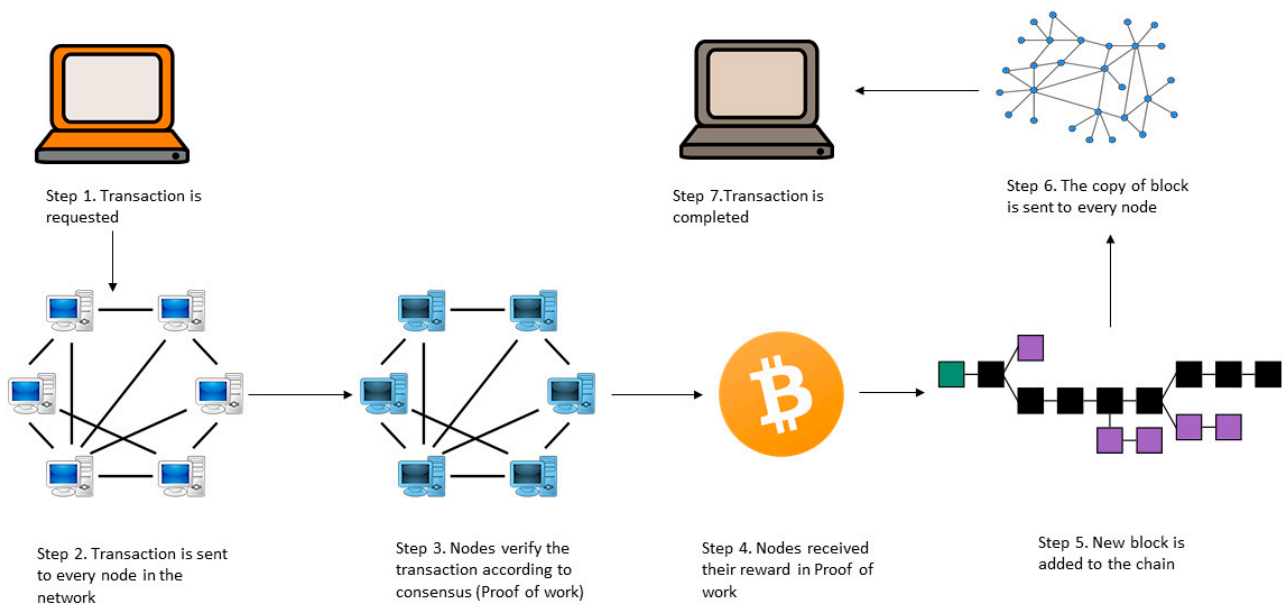


Figure 1. Blockchain Working Process.

In general, blockchain technology can be in public, private or consortium forms. The form implemented is entirely dependent on organizations and business requirements. Firstly, in a public deployment of blockchain, any participant can participate in the mining process, and transactions are validated anonymously. In other words, in public blockchains, the information is transparent to all the nodes in a network. With such transparency, this type of blockchain is secure because of the consensus algorithms. Bitcoin and Ethereum are the most famous examples of public blockchains. There are many applied examples of public blockchain in e-government. For instance, digital identities are used in e-government platforms for transaction purposes. A digital identity is a single identity assigned by the government to each citizen. Digital identity is extracted from the citizen's birth certificate, and transmitted and stored digitally. In this case, public blockchain is used to control, authenticate, and verify individuals' identity [46].

On the other hand, a private blockchain allows only specific users to enter the network. It has control over the access of keys and transaction requests. A private blockchain is more vulnerable to attack compared with a public blockchain. It requires payment for deployment and is more centralized than the public blockchain. Nevertheless, the private blockchain structure is adopted by many business and government organizations. The Dubai government, for instance, administers its house rental project through the Hyperledger private blockchain [30].

The third type of blockchain is a consortium, a hybrid of both public and private blockchain properties. The consortium blockchain is implemented in an electronic certificate-sharing system to achieve privacy and auditability over cross-border government services [47]. A privacy-preserving, consortium-based e-government infrastructure is closed and designed to share information among its stakeholders. A specific number of preselected nodes are allowed to work as users to validate the transactions. In an e-government consortium blockchain, each selected user has the right to create, access, validate, and review transactions. These types of consortia blockchains were, for example, used to overcome security and access challenges facing notarial offices in China [48].

There are several key risk factors that should be noted regarding the feasibility and suitability of blockchain governance. One is the availability of trusted hardware or IT infrastructure. Governments need a high degree of IT capacity; for example, ensuring that an endorsement key (EK) is burnt into every device to achieve a trusted network [11]. Another is the issue of privacy; blockchain was designed to protect the integrity of transactions; however, it is less focused on preserving the privacy of users. Hence, privacy issues of

citizens' private data in public blockchain databases could emerge [11]. Another risk factor is the energy requirements of large scale blockchain networks, especially public blockchains. For example, the processing power required for verifying transactions, known as Proof of Work (PoW), is very energy intensive. Despite its supposed immutability, blockchain remains vulnerable to security threats, including a 51% Attack, whereby a majority of miners gain control of hash power. This risk is mitigated by the huge scale required to attack a public blockchain [11].

Governments are now presented with various decisions and options, dependent on their specific requirements, before deploying blockchain for governance functions. These relate mainly to the relative needs for security, immutability, consensus determination, privacy, the consensus process, efficiency, or read permission. From the security point of view, a public blockchain is more immutable than a private or consortium blockchain, whereas there is a higher vulnerability to tampering in private and consortium blockchains. However, private and consortium blockchains are more efficient than a public blockchain, in terms of system performance.

In determining consensus, a public-type blockchain allows all miners to participate in the consensus process, the consortium type allows a selected number of nodes, and only one organization is permitted in a private blockchain [6]. Furthermore, the consensus process is permissionless in a public blockchain, whereas it is permissioned in the consortium and private types. Read permission is accessible to anyone in a public blockchain, while in the other two blockchains, it could be public or limited. Additionally, the blockchain concept of decentralization is fully implemented in the public blockchain, is partial in the consortium, and centralized in a private blockchain. More general users and governments, such as Oman, are, therefore, attracted to the features of the public blockchain, whereas the consortium and private blockchains (Hyperledger and Ethereum) are increasingly found in the business and private sectors [49].

Blockchain technology is fast gaining a presence in governance in the oil monarchies of the Arabian Peninsula. In fact, the Gulf Cooperation countries are establishing themselves to become a global hub for pioneering the technology. As mentioned previously, in the United Arab Emirates (UAE), entire government departments are being block chained [31]. Saudi Arabia also deployed the technology to upgrade the security of its e-government systems and public data. In previous years, the Saudi Arabian government worked with a centralized system and faced many internal and external threats [50]; as a result, there is a gathering momentum to comprehend the opportunities for similar countries, such as Oman.

6. Oman's Challenges in Providing Good Governance

In recent years, decreased oil revenues and rising unemployment forced Omani policymakers to make difficult decisions to overcome challenging economic and socio-political issues, which run counter to the rentier social contract. Omani authorities stated that "tough decisions" need to be made in these areas [51–53]. Key amongst these decisions is how to accelerate economic diversification and Omanization. In other words, how to quickly promote non-oil sectors and replace expatriate labor with Omani labor. This meant tackling the nation's 'rentier mentality' through the "reduction in the public sector workforce, the expansion of the private sector, and the curtailment of [government] subsidies" [54]. These policy reforms constitute the main pillars of Oman's Vision 2040 [55], which focuses on economic diversification into non-oil industries, reforming the labor market, and changing the way that the country develops its human capital and skills base [54].

Oman's problems in converting its impressive gains in governance since the 1970s into a sustainable system are not entirely the result of recent economic problems. Government officials admit that the country's public sector have been struggling with inefficiency, unproductiveness, and inflated operational costs for at least the last decade [56]. Therefore, by the time the new sultan, Haitham bin Tariq, ascended the throne in January 2020, there was an urgent imperative to restructure the public sector, enhance efficiency in public

institutions, and address the problem of rising unemployment. To his credit, and despite the unexpected calamity of the COVID-19 pandemic, measures for solving these structural problems were launched [57–59]. From our perspective, some of the most interesting steps taken in this direction involved investment in new technologies. The following sections elaborate the various issues identified above in Table 1.

6.1. e-Government and e-Services

Oman formulated an e-government strategy as early as 2003 [60]. This aimed to deliver government services in “an integrated and seamless way to foster an innovative approach” [61]. In other words, Oman’s plan for e-government envisaged the collaboration of all the government organs into a ‘whole-of-government’ approach to achieve efficiency, transparency, and effectiveness in government services. One salient tool in this regard is the ‘e-census’.

The e-census was announced in 2019 as “the first electronic [national] census without field visits” and which “requires Omanis and expats alike to update their information themselves” [62]. In this system, all information is stored on national statistical datasets, under such categories as population, housing, and establishments. Data from different ministries, government departments, electricity companies and municipalities should, in theory, be linked together in a single reference point [63]. Detailed information will be held about all Omanis and expats, based on the addresses of the properties they own or occupy. This would signify a major advance in the country’s capacity for accurate planning and provision of services, especially given the previously ad hoc and vague postal address system. However, it was shown that such hyper-centralized systems, while beneficial in many ways, create serious security and privacy vulnerabilities to cyber-attacks or system failures [12].

Another example of the desire for efficient e-governance was raised when the Oman government launched e-services to regulate the funding of mosques. In January 2021, the Undersecretary of the Ministry of Endowments and Religious Affairs (MERA) announced an electronic system for managing various information about mosques, including everything from building permits to ongoing maintenance [64]. According to the government, the next stage of this system will involve regulating financial resources to cover maintenance costs and to control charitable endowments [64].

6.2. Corruption, Fraud, and Attestation of Documents

Connected to the issue of tracking public funds is the sensitive topic of corruption. In January 2021, *Times of Oman* reported the results of the 2020 Corruption Perception Index Report, which showed the Sultanate ranked 49th in the world [65,66]. A review of previous media coverage on this issue showed similar reporting, seeking to show reductions in corruption and the government’s active role in this regard [67]. The establishment of institutions responsible for protecting public funds, especially, The State Audit Institute was linked with positive results in terms of fighting corruption [67].

However, a closer look at news covering fraudulent activities related to public funds reveals that the number of cases, in fact, increased in recent years. According to the Department of Public Prosecution, in 2016, the number of people accused of fraud and corruption was 112, which increased to 200 in 2018 [68]. Moreover, crimes related to public funds more than doubled from 55 reported cases in 2016 to 138 cases in 2017 [68]. Statements issued by the Public Prosecution Office, warning of long prison sentences for offenders, indicate a need for a stronger deterrent, and that embezzlement of public funds remains a serious problem in Oman [69,70].

Turning to another form of fraud, in recent years, government institutions in Oman faced problems involving fake academic certificates [71]. In 2018, the Ministry of Higher Education confirmed twenty false certification cases. In addition, Omani authorities identified thirty-nine fake universities worldwide, some of which had issued illegitimate qualifications to employees of Omani institutions (mostly educational) [72]. Besides the fraudulent

activity and question marks around quality and integrity that emerge, the procedures for accreditation of certificates and degrees are time-consuming, slow, and costly for both institutions and individuals. Moreover, as the above figures show, the current system of attestation of certificates via the responsible authorities (inside and outside Oman) is clearly not working. The authors know of some cases where the procedure for accrediting the qualifications of academic staff at Sultan Qaboos University were so slow and cumbersome that genuine, qualified international faculty decided against coming to Oman.

6.3. Labor Management, Omanization, and Employment

Over recent decades Omani authorities sought solutions to the high rate of unemployment among citizens. “Omanization” policies generally aimed to increase the role of the private sector in the labor market and to shift away from an overdependence on expatriate labor. Subsequently, the number of expats gradually reduced in both the private and public sectors [73], and legal arrangements were put in place for replacing foreign workforce with Omanis [74–76].

While Omanization aims to replace expats with Omanis, it led, in many cases, to the informal employment of foreigners [77] and created labor shortages in areas lacking skilled candidates [78]. It was argued that blockchain solutions can reduce complexity in recruitment processes by identifying qualified candidates and streamlining the recruitment procedures for citizens and residents [79]. Such blockchain-based systems could be applied to both the private and public sectors in Oman. In this way, accurate block-chained information on employers and the labor force can be utilized to know the number of qualified people needed in each sector, the extent to which this need can be met by Omani nationals, and the number of foreign workers required to fill any shortfall. This could also serve to address the problem of unobserved gaps in the labor force being filled by illegal informal labor.

Another recently adopted government e-service is a register for employment contracts via an online application provided by the Labour ministry [80]. Although the Ministry cannot intervene in agreements between employer and employee, all the details about the contracts are saved in the Ministry’s system to protect the parties’ employment contracts. One risk of this type of centralized digital employment contract register is that the government also links its own reputation to the upholding of contracts and becomes a de facto guarantor of employment agreements within an e-government portal (as opposed to normal channels of employment relations via courts and collective bargaining, for instance). Therefore, any breach or discrediting of the contract information may cause “the loss of users’ trust” and may ultimately harm citizens’ trust in the government.

6.4. Subsidy Reforms

Related to a longstanding political bargain in Oman, the government attempted to roll back its model of providing heavily subsidized energy, fuel, and water to citizens and residents. To minimize the socio-economic and possible political impact of ceasing subsidies, the government sought to implement targeted subsidies to low-income families. Omani authorities stipulated that the targeted subsidy system would result in no overall economic change for households earning less than 500 Omani Rials per month, whereas households earning more than 1250 Omani Rials per month would no longer qualify for subsidies [81,82]. The system will be administered under the National Electricity and Water Subsidy System [83,84]. However, the rollout of this new system faces immense challenges of complexity, transparency, and public acceptance in the context of citizens’ prior expectations around government support in a rentier state.

6.5. Tax Reforms

In the latter half of the 2010s, Oman experienced annual budget deficits due to persistently low oil prices, which were compounded by the economic shock of COVID-19. Subsequently, the Oman government was compelled to introduce major changes to its tax

policy to improve its balance sheet. These included increasing the corporate tax rate, eliminating tax exemptions, the introduction of a value-added tax (VAT), and in 2019, instigating a selective 'sin-tax' on goods, such as tobacco, alcohol, energy drinks, soft drinks, and pork products [85,86]. Most crucially, in the 2020–2024 Economic Plan, it was announced that personal income tax would be introduced from 2022 [87].

The government is hesitant in initiating these tax reforms. It was initially announced that VAT would be implemented in 2019 [88] but it was delayed twice before finally being launched in April 2021 [89,90]. The official reasons given for these delays were that the taxes required new legal regulations, new IT systems for administering taxation, and specialized training for tax officials [91].

Operating a new consumption-based VAT at the same time as initiating an entire PAYE personal income tax system promises to test the administrative capacity of the Sultanate. The complexity involved in the rollout of an entirely new tax system will be challenging and could lead to vulnerability to serious error or fraud [92]. The adoption of general taxation in the formerly tax-free (for individuals) Sultanate also carries a degree of political risk, which will only be exacerbated if serious errors or fraud occur that reduce public trust in the process of deriving and disbursing public funds.

6.6. Elections and e-Participation

The Oman government consistently states that it is working towards increasing the level of political participation in the Sultanate. To maintain the legitimacy of the existing institutional structures, the government is keen for citizens to actively participate, as well as feel that they are contributing to decision-making processes. This is especially important in the context of important changes to taxation, economic diversification, and Omanization. A key existing channel of participation is the elected lower house of Oman's parliament, the Majlis Al-Shura (Consultative Council).

Elections for the 86-seat Majlis al-Shura were last held in 2019 and electronic voting was used for the first time in Oman through the 'white card' system, which involved biometric identification via fingerprints. A remote voting application was also available for citizens residing overseas [93]. To use the mobile application overseas, voters needed a mobile SIM card, issued by an Oman-based mobile service company, and a Public Key Infrastructure (PKI) number [94].

The Oman Ministry of Interior stated that 349,680 individuals out of 713,335 registered voters cast ballots at 110 polling centers. A total of 52.7 per cent of those who voted were males and 47.3 per cent were women [95]. Only 25,000 voters selected candidates by using the white card option [96]. Election officials and voters reported problems in reliably and efficiently achieving biometric verification of voters' identity through fingerprint scanning [97]. Moreover, the experiment with mobile-phone voting applications led to concerns about the extent to which identity was reliably verified, as well as general security risks and system vulnerabilities. These issues served to reduce the integrity and the trust of participants in the e-voting innovations.

6.7. COVID-19 and Healthcare

Oman's struggle with the 2020–2021 global pandemic began on 24 February 2020, when two Omani citizens returned from Iran and tested positive for COVID-19 [98]. Subsequently, the government combatted the pandemic through a series of measures and restrictions, such as banning of movement around the country, closing borders to non-Omanis, banning public gatherings and Friday prayers [99], suspending public transportation [100], and closing educational institutions [101]. The economic impacts of the pandemic were severe and exacerbated the unemployment and recruitment problems outlined above.

The pandemic also highlighted issues with the governance and funding of public health services in Oman. On 24 March 2020, a public endowment fund was established to collect donations from individuals and companies to support the health sector [102]. Immediately, negative claims about the fund's transparency, legitimacy, and ultimate

beneficiaries were circulated in Omani social media, which the authorities were forced to publicly denounce as false [103]. It is impossible to know at this point whether there was any substance to the claims regarding the public endowment fund. The key point, however, is that lack of public trust reduced the efficacy of the collection effort.

7. Oman Government Perspectives on Blockchain Solutions

This section outlines the Oman government's attitude toward the adoption of blockchain technologies for e-governance, based on an interview via video conferencing with Dr. Ali Al Shidhani, on 7 April 2021 [51]. From the preceding review of recent and current e-governance-related issues in Oman and the academic literature regarding blockchain solutions, there is evidence of the potential of blockchain technologies. However, the question remains whether the government is open to the idea of adopting technology that promises to (1) decentralize governance in a way that is almost diametrically opposed to the centralized-governance model, established since the mid-1970s, and upon which Oman's implicit social contract rests; and (2) whether the nature of blockchain, which vastly reduces the need for human interventions in governance and administration, will only exacerbate the country's recurring problems with unemployment-related social unrest [104].

Clearly, there is significant government interest in the possible benefits of blockchain in Oman. This is increasingly evident since the first Blockchain Oman Symposium in Muscat in November 2017, which two of the authors of this study attended [105]. The government-sponsored *Blockchain Club* and a company named *Blockchain Solutions and Services* were both announced at the same Symposium. The Central Market Authority (CMA), the entity responsible for the stock market in Oman, is already using blockchain for voting in its annual general meetings (AGMs). In the private sector, Bank Dhofar [106] is already using Ripple for financial transactions and the Port of Salalah is a member of the global logistics blockchain consortium, Tradelens [107].

The government attitude to the emergence of blockchain was clear in the comments of Dr. Al-Shidhani. It was emphasized that the government is open to the benefits of blockchain. However, it was indicated that the government intends to proceed judiciously and more gradually than their neighbors in the UAE, who, as mentioned previously, stated their objective to move much of their e-governance onto blockchain. The Omani government intends to use it selectively and "in specific applications and specific situations" [51].

It was also indicated by Dr Al-Shidhani that a number of Omani government officials responsible for information and communication technologies (ICT) are well informed and aware of its potential applications. However, at the broader level of government and the general public, there is little informed awareness of blockchain, with an estimated level of awareness of informed awareness of around 25 per cent with much capacity building yet to be achieved. There is, however, an emerging awareness of the potential of blockchain, with increasing demands for tertiary education and postgraduate research into blockchain. Seminars and workshops are increasingly being offered at Sultan Qaboos University and at private universities [51].

Regarding political participation, there is openness to the idea of adopting blockchain solutions. When asked whether the Omani government might consider adopting blockchain for its elections, Al-Shidhani [51] responded:

Yes, I think, it's an option . . . Technology must be introduced to fill gaps, to solve problems, to expedite processes and so on. If the current voting system . . . is malfunctioning or there are weaknesses in the current voting system and those weaknesses can be addressed by using blockchain, then, yes, blockchain should be the way to go. Just like what [the] Central Marketing Authority did when they introduced blockchain voting in annual general meetings of companies.

Regarding the question of the decentralizing nature of blockchain and how this could represent a complete turnaround from the centralized nature of Omani governance and state–society relations, the response of the government official is worth quoting in full.

We have a problem of centralization, and we want to decentralize. Decentralization can be done through proper laws, regulations, delegation of authority and so on. There are some structural and regulatory frameworks that need to be put in place. If technology, like blockchain, can be used to help in this direction, it will be used. If other technologies can also be used to help this, it will also be used. I just try to be careful not to draw a direct line between what we want to do in the country in terms of decentralization with a technology known for decentralization. . . . So, maybe usage of blockchain should not be [greatly] associated with [the] decentralization efforts that the government wants to [achieve]. Maybe the usage of blockchain is associated more with authenticity of information, with legitimacy of data, with tracking and immutability . . . I think that is where there is more linkage to Oman than decentralization aspects [51].

Finally, we turned to the question of how blockchain might impact employment issues in Oman. It was undisputed that the adoption of blockchain as a platform for e-government would lead to the redundancy of many administrative roles within the public sector that traditionally employed large numbers of Omani nationals. In theory, however, this replacement of manual governance services with digital blockchain e-governance aligns with government priorities. Over the last quarter-of-a-century the Oman government repeatedly emphasized a desire to reduce the size of the public sector and to boost the share of the private sector in the labor market and overall economy. This was part of the country's Vision 2020 and Vision 2040 strategic plans, promoted, respectively, since 1995 [108]. Moreover, government representatives are confident that the transition to new technologies, including blockchain, should not be delayed due to fears of a negative impact on the labor force. Again, it is worth quoting, in full, the response of Dr Al-Shidhani on this issue of technology and employment.

There is this philosophical debate about technology versus job creation, and how technology will eliminate jobs and introduction of technology will also introduce jobs but what would be the net result? Are we going to end up with more jobs than eliminated jobs? Or the opposite? Other jobs, other periphery jobs, are created because of the introduction of the technology. And, in my opinion, I don't think it is going to have a big impact because I believe that new technologies introduce new types of jobs [51].

8. Discussion

Data collected from news media between 2018 and 2020 revealed seven governance issues (excluding education, which we omitted) that can be deemed important governance issues requiring further academic attention in the Oman context. These were: public sector reform and e-services; issues of employment; taxation; public healthcare; elections and e-participation; corruption, fraud and attestation of documents; and reforms to public subsidies. This section discusses how blockchain technology may offer solutions, but also introduce risks, in each area.

8.1. Blockchain Technology, Public Sector Reform and e-Services?

Oman wants to reform its public sector and increase the efficiency, public uptake, and trust in e-services. By using blockchain technology, sensitive information and the private data of Omani citizens and residents could, in theory, be stored securely against unauthorized access, alteration, or system failure. Looking at the example of public endowments raised above, studies showed that blockchain-enabled charitable services can enhance tracking and accounting for donations, creating transparency for both beneficiaries and contributors [16]. In this way, the trust of contributors in the endowments system can be sustained, which could, in fact, attract more people to contribute to endowment funds, reducing pressure on the government to provide for the construction and maintenance of religious infrastructure for a growing population. A risk factor for block chaining e-services in government could be privacy issues of personal information within public blockchains [11].

8.2. Blockchain and Employment Issues

This is arguably the most critical risk area in terms of blockchain solutions. Potential blockchain applications include plans to establish a public block-chained employment contract register in Oman. This would be far less prone to failure and related problems. Another blockchain-based option would be for employers and employees to enter bilateral blockchain-based 'smart contracts' that do not require any government involvement. Overall, the job market in Oman will increasingly be impacted by technologies; not only blockchain, but also other automation systems, including Artificial Intelligence (AI) and robotics [109,110]. The high number of public sector jobs, mostly in administration, that underpin the redistributive model of Oman's rentier social contract will rapidly be made redundant by such technologies and could swell the ranks of the unemployed in the short to medium term. Hence, there is an urgent need for high-level technical training and re-skilling of Omani citizens to align Omanization policies with a rapidly changing work environment.

8.3. Blockchain and Taxation Reform

In the blockchain literature, it is asserted that a blockchain-based tax system can be effective in virtually eliminating tax fraud and increasing transparency in the allocation of public funds [111]. Moreover, collecting tax via blockchain-based models can eradicate double spending, reduce the potential for fraudulent tax refunds, and will "automatize a great part of the work previously conducted manually" by tax employees ([111], p. 453). This final point relates to the previous issue regarding employment—the double-edged sword of blockchain—whereby much-needed efficiencies also come at the expense of public sector jobs that formed one pillar of the rentier social contract.

8.4. Blockchain and Public Healthcare

As discussed above, regarding corruption, the immutability and transparency of a public blockchain could have prevented negative public perceptions of public health funding and could have mobilized much-needed public funds more effectively to help the government tackle the pandemic. In terms of healthcare and public health provision, especially during health crises, recent studies focused on responses to the pandemic that highlight endemic limitations of healthcare systems around the world. As a result, a consensus is emerging around the utility of adopting new technologies, such as blockchain and AI in healthcare, to fight the current pandemic and future outbreaks ([112], p. 1). This argument is based on claims that blockchain will be effective in preventing and responding to pandemics by "enabling early detection of outbreaks, [whilst] protecting user privacy, and ensuring reliable medical supply chains during the outbreak tracking [sic]" ([112], p. 1).

8.5. Blockchain, Elections and e-Participation

E-voting systems continue to be questioned in emerging studies. Issues include a lack of standards, security and reliability risks, vulnerability to attacks, fraud, malicious software programming, costly technical tools, and secure storage of transactions [13]. Blockchain-based e-voting [113] is currently being discussed as "the next generation of modern electronic voting systems", largely due to its immutable features ([13], p. 2). In theory, by applying public blockchain technology to e-voting systems, confidentiality, anonymity, and accuracy of results would be ensured. Consequently, trust in electoral processes and, therefore, participation rates, might increase, enhancing the overall legitimacy of elections and political participation [13,29].

8.6. Blockchain and Corruption, Fraud and Attestation of Documents

The literature on blockchain-based solutions shows clearly that the transparent, decentralized, and cost-effective features of blockchain technology can reduce crimes involving public funds [15]. With transparency and immutability of accounting almost guaranteed via blockchain-based technology, it could be expected that the number of crimes committed

in this area could decrease. To overcome issues related to storing and managing credentials, there is evidence that blockchain-based applications may provide “a sustainable record of achievements” for users and vastly reduce administrative, reputational, and recruitment costs for universities and colleges [18]. In this area, optimum efficiency would be achieved by interfacing or integrating with global blockchains of academic achievement and qualifications to instantaneously and securely attest the qualifications of the large number of international recruits into the Omani education sector. At the time of writing, as far as we know, such a system is yet to be established.

8.7. Blockchain and Reforms to Public Subsidies

Applying blockchain to potentially complicated and politically risky subsidy reforms could have benefits. For instance, block-chained and means-tested systems for targeted subsidies could be more manageable, transaction costs would be minimized and, most importantly, the potential for corrupt exploitation of the subsidy system would be reduced [16]. In short, the application of a public blockchain to subsidy-reform measures could save money, eliminate errors and fraud, and ultimately enhance the intended effect of assisting more low-income families in need of social transfers. Similar to other e-services, privacy issues would need to be addressed in this area.

8.8. General Issues with Blockchain in the Oman Context

Early indications from the Oman government suggest that they intend to use blockchain to address technical weaknesses in existing systems, such as the verification issues described around e-voting. It would certainly help in this regard. However, there seems to be little attention given to the more intangible impacts on the legitimacy and perception of electoral processes if they were to be conducted through immutable and transparent public blockchain technology. In terms of procedures for running elections, Oman is one of the best in the Middle East, in terms of global rankings on electoral integrity [114]. Consequently, there is not an actual problem with the technical conduct of elections. There is, however, a problem around public perceptions of the elections. (This view is based on numerous private conversations with Omani citizens by the first author from 2013 to 2019.) There is not a high level of trust in the process, or the candidates themselves. Blockchain, by its very nature, cannot be manipulated easily and should in theory increase public trust and, therefore, increase public participation in elections. Nonetheless, the point raised by Praharaj et al. [24,25] that digital infrastructure is not necessarily a guarantee of improved self-participation or, for that matter, a substitute for substantive governance transformation is salient.

The notion of implementing a decentralizing technology amid a highly centralized rentier state is interesting in that there remains a government perception that decentralization of the overall government structure is a separate issue from the way that blockchain could decentralize every aspect of governance. For instance, by adopting public or even consortium blockchains in the various departments and agencies of government, it would naturally mean less capacity for centralized actors—directors, under-secretaries, ministers and so forth—to exercise discretionary authority in decision-making and in the presentation (or not) of information and policies to the public. The cumulative effect of this across different government sectors would, naturally, be decentralizing.

Moreover, the decentralizing effect would not necessarily stop at the borders of Oman. For instance, the UAE and the Kingdom of Saudi Arabia are exploring shared cryptocurrencies for cross-border payment systems [40], as well as a “Court of the Blockchain” for cross-border jurisdiction [115]. The fact that blockchain will necessarily assume cross-border dimensions was acknowledged by the government official, when he mentioned in relation to attestation of domestic and international qualifications that, the essence behind blockchain is that entrusted entities can join a network through blockchain. As a result, this ecosystem of entrusted networks is global. The networks are not within the domain, or they are not [limited to] the geographical area of one country. Indeed, for a blockchain system

to be successful, it must be global. Furthermore, it must encompass most, or a majority of, stakeholders.

In terms of employment issues, the teleological perspective that technology adoption leads to new forms of labor demand does not necessarily consider: (1) the unique features of rentier systems, which operate quite differently from other types of diversified market economies and (2), the fact that Oman faces urgent pressures from unemployment at the present time.

In 2011, civil unrest occurred across Oman, largely related to the frustrations of unemployed (or underemployed) youth, who demanded more jobs and higher salaries; essentially, a larger and more transparent share in the dividends of the oil-based rentier economy [116]. The government's response to these pressures was to quickly announce the creation of up to 50,000 new jobs, mostly in the public sector, increases to the minimum wage, and jobseeker allowances to appease the protesters [117]. Ten years later, similar protests occurred in late May 2021, to which the new sultan was forced to respond in similar fashion with a promise of 32,000 additional jobs (many of which are temporary or part-time), spread across the public and private sectors [118].

Two key points are salient in this regard. First, the government faces political obstacles around implementing its Vision 2040 plan [119] to reduce the size of the public sector, due to persistent public demands for the government to uphold the main pillars of the rentier social contract jobs, subsidies, and zero taxation. This will consequently make it difficult to use blockchain solutions to shore up and enhance e-governance in the short term, as this would inevitably involve the redundancy of many administrative roles in government. Second, the demand for "side jobs" related to new technologies, such as blockchain, will require precious time to develop and will require rapid re-skilling and restructuring of the labor force, as well as raising public and governmental awareness (not to mention willingness) to move away from traditional, highly centralized public sector models.

9. Conclusions

The results of this exploratory phase of a sequential mixed-methods study suggest that there are potential advantages to be obtained for Oman from being an early mover into blockchain e-governance solutions. Data collected from news media between 2018 and 2020 revealed seven governance issues (excluding education, which we omitted) that can be deemed important governance issues requiring further attention. These were: public sector reform and e-services; issues of employment; taxation; public healthcare; elections and e-participation; corruption, fraud and attestation of documents; and reforms to public subsidies. We examined each of these areas and consulted the international literature on blockchain pertaining to each. Our results indicate that, in theory, substantive potential exists for blockchain solutions to enhance the efficiency, cost effectiveness and legitimacy (public trust) of public administration and governance functions in Oman. However, in accordance with phase two of a sequential mixed-methods design, targeted quantitative studies must be conducted into each of these issues to determine a greater degree of knowledge regarding the cost/benefit calculus. All these public governance areas need to be quantitatively examined to test potential for greater cost efficiencies, improved accuracy and reliability of information systems, transparency and accountability of public services, and an upgrade in the overall level of legitimacy and public trust in the institutions of governance.

The most critical areas highlighted as foci for future research in the Omani context are the question of employment, where blockchain could have negative impacts on an already stressed labor market, and the politically explosive question of taxation reform, both of which lie at the heart of the rentier bargain of Oman and other GCC states. The belief of the Oman government officials that new work opportunities from new technologies, such as blockchain, can offset the reduction in the traditional public sector should be tested using quantitative predictive data analysis. Moreover, while the government seems aware and open to the possible benefits of blockchain solutions, it may face political resistance to the

replacement of a socially constructed system of trust—based on a centralized state and a rentier system—with a technologically constructed and decentralized mode of creating trust based on technology. This area requires further research by social scientists. In sum, while there are many good reasons why Oman should adopt blockchain solutions in the immediate future, it remains to be seen how the encounter between old social contracts based on “Leviathan” or new social contracts based on “Nakamoto” will unfold.

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