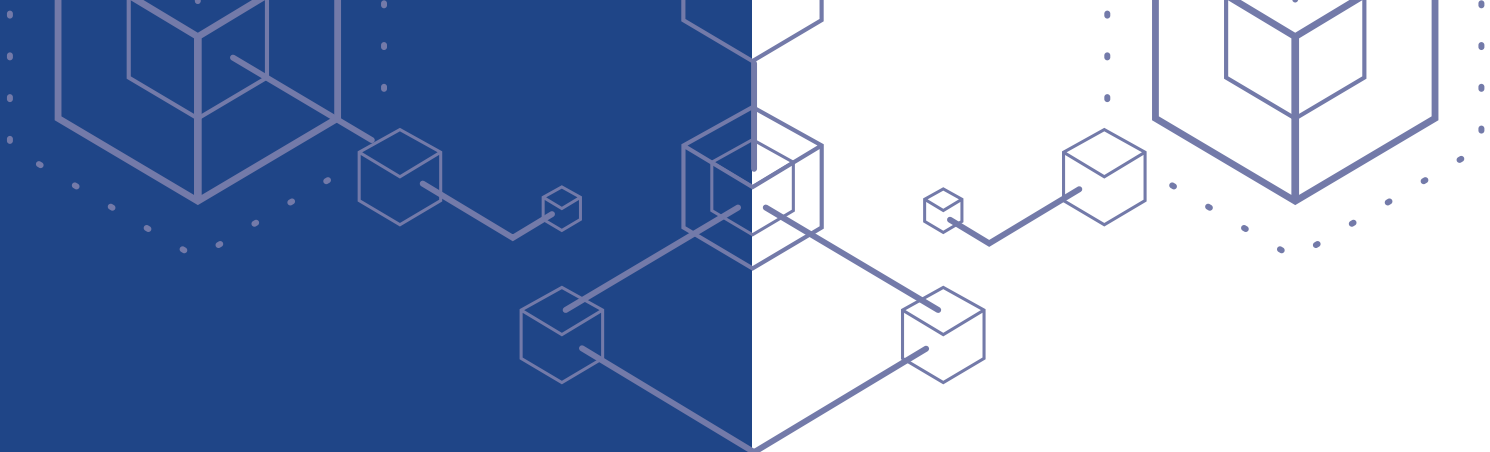




NATIONAL BLOCKCHAIN BLUEPRINT FOR QATAR

April 2022

This document was collaboratively produced by Communications Regulatory Authority, Hamad Bin Khalifa University and Qatar University



NATIONAL BLOCKCHAIN BLUEPRINT FOR QATAR

April 2022

This document was collaboratively produced by Communications Regulatory Authority, Hamad Bin Khalifa University and Qatar University



TABLE OF CONTENTS

1. Executive Summary	3
2. Introduction	4
3. Blockchain Technology	4
3.1 Blockchain Categories	5
3.2 Benefits	6
3.3 Challenges	7
4. Regulatory Foundation	8
5. Adoption Foundation	10
5.1 Pilot Projects	10
5.2 Start-ups and Businesses	10
6. Innovation and Creativity	11
6.1 Infrastructure	11
6.2 Skills Awareness	12
6.3 Education	12
7. Opportunities For Qatar	14
7.1 Government Services	14
7.2 Smart Cities	15
7.3 Energy	15
7.4 Health and Sports	15
7.5 Fintech	16
8. Conclusion	17
9. References	18

1. EXECUTIVE SUMMARY



The National Blockchain Blueprint highlights how the blockchain technology can contribute to building an innovative and growing IT sector in Qatar increasing domestic and foreign investment as stated in the CRA Strategy 2021–2025, to supporting Qatar National Vision 2030 (QNV) and Qatar National Development Strategy, as well as to enabling a seamless transition towards smart Qatar.

This blueprint underlines the potential of the blockchain technology and the opportunities that it can offer to the State of Qatar, identifies key blockchain requirements, and provides a set of recommendations towards achieving the following key objectives:

- 1.** Identifying and building an efficient regulatory foundation for blockchain,
- 2.** Creating a solid foundation for the government’s approach to blockchain, and
- 3.** Creating and enabling a supportive environment for creativity and innovation.

Qatar needs a comprehensive blueprint to facilitate blockchain

adoption, which can support the national vision and goals and to achieve the desired growth and prosperity in a knowledge-based economy. As illustrated in Figure 1, this blueprint establishes the frame for blockchain at national level and identifies its key elements.

Development of a solid regulatory framework is essential for enabling the investment environment and creating a strong industry and adoption of emerging technology. The regulation is not only important to protect users and ensure security, but also to provide the adequate legal framework that allows blockchain innovation and adoption. This can be achieved by identifying the different domains of blockchain-based services, their associated regulatory requirements and appropriate regulatory approach to serve each domain. Moreover, this document outlines the necessities and incentives that must be provided by each sector for the technology adoption that will allow startups, pilot projects and new companies to emerge. Lastly, lays out the basics for enabling a conducive environment for creativity by upgrading the

infrastructure, bringing expertise and competencies, and improving the education system to include emerging technologies in the various stages of education. The blueprint examines the most prominent opportunities that blockchain could bring to various governmental and

business sectors to support QNV and build Smart Qatar. It also carefully identifies the corresponding blockchain requirements and issues that need to be addressed, including regulation, infrastructure, and awareness level. Finally, based on the considered opportunities

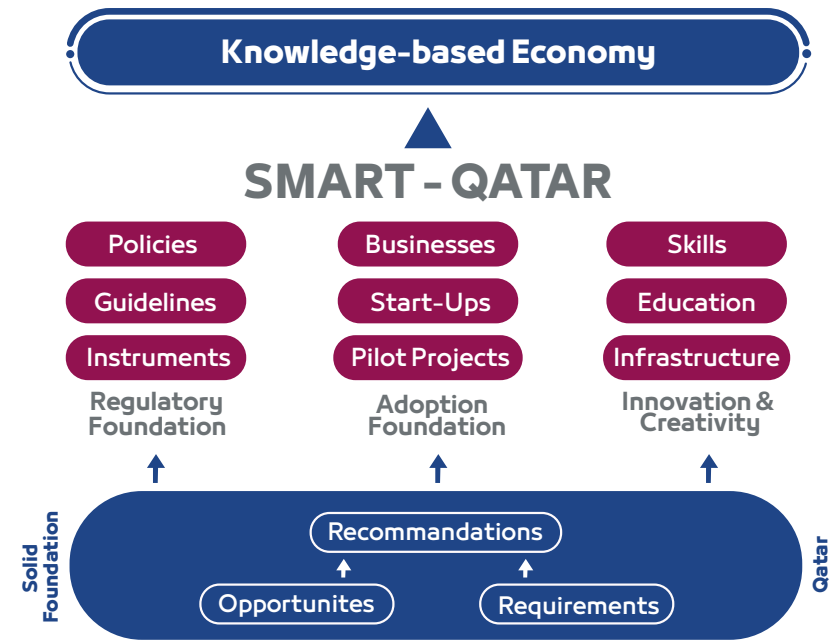
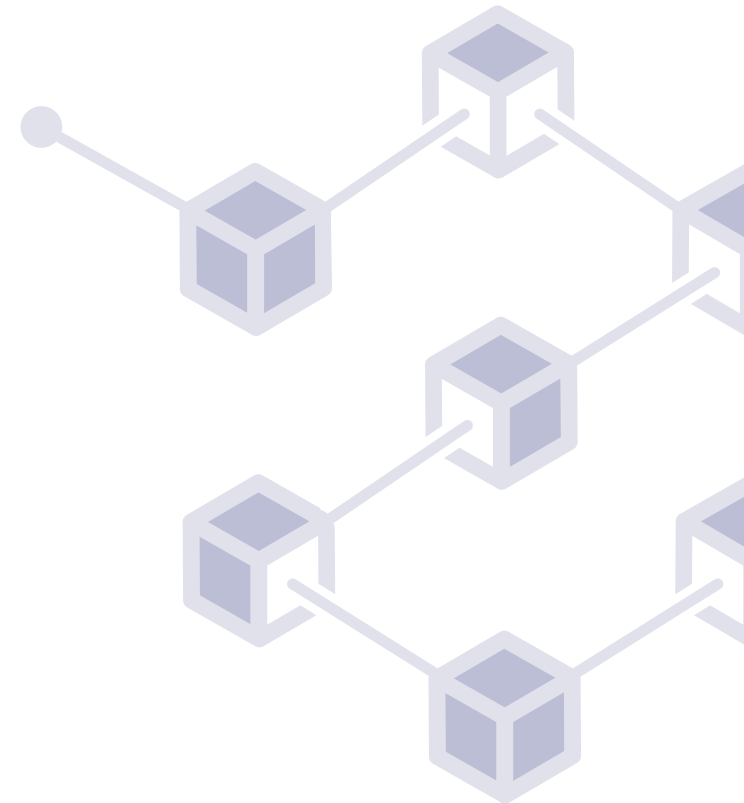


Figure 1: National Blockchain Blueprint

and requirements, provides the necessary recommendations for blockchain adoption inside Qatar.





2. INTRODUCTION

The State of Qatar has an ambitious National Vision 2030 roadmap for economic growth and social development, which includes a specific objective to develop world-class technology infrastructure and services to enhance the quality of life and help grow the economy in Qatar. As a promising advanced technology, blockchain can play a key role in shaping the future of many businesses in Qatar with efficient, secure, and cost-effective transactions.

Globally, recent years have witnessed a growing interest in blockchain. It was an important topic in the World Economic Forum's annual meeting in Davos [1], also Cisco has estimated that 10% of global GDP will be stored on blockchain by the year 2027 [2]. Gartner predicts that by 2025, the business value added by blockchain will grow to over \$176 billion, surging to over \$3.1 trillion by 2030 [3]. Outlier Ventures says that over the first half of 2019, blockchain-based startups raised \$822 million from 279 separate venture capital deals, with 159 investments made through seed funding rounds.

Leading economies like Australia [4], Germany [5], and India [6], in addition to others, have already developed strategies to adopt blockchain technology in governmental and private sectors. A clear state-wide strategy regarding emerging technologies and entrepreneurship will sustain the strategic position of Qatar regionally and internationally through economic diversification.

Qatar could also be one of the leading countries in fostering Blockchain innovations. With the country's small size and population, Qatar has a unique opportunity to capitalize on available resources and to interconnect governmental and private organizations for efficient, secure, and fast data exchange in different sectors such as healthcare, industry, energy, and education, which would have an enormous impact on sustainable development.

Blockchain is a technology that fundamentally transforms the way transactional systems operate by moving from a centralized to a decentralized model that is more secure, transparent, and cost-effective. Blockchain has the potential to disrupt existing businesses and drive new ones by eliminating the need for intermediaries.

Basically, blockchain technology is a data structure that is organized as a chronologically ordered list of "blocks" that are cryptographically

"chained" together, making it tamper-proof (permanent). A block is a data container that is appended to the ledger only if a majority of participants come to an agreement (consensus) on its validity. The distributed nature of the blockchain eliminates the risk of a single point of failure, and its tamper-proof property ensures that blocks cannot be improperly manipulated or forged, which enforces the overall security and increases transparency. Figure 2 illustrates in a step-by-step view how does blockchains work:

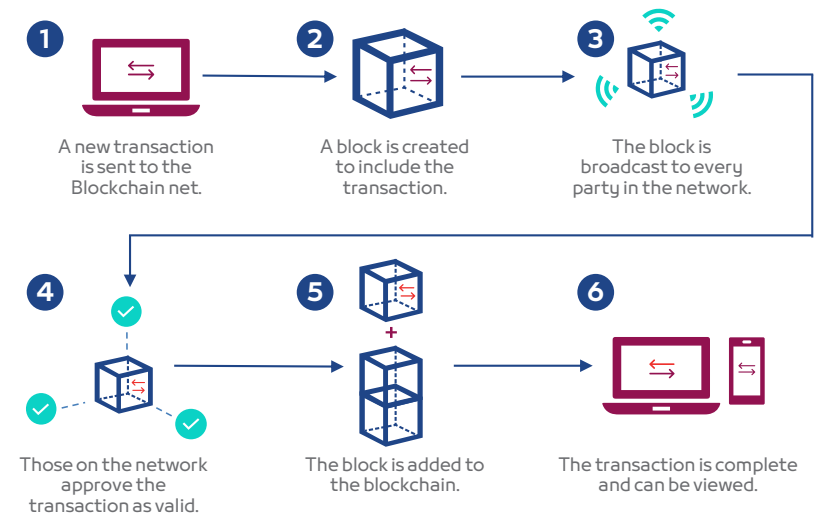


Figure 2: How does blockchain work?

3. BLOCKCHAIN TECHNOLOGY

3.1 Blockchain Categories

From a security and access control perspective, blockchain can be categorized as: 1) public, 2) private, or 3) Hybrid/Consortium, based on whether the ledger can be accessed by anyone or only by known/restricted participants. Public blockchain allows everyone to participate with no control and with no identified ownership, and hence, will be suitable for certain public applications and

services such as cryptocurrencies, and some public health services. Private blockchain, on the other hand, provides more control from a single network owner inviting participants to read/write from/to the ledger. The hybrid category facilitates the interaction between a consortium of entities with specific access control to set who can read/write. Figure 3 below summarizes the general differences between these three blockchain categories.

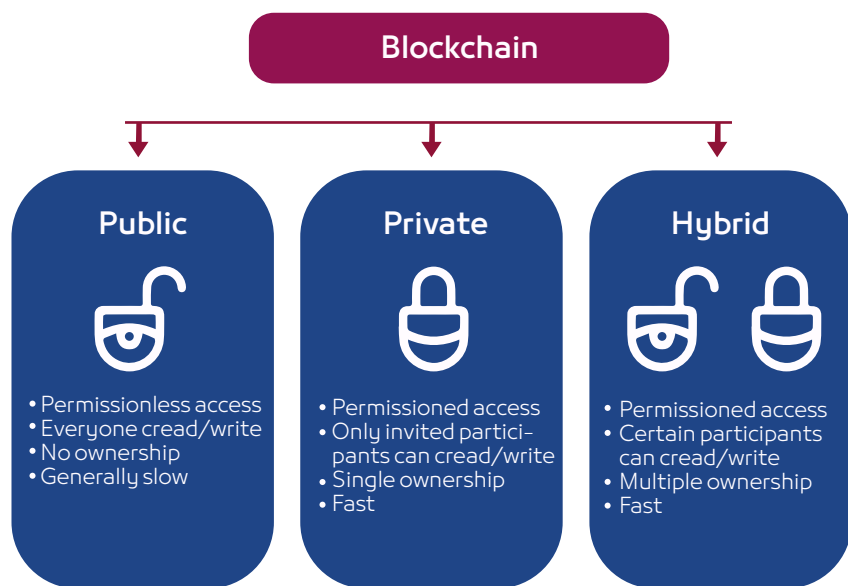


Figure 3: Blockchain Categories

Recommendation:

- As most of the applications in different domains require some level of ownership and access control, both private and/or hybrid blockchains should likely drive the adoption of blockchain in governmental and private sectors in Qatar.
- Public blockchain adoption should be limited to applications that do not require ledger access restrictions and/or ownership privileges such as cryptocurrencies, and some public services.
- The adoption of a particular blockchain type, should also consider its environmental impact in term of energy consumption and carbon footprint. Some of the public blockchains, such as Bitcoin or similar cryptocurrencies, are known to have huge appetite for energy, often compared to the annual consumption of an entire country. In the other hand, private, consortium blockchains and even some of public blockchains, which use a completely different structure than the traditional Bitcoin, have a much lower carbon footprint and

energy consumption. Moreover, considering renewable energy sources to power blockchain networks will significantly reduce carbon footprint.

3.2 Benefits

The way blockchain solves the problem of trust among untrusted parties, without relying on any kind of intermediaries, has the potential to improve and enable new transaction-based businesses across almost every industry. It facilitates direct interactions between untrusted entities, enhances security, reduces costs, improves traceability, and increases efficiency and speed. Such a technology is going to be impactful in many government and private sectors. The main key benefits of blockchain are summarized in Figure 4.



Security by design:

Blockchain removes the single point of failure vulnerability, prevents transactions from being altered, and safeguards data integrity on the ledger.



Enable value-exchange transactions:

Blockchain carries the potential to become a new standard for the exchange of value between connected peers while being significantly faster, cost-effective and less complex.



Improve traceability and auditability:

Blockchain provides immutable proof of the audit trail and transactions. This makes transactions easily traceable, verifiable and prevents frauds even in complex businesses.



Deliver cost savings:

Blockchain, with its distribution nature, append-only feature and a consensus mechanism, eliminates intermediaries and consequently, remove their related transaction costs.



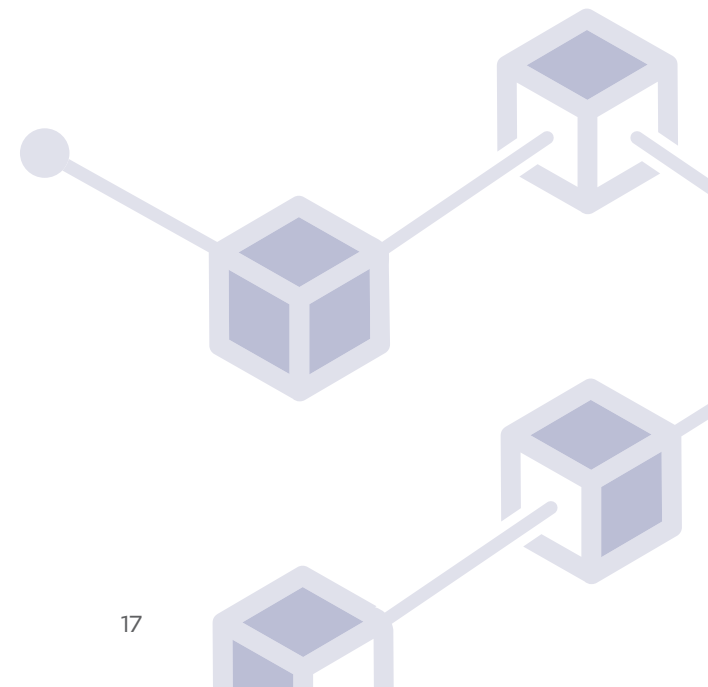
Enable automation with self-enforcing contract capability:

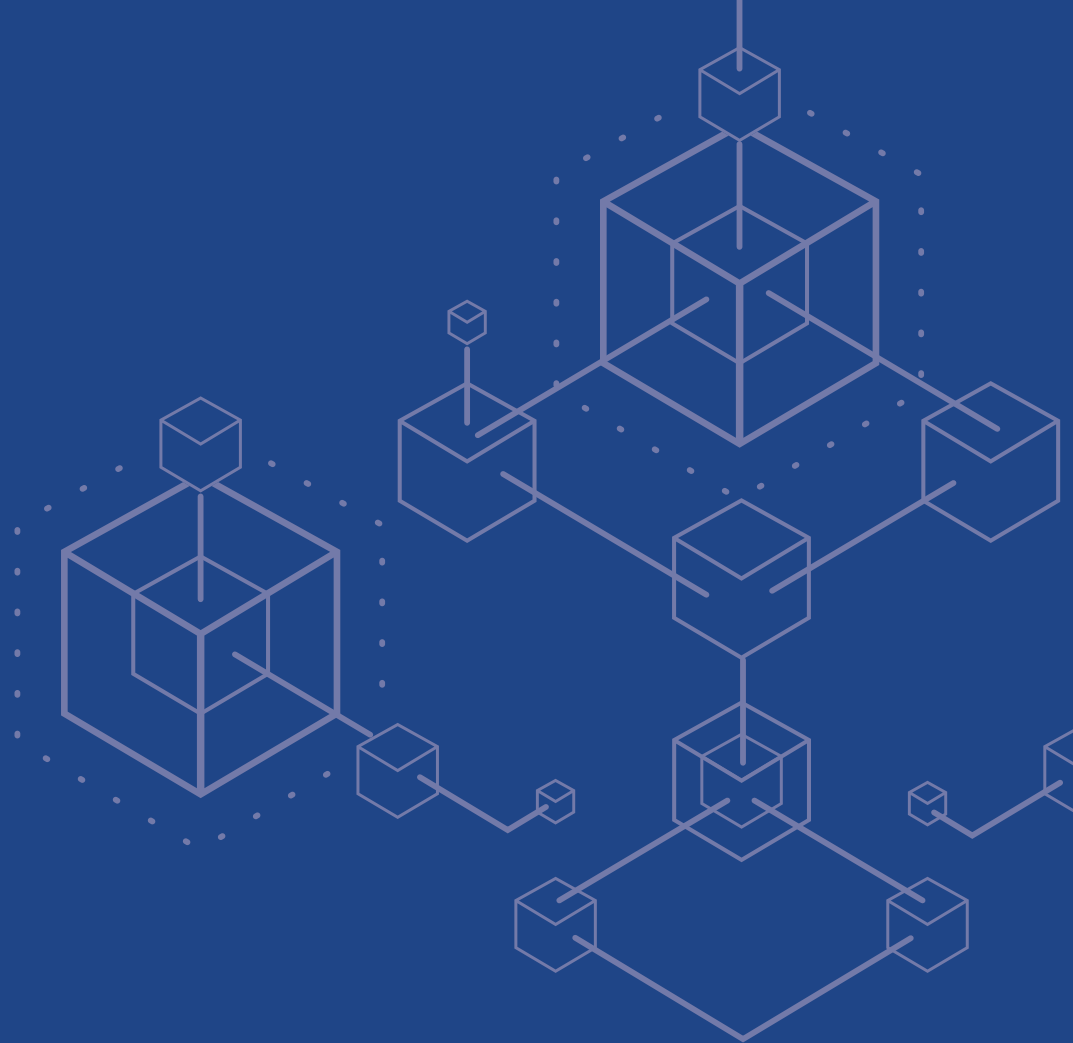
Blockchain supports the execution of smart-contracts, which are independent and irrevocable to self-enforce rules of digital agreement between any business entities or parties.

Figure 4: The key benefits of blockchain

3.3 Challenges

Despite blockchain benefits, there are some challenges that need to be carefully considered and addressed, as those may become barriers for the successful adoption of the technology by the different governmental and economic sectors. These challenges include the lack of (1) awareness and ICT skills needed to develop and customize the technology for different sectors, (2) laws and regulations that govern the adoption and usage of blockchain in governmental and private sectors, and (3) critical infrastructure and standard platforms for rapid blockchain service provisioning.





4. REGULATORY FOUNDATION

Regulatory setup is not concerned with the technology but rather with the actions of the parties involved in providing or using the technology-based services [8]. In the case of blockchain technology there are several common aspects of the technology-based services that need to be addressed in the regulations, mainly to comply with local, regional and/or international laws. Some of the most common examples of these are (i) the ability to remove data based on the request of authorities/legislation, which is restrained by tamper-proof property, and (ii) the ability to identify individuals' accountability for specific

transactions, which is also limited by anonymity feature [9]. In addition to the common services aspects, there are service domain (use case) specific regulations that are handled by the identified domain regulator. As shown in Figure 5, each use case would require a different regulatory approach. Based on the use case defined by the sectors/industries, a suitable regulatory approach can be taken such as the development of policies, guidelines, regulatory instruments, or framework. CRA can support in issuing the required regulatory instrument (or tool) to facilitate the adoption of the blockchain technology.

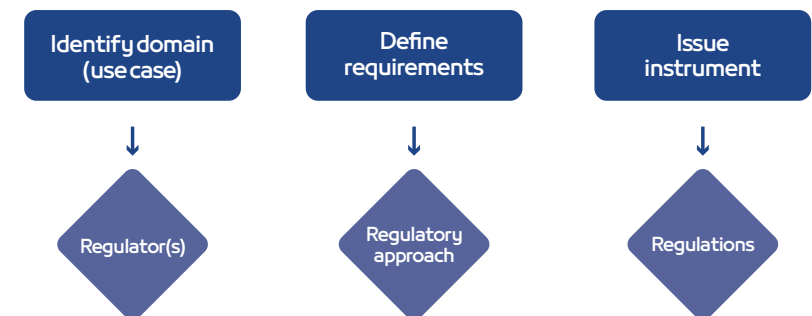


Figure 5: Regulatory Foundation

4. REGULATORY FOUNDATION

In the blockchain industry, regulators have demonstrated being a segment of stakeholders which appreciates that blockchain is here to stay. Therefore, there has been a substantial move worldwide towards regulating blockchain technology usages. Among the key areas considered are Distributed Ledger Technology (DLT), smart contracts and other digital assets.

The regulatory role, as mandated by the European Union Blockchain Observatory and Forum in [9], is: "Regulators should provide guiding principles to attract private-sector investors, ensure consumer protection and citizens' rights, and provide safeguards against anti-competitive practices." The authors in [9] propose eight guiding principles to regulators for their move towards this mandate: (i) Craft simple yet usable definitions of the technology. (ii) Communicate legal interpretations as broadly as possible. (iii) Choose the right regulatory approaches for the question at hand. (iv) Harmonize the law and interpretations of it. (v) Help policy makers develop an

understanding of the technology. (vi) Work on high-impact use cases first. (vii) Closely monitor developments in less mature use cases and encourage self-regulation. (viii) Make use of blockchain as a regulatory tool.

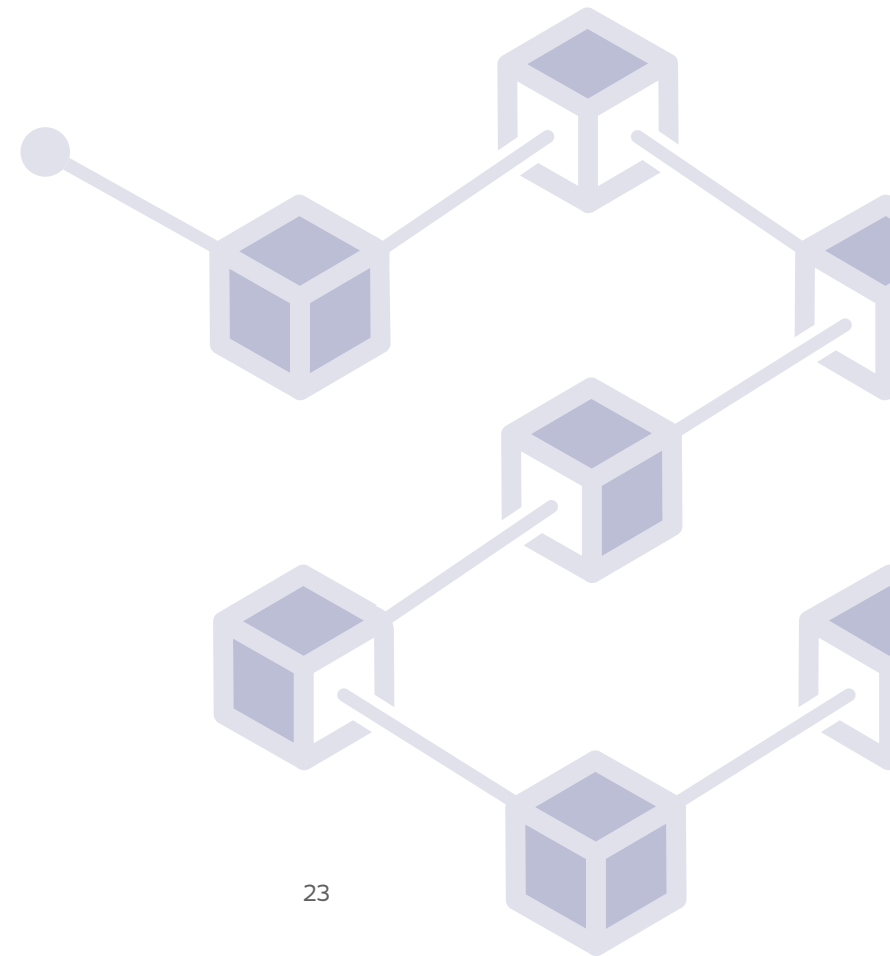
In Qatar, the key stakeholder government entities that needs to be involved in the regulatory activity of blockchains are envisioned to be Qatar Central Bank (QCB), typically in cryptocurrency, financial transactions and Initial Coin Offering (ICO), Qatar Development Bank (QDB), for regularizing investment related activities and providing incentives for blockchain technologies; Ministry of Communications and Information Technology (MCIT) with its Innovation Center for blockchain technology; and Ministry of Justice, for formalizing the legal framework, National Cybersecurity Agency, for data classification and cyber security. Of course, several other government and private sector entities will need to be involved based on the domain of application.

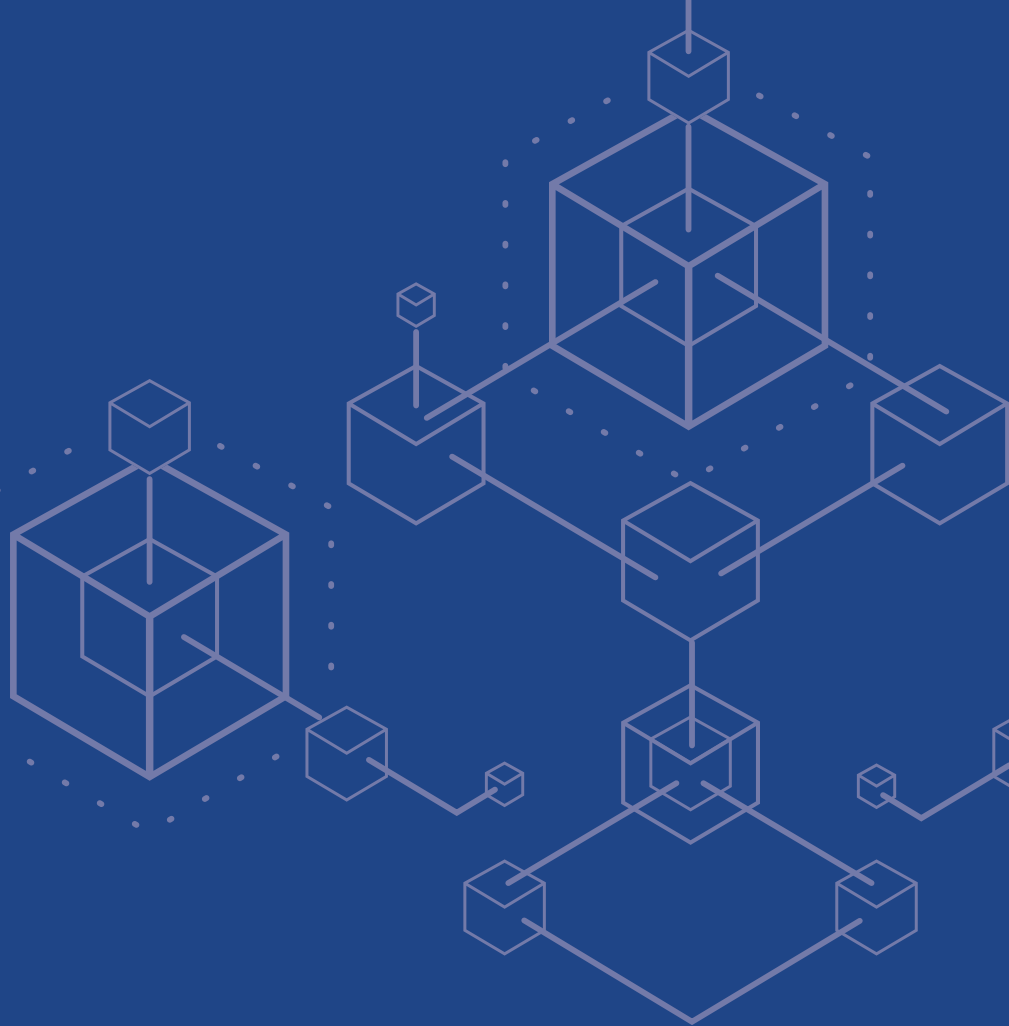
Recommendations:

- Establish a national regulatory foundation guide in the form of a study of the common services' regulatory requirements alongside benchmarking with relevant international examples.
- Engage different potential stakeholders and regulators

in an open discussion about potential technology use cases and their associated regulatory requirements.

- Establish a country-wide initiative in the form of a government-lead consortium with wide involvement from the private sector to kick-off the creation of country strategy as well as initiate and coordinate the regularization activities.





5. ADOPTION FOUNDATION

One of the goals of this blueprint is to define the necessities and incentives that must be in place to adopt the technology that will allow startups, pilot projects, and new companies to emerge.

5.1 Pilot Projects

As a relatively new technology globally, blockchain is at the implementation stage, and developers are still figuring out what works and what does not. Therefore, new blockchain project should commence with a pilot program. Pilot projects provide opportunities to identify successful methods, share learned lessons, and identify whether all works smoothly in practice. More specifically, a pilot project allows to:

- Validate the benefits of switching from a centralized to decentralized solution.
- Identify technical problems and investigate potential solutions.
- Assess and determine the cost of switching to a blockchain-based solution.
- Manage risks to identify threats and opportunities

presented by blockchain.

- Promote creative thinking and new ideas through experimentation.
- Be always in the foreground and on the cutting edge of new solutions.

Many businesses and governments worldwide have started to consider blockchain in their long-term technology roadmap. Modern digital systems are very complex and require careful verification before integrating any large-scale blockchain-based solution into production. Therefore, reliance on pilot-projects is obvious and essential towards the adoption of any emerging new technology.

Recommendations:

- **Respective authorities** of each sector need to define the basic regulatory requirements, during the pilot project development, for discussion and approval prior to their final introduction.
- **Respective authorities** should encourage and support

the development of pilot projects for both government and business sectors, especially where blockchain presents potential benefits.

- **Respective authorities** should identify a list of priority sectors to implement pilot projects.
- **Respective authorities** also should define the possible in-kind/in-cash support that can be provided to promote pilot projects in these priority sectors.

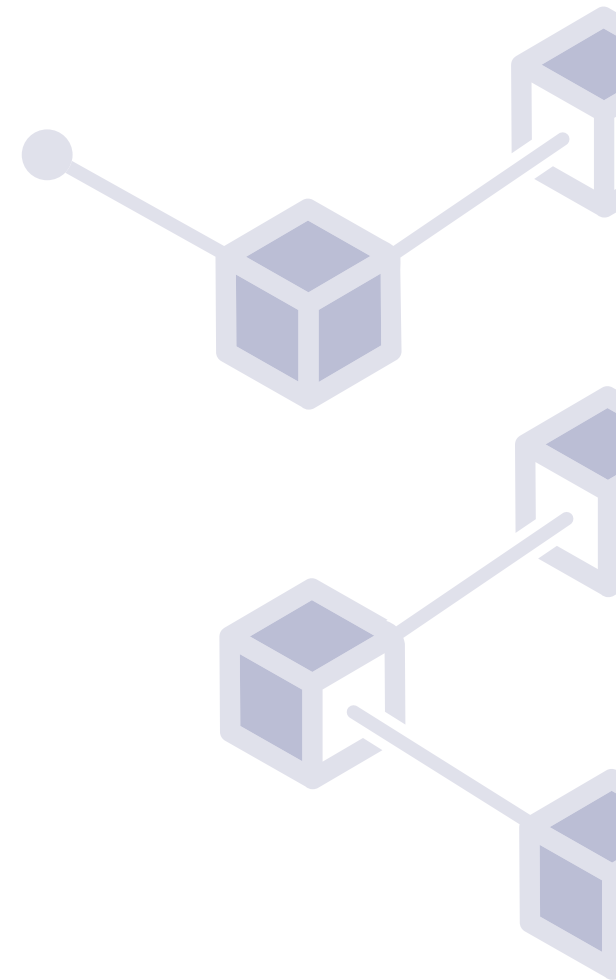
5.2 Startups and Businesses

Another way to boost blockchain adoption is to provide the adequate incubation environment for promising startups which may become leaders for global blockchain disruption. So far, Qatar has made great efforts to create a vibrant entrepreneurship ecosystem by establishing important institutions and organizations to help entrepreneurs: incubators and funding organizations, including the Qatar Development Bank (QDB), Center for

Entrepreneurship (Qatar University), Qatar Business Incubation Center (QBIC), Digital Incubation Center (DIC), Qatar Science and Technology Park (QSTP), and Qatar Foundation (QF). Blockchain is a network-based technology, and for such a technology to gain competence, industry stakeholders and government should cooperate with each other to unlock its full potential.

Recommendations:

- Encourage all blockchain-based initiatives, especially in priority sectors.
- Define special funding programs to support blockchain startups in priority sectors, through the existing incubators and funding organizations.
- Create a new consortium-based funding organization that involves all stakeholders to promote blockchain-based startups and businesses.





6. INNOVATION AND CREATIVITY

Another objective the blueprint aims to achieve is to set out the basics to enable a conducive environment for creativity by upgrading the infrastructure, bringing expertise and competencies, and improving the education system to include emerging technologies in the various stages of education.

6.1 Infrastructure

Since 2008, Qatar has invested heavily in advanced Information and Communication Technology infrastructure, ICT products and services, and digital government, which has had a positive impact on all sectors. Qatar's both fixed and mobile infrastructure has been deployed and currently with universal coverage and of high quality by international standards. The early adoption of 5G technology and further network upgrades would allow provision of advanced services based on 5G, cloud computing and Internet of Things (IoT).

Moreover, Qatar will soon open a regional data center, with the aim of providing public cloud

services that correspond to the goals of the country and its digital transformation. For blockchain adoption, the current existing infrastructure will definitely be of a great advantage, however, specific requirements need to be also considered.

More specifically, blockchain applications need to be run on top of existing platforms, such as Ethereum and Hyperledger, that are deployed on a distributed network of nodes. For pilot projects and startups, having a local test network, either physically distributed network or cloud-based blockchain service, will facilitate the deployment and testing of new applications while reducing the cost.

Recommendations:

- Establish a high-performance cloud-based blockchain platform to accelerate and facilitate prototyping and testing, with priority given to pilot projects and startups.
- Establish a physically distributed blockchain network

among different institutions including ministries and universities. The network will serve for testing and to host actual blockchain applications.

6.2 Skills Awareness

Advanced ICT skills-set are the key background needed to start working with blockchain technology. Qatar National ICT Plan 2015 [7] has identified ICT skills as one of the major challenges. While the public sector and schools continue to integrate ICT into the working environment and the school education system, more efforts are needed by the State to eradicate digital literacy in Qatar. Due to the lack of the necessary digital skills common in developed nations, Qatar's economy is missing various opportunities to benefit from emerging cutting-edge technologies and therefore potential to grow. It is critical to know that the scope of needed skills to benefit from blockchain also include multidisciplinary expertise in ICT and other disciplines.

Recommendations:

- Consider new ways for offering formal education and training programs, with employees in the public and private sectors being critical stakeholders. Non-technical employees especially at the decision-making level (e.g., middle, and upper management) need to build awareness through short training courses and targeted campaigns about blockchain benefits in their sector, with emphasis on the return on investment.
- Deliver advanced training programs for specialized IT staff in distributed systems, basic blockchain programming, and advanced blockchain concepts, such as smart contracts, consensus algorithms, and security/privacy of blockchain platforms.
- Encourage employees to get formal certification in blockchain technology from existing multinational ICT service providers, by offering a special promotion to the employees

who obtained the certificate successfully.

- Ensure that IT service providers have technical expertise and training capabilities to provide the needed support for government and private entities interested to invest in blockchain projects. These providers should work in coordination with universities and the government to help develop short awareness courses and advanced modules for IT staff.
- Request the Human resource management in private and public companies to define a clear policy that will help attract IT talent - experts in the blockchain field to join and work in Qatar.

6.3 Education

For students in the K-12 education system and in higher education institutes, there is a need to develop general awareness courses to introduce the benefits of blockchain and different technologies in various sectors. There is also a need to train school instructors in blockchain and other emerging technologies to help integrate these concepts in their

courses (train the trainer). For students in ICT and related fields, there is a need for undergraduate and graduate courses in the general areas of distributed systems, programming, and advanced courses about the use of blockchain in different domains. These courses for senior high school, undergraduate and post-graduate students can be developed by academic experts in local universities. Higher education institutes can contribute in the development of these courses to improve ICT capabilities and ensure marketability for their graduates. Higher education institutes can develop customized blockchain training programs, on-job training, and internship programs with top service providers and through exchange programs.

Vocational Training is a great place to train blockchain experts. Qatar academic institutions and research centers can collaborate with the Ministry of Communications and Information Technology (MCIT) to explore programs or certificates for their students in this promising area. Finally, it is also important to explore on-line education

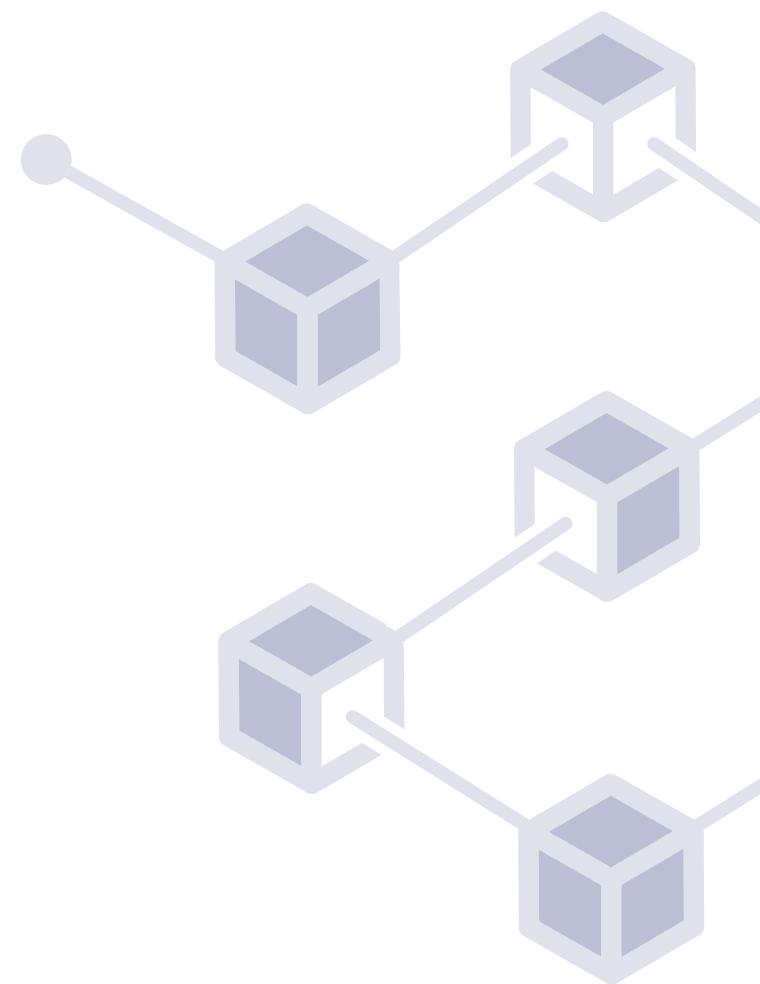
and executive degrees from local and global higher education or professional technical institutes. These courses have high quality and practical approaches to develop the necessary skills in our workforce in the form of a formal certification or a micro-degree. Life-long learning can be a great way of re-skilling the existing ICT workforce and developing ICT skills among experts from all sectors, including finance, logistics, healthcare, retail and education. We can add these courses especially the ones locally developed in the Qatar National e-Learning Portal, which offers online courses in IT and business for ICT professionals and partner organizations.

Recommendations:

- Develop an academic and experiential learning curriculum for blockchain for K-12 education systems and in higher education institutes.
- Train the trainers about blockchain and other emerging technologies to help integrate these concepts in their courses.
- Introduce new blockchain courses for undergraduate and graduate

students in most domains, and more advanced courses for ICT students.

- Define a national committee mainly formed by academic experts from local universities to design and develop the academic program for undergraduate and post-graduate students. This committee could also include members from industry and government to help in developing academic programs while considering actual needs from both industry and government.



7. OPPORTUNITIES FOR QATAR

Blockchain development will happen organically in each sector based on the needs and requirements. It is critical that each sector identifies the use cases important to them to address the problems they face. After some learning and development, sector leaders will coordinate with their relevant stakeholders to assess the technology, identify the required use cases, and provide a strategy plan on how to implement it. This approach will help each sector to develop a mature strategy with useful and achievable goals.

Each sector needs to follow a systematic process to decide on the needs for blockchain using a cost-benefit analysis. The following criteria developed by PricewaterhouseCoopers (PwC) [10] can help assess if blockchain adoption would bring benefit for a particular use case:

- Is data shared by multiple parties?
- Is data updated by various parties?
- Is verification required?
- Do intermediaries add complexity?

- Are interactions time sensitive?
- Is there an interaction between transactions?

A “Yes” answer to most of these questions shows that blockchain can be investigated further as the right solution. Leveraging blockchain opportunities will require the government, industry, and researchers in each sector to identify the use cases. We are pointing out some of the sectors critical to Qatar’s development with potential use cases in the following list.

7.1 Government Services

Blockchain can empower businesses and citizens to manage their data developing a secure system while optimizing government-citizen interaction. Blockchain will help eliminate administrative paper-based transactions and automate bureaucratic processes. The list of blockchain-based use cases for government services includes but not limited to:

1. Data sharing across entities, digitizing citizen ID and rights, transparent voting, and tax records.
2. Management of land, property,

and housing to enhance tracking of physical assets.

- 3.** Smart regulations: to develop advanced legal documents and automated rules with blockchain-based smart contracts.
- 4.** Digital diplomas and certificates: students can securely share verified digital copies of their degree with employers and other third parties. In addition to diplomas, blockchain can also serve to share other types of education-related records, such as students' academic transcripts and scientific papers, as well as the management of intellectual property.

7.2 Smart Cities

"Smart-city" is a conceptual model for future urban environments that takes advantage of the advance in Information and Communication Technologies (ICT) to deliver a set of cutting-edge services and facilities, and improve the overall urban infrastructures (parking lots, road networks, metro and bus stations, etc.) and quality of life. The list of blockchain-based use cases for smart-cities includes but not

limited to:

- 1.** Transportation Management: such as decentralize ride-sharing economy.
- 2.** Supply-chain and logistic: include product and shipment traceability, and business information sharing at inter and intra cities level.
- 3.** Smart telecommunication services with advanced spectrum allocation across different operators.

7.3 Energy

Today's energy industry is a complex system with multiple sources, suppliers, distributors and middlemen, and is consistently upgraded by new technologies ensuring a low-carbon future and efficient network management. The list of blockchain-based use cases for the energy sector includes but not limited to:

- 4.** Security of metering and billing.
- 5.** Grid network management.

- 6.** Peer-to-peer energy trading.
- 7.** Green certificates and carbon trading.
- 8.** Electric-vehicles charging.

7.4 Health and Sports

Health and wellness of nationals and residents is the top interest and usually one of the highest government expenditures in all countries worldwide. The healthcare ecosystem is one of the most complex systems, due to versatility of the stakeholders involved in patient treatment, development and supply-chain of medications and health equipment, and even legal and insurance domains. Sports also emphasize the wellness and healthy lifestyle of the society with additional applications and challenges such as athletes monitoring and management, and games organization and ticketing. The list of blockchain-based use cases for health and sports includes but not limited to:

- 1.** National health first-responder: facilitate health-related transactions and

information sharing between different stakeholders e.g. hospitals, insurance, clinics, airlines, insurance companies etc. to discover, manage, and respond to national health issues.

2. Patient and athlete monitoring: secure and trusted exchange of monitoring information between individuals and institutions to guarantee the authenticity of data and possibly monetize and incentivize the contribution of health-related data from individuals.

3. Medical Supply-chain management: trace and audit medications e.g. drugs, vaccines, tests, etc. and other health and monitoring equipment to vet the authenticity and origin of these items.

4. Sports games management: facilitate the trust and validity of trading and ticketing systems.

7.5 Fintech

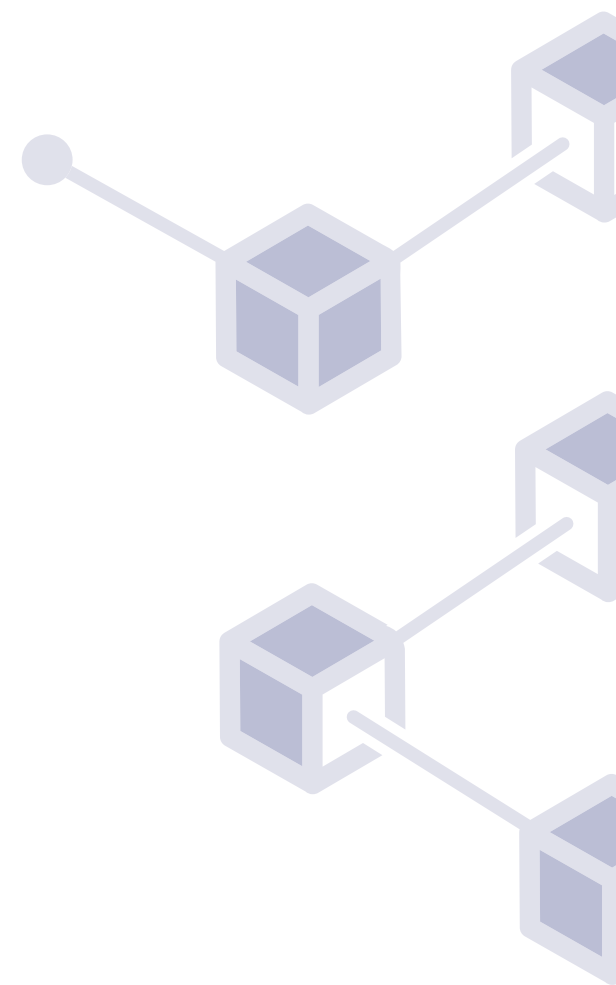
Fintech describes the board area in the intersection between financial services and technology. The internet redefined the term

Fintech as technologies that are disrupting traditional financial services. Revenue will be migrating gradually from traditional financial services to Fintech services in the areas of payments, crowdfunding, wealth management, and lending. The list of blockchain-based use cases for financial services includes but not limited to:

- 1.** Digital payments facilitate the transfer of value or assets in a direct and cheap fashion using cryptocurrencies outside traditional financial institutions.
- 2.** Smart contracts contain predefined rules under which the parties of that smart contract agree to interact with each other. When these predefined rules are met, the agreement code is automatically executed to

facilitate, verify, and enforce the negotiation or performance of an agreement or transaction.

- 3.** Digital identity using blockchain allows users to choose how to identify themselves and with whom to share their identity. One registration can allow all services connected to the blockchain to use their identity.
- 4.** Shared trading of stocks can be simplified avoiding brokers and the stock exchange.





8. CONCLUSION

This blueprint discussed the key requirements for blockchain adoption in the State of Qatar and provides comprehensive recommendations that help in (1) building a solid regulatory foundation, (2) creating an adoption foundation, and (3) enabling an adequate environment for creativity and innovation.

Implementation of blockchain in use cases addressing challenges in different sectors will have a significant positive impact on the human and economic development of Qatar. Blockchain and advanced technologies will lead to jobs creation and skills development in the government, startups and large businesses leading to a competitive edge through an educated and motivated workforce. Progress in blockchain adoption will enhance economic diversification as it will trigger the establishment of new startups and lead to business opportunities to provide the needed services in existing and new sectors. The availability of the blockchain infrastructure and global partnerships can make it easier for international businesses

to work in Qatar and therefore stimulate investment and further innovation.

In summary, the implementation of the above recommendations will contribute to the human capital development through jobs creation and skills development. It will stimulate economic growth and increase the regional and overall competitiveness of the State of Qatar, allow provision of better services to individuals and companies, and attract local and foreign investments.



9. REFERENCES

- [1] “Deep Shift Technology Tipping Points and Societal Impact” Survey Report by World Economic Forum, September 2015.
https://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf
- [2] “Blockchain technology whitepaper” by Cisco.
<https://www.cisco.com/c/dam/en/us/solutions/collateral/digital-transformation/blockchain-whitepaper.pdf>
- [3] Forecast: Blockchain Business Value, Worldwide, 2017–2030,
<https://www.gartner.com/en/documents/3627117/forecast-blockchain-business-value-worldwide-2017-2030>
- [4] <https://www.industry.gov.au/sites/default/files/2020-02/national-blockchain-roadmap.pdf>
- [5] <https://www.ledgerinsights.com/germany-official-blockchain-strategy/>
- [6] https://www.niti.gov.in/sites/default/files/2020-01/Blockchain_The_India_Strategy_Part_1.pdf
- [7] <https://www.motc.gov.qa/en/documents/document/qatar-s-national-ict-plan-2015-advancing-digital-agenda>
- [8] Ellul, J., Galea, J., Ganado, M. et al. Regulating Blockchain, DLT and Smart Contracts: a technology regulator’s perspective. ERA Forum 21, 209–220 (2020).
<https://link.springer.com/article/10.1007/s12027-020-00617-7>
- [9] https://www.eublockchainforum.eu/sites/default/files/reports/report_legal_v1.0.pdf
- [10] <https://www.blockchain-council.org/blockchain/how-to-implement-blockchain-successfully/>

