Background paper to the preparation of the 24ᵗʰ CSTD priority theme on Harnessing Blockchain for sustainable development

Author: Rasim Alam, MPP, Harvard Kennedy School

A Policymaker's Guide to Blockchain Technology Implementation and Innovation

Abstract: As Blockchain technology matures and applications of the technology become more widespread, policymakers will need to assess their country's ability to harness Blockchain technology and recognize the best pathway to Blockchain adoption. This research paper presents a country-level assessment framework for Blockchain implementation and recommends pathways to improve the rate of learning. The assessment framework can be used to identify the stages of Blockchain development, the steps towards full Blockchain adoption, and the opportunities and challenges in the implementation process.

Keywords: Blockchain, Assessment Framework

National Innovations System: Blockchain

Funding Resources
- ❖ ICOs/STOs
- ❖ Access to credit/capital
- ❖ Grants and Research funding

National Coordination
- ❖ National Digital Strategy
- ❖ Blockchain Steering Committee

Digital Infrastructure
- ❖ Digital Economy
- ❖ Ease of Starting Business
- ❖ Intellectual Property

Education, Research, and Training
- ❖ Workforce training
- ❖ Research Institutes
- ❖ Knowledge Transfers

Regulation
- ❖ Taxonomy
- ❖ User Protection
- ❖ Innovations-friendly Regulation
- ❖ Legal and Regulatory Framework

Public-Private Engagement
- ❖ Blockchain in Gov
- ❖ PPPs
- ❖ Innovations Strategy

International Cooperation
- ❖ Standard Setting
- ❖ Blockchain Consortiums
- ❖ Tech Giants and Int'l Bodies

Table of Contents

Figures

Abbreviations:

AML - Anti-Money Laundering

API – Application Programming Interface

CBDC – Central Bank Digital Currency CTF –

Counter Terrorism Financing

DAO – Decentralized Autonomous Applications

Dapp – Decentralized Application

DeFi – Decentralized Finance

DLT – Decentralized Ledger Technology

GDPR – General Data Protection Regulation

ICO – Initial Coin Offering

ICT – Information and Communications Technology

IEEE: Institute of Electrical and Electronics Engineers

ISO: International Organization for Standardization

KYC – Know Your Customer

NFT – Non-Fungible Token

NIS – National Innovation System SDG –

Sustainable Development GoalsSME –

Small and Medium Enterprise

STEM – Science, Technology, Engineering, and Mathematics

STO – Security Token Offering

Executive Summary

A decade after the launch of Bitcoin, Blockchain is fast becoming recognized as a core technology capable of providing greater efficiency, autonomy, and security. Although many technological and organizational challenges remain, sectors as diverse as healthcare, central bank digital currencies, supply chains, finance, and government are experimenting with Blockchain. As Blockchain technology matures, and Blockchain derivatives such as cryptocurrencies become non-trivial parts of the economy, policymakers must familiarize themselves with the technology, manage risks, and promote innovation in Blockchain.

How can policymakers assess their country's innovation and implementation capacity for Blockchain? How can policymakers design *development pathways* for Blockchain implementation with the policy instruments available to them?

This paper presents a policymaker's guide to Blockchain innovation and implementation. It provides a country-level framework to assess Blockchain-readiness in seven assessment areas and pairs it with policy recommendations with real-world examples. The research will guide readers to find technological and organizational bottlenecks, understand the pathways to better Blockchain implementation, and examine policies that can improve the rate of learning and adoption capacity.

This study uses the National Innovation System (NIS) as a guiding framework. The assessment tool and recommendations were designed from analyzing national Blockchain strategies, data from a United Nations Conference on Trade and Development survey to stakeholders in member countries, and secondary sources in the Blockchain literature. The assessment framework was curated with input from six experts in academia, research, and industry.

The assessment tool comprises of seven policy areas: (1) Digital Infrastructure, (2) Funding Resources, (3) National Coordination, (4) Education, Research, and Training, (5) Regulation, (6) Public-Private Engagement, and (7) International Cooperation.

Each of these assessment areas is subdivided into "low," "medium," and "high" capacity levels, so readers can identify a particular country in one of these levels for each assessment area. The exercise provides a matrix of capacities that can be used to find the strengths and weaknesses of a particular country's National Innovation System for Blockchain.

Lastly, the paper ends with a recommendation section that provides tailored suggestions for countries at different levels of innovation capacity. A summary of these recommendations is provided below:

Maturing NIS Countries:

- Develop the base infrastructure upon which developers and entrepreneurs can build applications with frontier technology. Invest in Blockchain education and research through grants, workshops, and training opportunities, especially through public universities. Establish a taxonomy of digital tokens to assist in regulation. Lighthouse projects that integrate Blockchain appendages to

legacy systems can highlight Blockchain's uses and build institutional knowledge. Finally, forming a Blockchain steering committee can start the process of assessment, strategy, and skill-building within the government.

Intermediate NIS Countries:

- Prepare a national Blockchain strategy to align national priorities on frontier technology development. Protecting users and investors will require a licensing process for cryptocurrency exchanges and other ancillary services. Research centers, regulatory sandboxes, conferences, and workshops can create new linkages between regulators and stakeholders that benefit the innovation process. Lastly, connect the local Blockchain ecosystem with international stakeholders.

Mature NIS Countries:

- Support ventures that are addressing technical, organizational, and interoperability challenges through funding and institutional support. Improve the digital operations of financial services for better integration of fintech. Design regulations with flexibility and innovation as guiding principles. Address standardization challenges through international cooperation, and lastly, improve each layer of the Blockchain infrastructure for a more robust innovation ecosystem.

Figure 1: National Innovation System - Blockchain
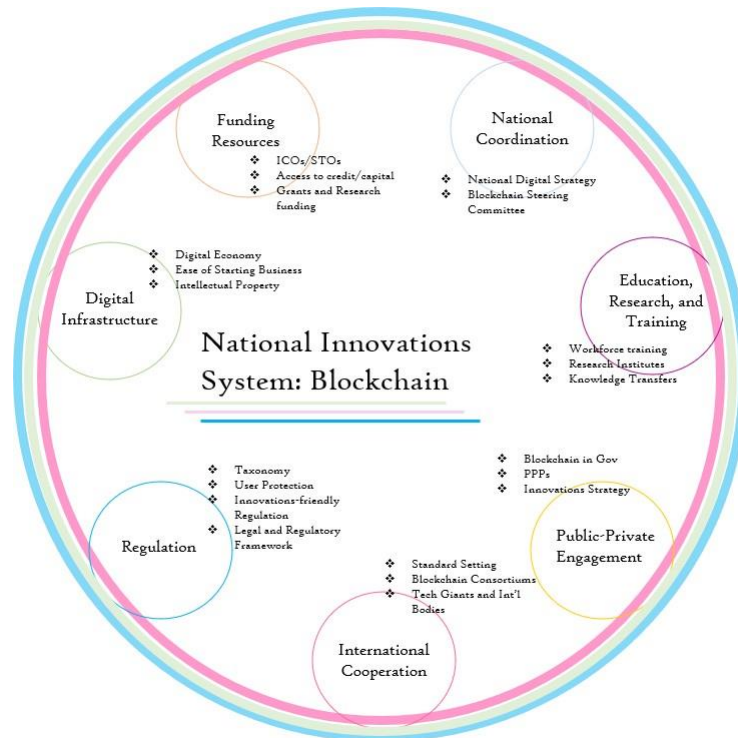
Section 1: Introduction

Blockchain technology was first popularized through the cryptocurrency Bitcoin in 2008. One of the first notable purchases through Bitcoin was made in Florida when two pizzas were purchased for 10,000 BTC worth over $500 million today.[i] Recently, Tesla committed to accepting Bitcoin for its products and invested $1.5 billion in the cryptocurrency, signaling a change in mainstream acceptance of Bitcoin and Blockchain technology at large.[ii] In a survey of more than 60 central banks in late 2020, 86 percent reported experimenting with Central Bank Digital Currencies.[iii] New Blockchain digital products have also emerged. Non-Fungible Tokens (NFTs) are changing how artists charge royalties for music[iv], and how digital art is valued.[v]

Figure 2: The NFT "Everydays: The First 500 Days" sold for $69 million in March 2021
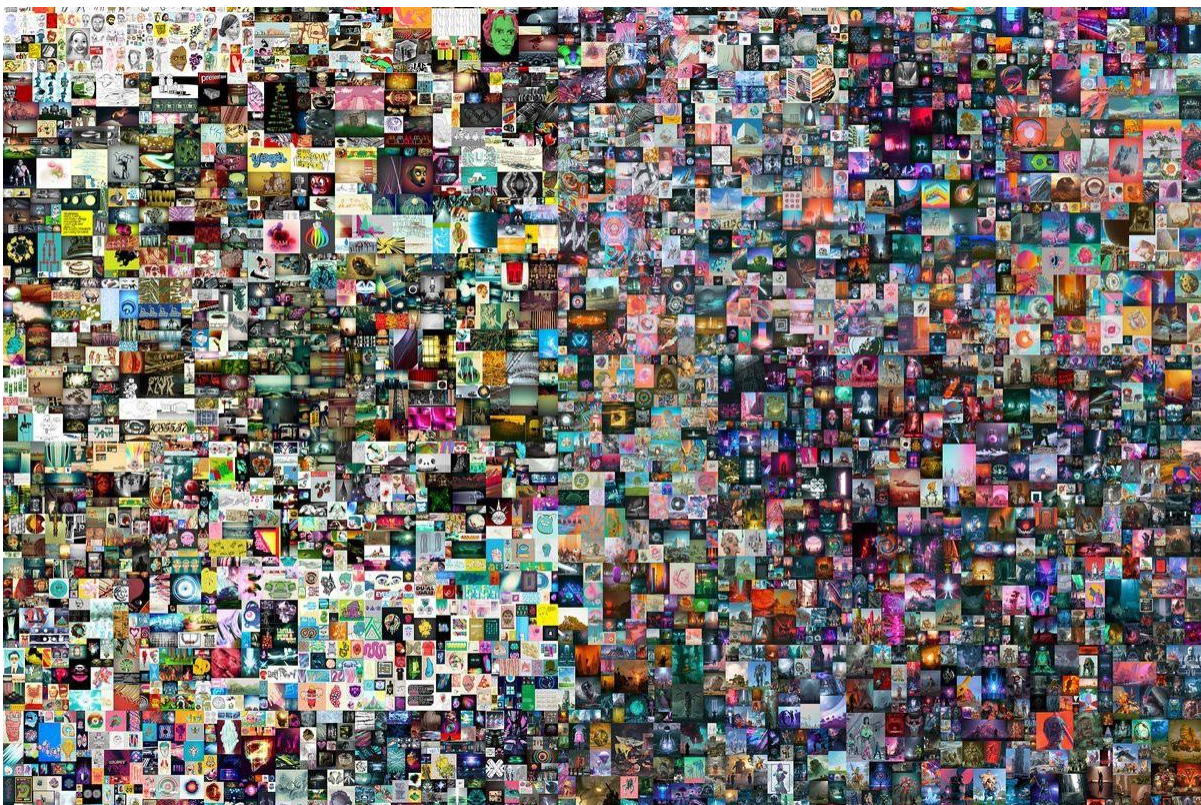
Source: The Verge

Although cryptocurrencies are still the fastest growing use-case of Blockchain, sectors as diverse as energy, supply chains, information management, decentralized organization, healthcare, and government have started to find benefits in replacing centralized legacy systems for Blockchain alternatives. A Deloitte global survey of top executives reports that 55 percent of survey respondents[vi] said Blockchain is in their organization's top five strategic priorities.[vii]

Blockchain allows decentralized services that do not require a single point of control. The attributes of Blockchain networks, therefore, have certain advantages that are not available to legacy database systems such as immutability, transparency, and decentralization. These attributes in the right conditions can be used to operate cheaper, more secure, and tamper-proof data transfers.

However, these same attributes pose new risks: the challenges of territoriality and accountability for global Blockchain networks, regulatory challenges with fraudulent use-cases, the environmental impact of mining, as well as endogenous technological problems of scalability and interoperability. Cryptocurrencies have been used for buying illicit goods, money laundering, and as payment for ransomware attacks. The advent of stable coins (See Appendix B) such as Facebook's Diem (previously called Libra) is a point of concern for regulators as they may compete with fiat currencies.[viii] For these reasons, Blockchain applications have faced considerable skepticism from industry and regulators in recent years, known popularly as "the Crypto Winter."

Fears about untested technology are not unfounded. But greater mainstream acceptance, higher regulatory scrutiny, and better oversight of cryptocurrency service providers will improve trust and create better incentives for people to use cryptocurrencies for legitimate purposes. A technological paradigm-shift precipitated by Blockchain is already here, and policymakers can no longer afford to ignore Blockchain and users of the technology. Rather, early movers may find themselves at an advantage, with opportunities to "leap-frog" technological advancement.

Improving the innovation climate for Blockchain will accomplish two things: prepare the technological infrastructure and workforce for other frontier technologies such as AI, Cloud Computing, and Internet of Things. One survey of Blockchain startups founds that 70 percent of respondents use one other complementary frontier technology for their product or service.[ix] Secondly, Blockchain, under the right use-cases, can have a positive economic and social impact. 76 percent of the respondents said their start-up addresses at least one Sustainable Development Goal (SDG).[x]

Blockchain technology by itself will not solve the challenges of trust and security. The technology by itself is no panacea, and organizational transformations must accompany technological changes to fully utilize Blockchain's advantages. It is also not likely that Blockchain applications will replace all or most legacy systems. Blockchain is a technology with specific advantageous features, and policymakers must be prudent in deciding where these applications serve well. As the technology matures and applications of the technology become more widespread, policymakers will need to assess their countries' ability to harness Blockchain technology, the infrastructure, and human resources available that will impact Blockchain adoption and recognize the best pathway to adoption. As countries decide on the best course of action, the legal and policy frameworks guiding the technology will converge. Policymakers will require a developed understanding of multiple aspects of Blockchain: technological, regulatory, governance, and organizational, among others.

This research paper seeks to address the growing need for country-level assessment for Blockchain implementation and recommends pathways to improve the rate of learning. The paper provides an assessment tool for policymakers to identify the stages of Blockchain development, the steps towards full Blockchain adoption, and the opportunities and challenges along the way. The

paper also discusses the developments in the global Blockchain ecosystem, regulatory measures, steps taken by different countries to accelerate growth, and the best practices regarding Blockchain regulation.

Section 2: Methodology

The assessment framework is built from analyzing national Blockchain strategies published by government bodies, data from UNCTAD's survey regarding Blockchain related challenges addressed to ICT regulators in member countries, secondary research in Blockchain literature, and interviews with six Blockchain experts. The experts include a regulator in the Latvian government, an expert in Central Bank Digital Currencies (CBDCs) working at the World Economic Forum, a research specialist and founder of the Blockchain Research Lab, an IT specialist at FinCen, and an ICT advisor working at ESCWA at the UN, and the co-founder and CEO of Ejara, a mobile-crypto investment company. The study also used secondary sources to collect Blockchain initiatives, national and state level regulation policies, and pertinent developments in the industry.

National Blockchain strategies were analyzed to understand the incremental steps governments have taken to encourage Blockchain innovation. The surveys were used to identify major issues that stakeholders are facing, especially with organizational and structural changes required for implementation of Blockchain at various levels. Expert input helped check for gaps and improvements in the framework, explaining specific challenges, and informed various developments in the global Blockchain space: KYC regulation in certain countries, development of CBDCs, and challenges in cooperation.

The National Innovations System framework was used to design the assessment tool and provide policymakers a holistic view of the Blockchain innovation ecosystem. The assessment framework addresses different policy areas, how they relate to Blockchain innovation and implementation, and provides examples of policies to improve the rate of learning. The assessment tool separates each area into a "low", "medium", and "high" category for readers to distinguish a given country's capacity level for each assessment area.

Lastly, the recommendations section uses a low-intermediate-high innovations capacity framework to suggest policy recommendations, providing a tiered approach to improve the national innovation system.

Section 3: Benefits and Challenges of Blockchain Platforms

Policymakers must understand that the attributes that are novel and beneficial in Blockchain platforms can also be disadvantageous in the wrong conditions. The decentralized payments system of Bitcoin, which reduces dependency on centralized institutions, can also facilitate illegal transactions. The immutability of Blockchain that prevents data tampering can also be severely cumbersome when information on the Blockchain must be updated. Therefore, when the benefits and disadvantages of Blockchain platforms are discussed, they are often representations of the same features in two different contexts. Policymakers must understand the risks of the technology and identify the use-cases in which the benefits outweigh the costs. Policymakers must also understand that for many use-cases Blockchain technology is not necessary, and other technologies may serve just as well.

The primary benefit of Blockchain technology is the decentralized ledger that is accessible to any node on the network. This could have implications for radical transparency in how data is shared. In the best case, the current model from local storage to cloud storage will be replaced by a peer-to-peer system of data sharing, circumventing the need for data silos. Blockchain platforms can allow users to prove the authenticity of their data without jeopardizing privacy, for example with medical records. Government departments can use the same consortium Blockchain platform to ensure authorization, identity management, data sharing, without the need for several different systems that repeat these functions. The difficulty of data-tampering in a Blockchain system can be useful for compliance, auditing, ensuring data integrity, and tracking ownership. Blockchain platforms may also provide efficiency benefits, for example, in cross-border payments which are currently both expensive and time-consuming. The benefits of Blockchain are highly dependent on the use-case and quality of execution. Largely, the technology's is still in the experimentation phase and will require time to reach mainstream usage.

Meanwhile, there are several challenges that must be resolved. The proof-of-work consensus mechanism is computationally expensive. There are scalability problems with large Blockchain networks, allowing fewer transactions per second compared to legacy systems. The regulatory regime has not been updated for digital tokens in many jurisdictions, leading to risk and uncertainty for entrepreneurs. End-user services such as coin wallets and cryptocurrency exchanges are yet to mature, and the peripheral industry needs to develop further for Blockchain platforms to serve mainstream users. However, Blockchain technology is also evolving rapidly, and the technological and organizational drawbacks of today may not be so insurmountable in the near future.

Figure 3: Blockchain Attributes, Benefits, and Challenges

	Benefits	Challenges
Decentralization	• No single point of vulnerability • Limits dependency on centralized authority • Permissionless platforms promote inclusiveness; anyone can join the network	• Governance of global platforms is difficult • Decentralization may enable illegal transactions and money laundering • Decentralization causes scalability issues
Immutability	• Data is tamper-proof once entered into the system • Potential for greater transparency between parties	• Information, once entered into the platform is difficult to update or edit • High cost to human error
Efficiency	• Certain transactions such as cross-border payments can be more efficient using Blockchain • Without intermediaries, the maintenance costs of applications can be lower	• Computational cost of consensus mechanisms like proof-of-work is extremely high.
Automation	• Smart contracts allow transactions between two parties without trusted intermediaries • Decentralized applications can be deployed without any oversight required	• Smart contracts may have vulnerabilities that are hard to detect • Unlike traditional contracts, smart contracts are difficult to re-negotiate or update
Transparency	• Public ledgers improve transparency of transactions, useful for compliance and auditing.	• Anonymity may not be guaranteed in public ledgers, potentially leading to exposure of sensitive data • For certain use-cases, transparency of this nature may be detrimental

Section 4: Blockchain and the Regulatory Landscape

In the long term, regulation is vital for the mainstream acceptance of cryptocurrencies and Blockchain services. Innovation friendly regulation will reduce legal uncertainty for Blockchain companies, provide better security for users, and reduce the barriers of entry for entrepreneurs. In fact, policymakers being late to regulate Blockchain may cause businesses to seek better pastures with more legal certainty.[xi] For an in-depth discussion on the need for regulation, see Appendix D.

A 2020 Deloitte survey found that 40 percent of the companies they surveyed were investing $5 million or more on Blockchain in the coming year.[xii] The three most stated use-cases were:

data validation, data sharing, and identity protection.[xiii] On the other hand, 54 percent of survey respondents in 2020 said Blockchain was "overhyped", up from 34 percent in 2018.[xiv] The survey is a reflection of the reckoning around Blockchain's early enthusiasm as well as the growing interest in legitimate, business specific applications of the technology. At the same time, in a PWC survey, respondents reported that the biggest barrier to Blockchain adoption was the lack of regulation. As corporations increase their investments in Blockchain, and more users come to use Blockchain services, the regulatory infrastructure will be required to catch up with the changes in the industry.

Figure 4: Barriers to Blockchain Adoption[xv]
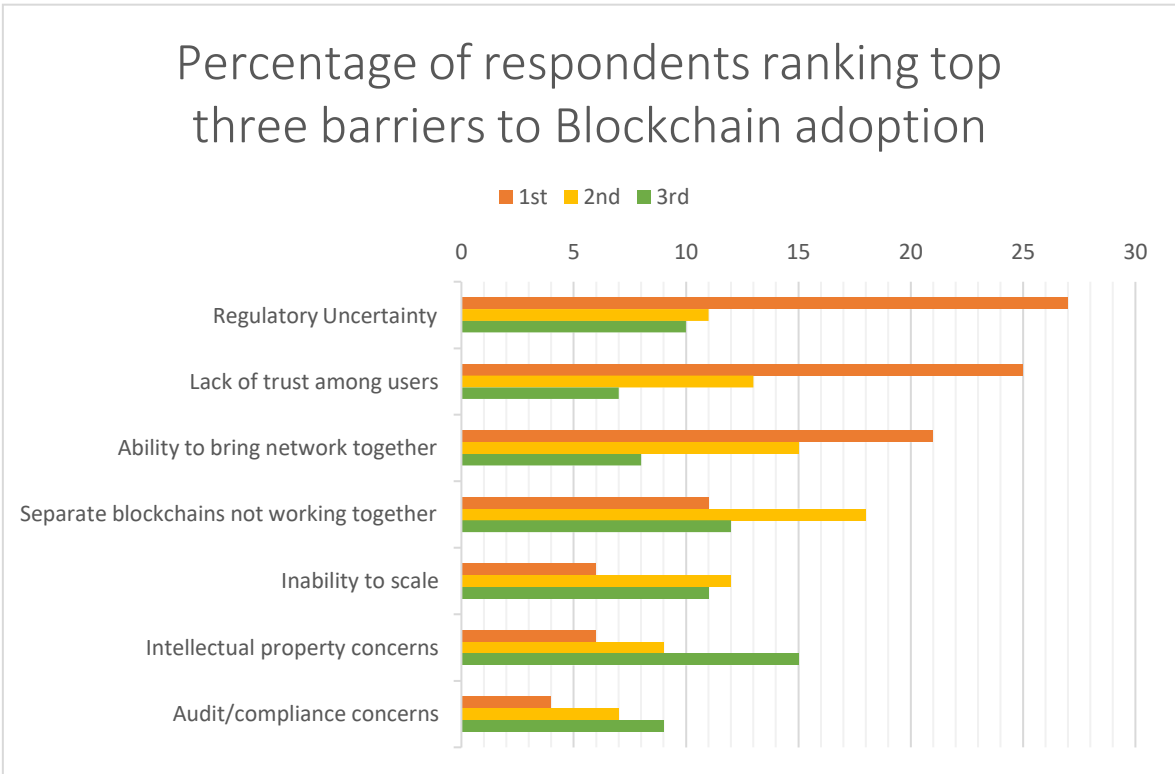
Note: N: 600
Q: Which of the following will be the biggest barriers to Blockchain adoption in your industry in the next three to five years? Source: PWC Blockchain Survey 2018.

Most countries do not recognize cryptocurrencies as legal tender, and the crypto market is largely unregulated. A 2018 study reported that cryptocurrencies were banned in 9 countries, such as Iran and China, and using cryptocurrencies was strongly discouraged in another 16 countries.[xvi]

Central banks from many countries have issued warnings regarding the volatility of cryptocurrencies and the risks associated with using an unauthorized asset that is not controlled by a central organization.[xvii] At the same time, central banks have also started experimenting with Central Bank Digital Currencies or CBDCs (See Appendix E) for both retail and inter-bank payments.

Countries are taking a case-by-case approach to Blockchain applications and allowing new innovations to be tested in special regulatory sandbox arrangements. The regulatory sandboxes allow companies to test out new use-cases, their interoperability with legacy systems, and taxation and regulation details of the product before it is allowed for public usage.

Regulation of Blockchain has been focused on cryptocurrency exchanges and wallets, where countries like the United States and Luxembourg have brought them under the existing financial regulations framework.[xviii] Other countries such as the UAE and Malta have proceeded further with regulation. Malta has established a Digital Innovation Authority to spearhead Malta's crypto-friendly regulation (see details in Appendix F). A full analysis of the global regulatory differences in Blockchain and cryptocurrencies is beyond the scope of this paper, but a few regulatory developments are highlighted below.

The Markets in Crypto Assets (MiCA) framework proposed by the European Commission, as part of the European Digital Finance package, seeks to establish one regulatory system for all 27 member countries by 2024. MiCA establishes a common taxonomy for digital tokens, comprised of crypto-assets (e.g. Bitcoin), utility tokens (e.g. Filecoin), asset-referenced tokens (tokens backed by an index of assets e.g. Libra basket coin), and E-money tokens (legal tender e.g. USDC).[xix] MiCA seeks to establish long-term legal certainty for crypto-operators and users, but MiCA's compliance requirements for startups and entrepreneurs may harm innovation.[xx] Regardless, MiCA will be a deliberative process with all relevant stakeholders and MiCA stands to resolve many of the legal gray-zones that currently exist in the European market. The EU must also resolve how Blockchain platforms will fulfill the requirements of the GDPR.

Other than reporting profits and taxation, the U.S. does not have a national-level regulation on cryptocurrencies, leaving states to decide how crypto businesses are regulated. Wyoming and Colorado hope to attract investment in fintech, with the latter exempting cryptocurrencies from state securities regulations.[xxi] Whereas New York established the BitLicense for crypto businesses, requiring stringent KYC/AML regulation and a $5000 licensing fee, encumbering new businesses. The Financial Crimes Enforcement Network (FinCEN) proposed new rules for cryptocurrency exchanges to store user information for transactions above $3000, changing the status of privacy for crypto users. These rules are now in the public comment period until Mar 29, 2021.

The Swiss Financial Market Supervisory Authority, FINMA, has used a simple taxonomy for regulating cryptocurrency: payment tokens such as Bitcoin, Litecoin, utility tokens such as Ether, and asset tokens that are subject to securities laws.[xxii] FINMA has also established AML/KYC and CFT regulations, enabled tax

payments in cryptocurrencies, and created a licensing process for exchanges and banks dealing with cryptocurrencies.[xxiii]

Singapore, Malta, and Gibraltar have also decided on proactive regulation of tokens to encourage innovation.[xxiv] After a few high-profile hacks of crypto-exchanges, Japan introduced new crypto regulations in 2020, establishing licensing and stricter AML and KYC regulations for exchanges.[xxv] These regulations have resulted

in several exchanges terminating operations in the country.[xxvi] This is an expected byproduct of new regulations, and whether this will harm Japan's global competitiveness in Blockchain services is yet to be seen. However, the regulations have had the benefit of removing from the market unregulated and risky businesses. In the long run, regulations that protect users and ensure a legal procedure for crypto businesses will help mature the industry.

Figure 5: Regulatory Framework for Cryptocurrencies (2018)

Application of Tax Laws	
ISO Code	Country Name
AR	Argentina
AT	Austria
BG	Bulgaria
FI	Finland
IS	Iceland
IL	Israel
IT	Italy
NO	Norway
PL	Poland
RO	Romania
RU	Russia
SK	Slovakia
ZA	South Africa
ES	Spain
SE	Sweden
GB	United Kingdom

Anti-Money Laundering & Anti-Terrorism Financing Laws	
ISO Code	Country Name
KY	Cayman Islands
CR	Costa Rica
CZ	Czech Republic
EE	Estonia
GI	Gibraltar
HK	Hong Kong
IM	Isle of Man
JE	Jersey
LV	Latvia
LI	Liechtenstein
LU	Luxembourg
SG	Singapore
KR	South Korea

Both	
ISO Code	Country Name
AU	Australia
CA	Canada
DK	Denmark
JP	Japan
CH	Switzerland

Source: Created by the Law Library of Congress, June 2018. [xxvii] Blockchain regulation is rapidly changing, and this map may not reflect the current state of the regulations.

Guiding Principles for Regulation:

Taxonomy is the first step: cooperate with other jurisdictions to have a shared legal definition of Blockchain, cryptocurrencies, and smart contracts. For e.g., Ethereum as a utility token, altcoins as securities etc.

Cryptocurrency regulation and Blockchain regulation need not be the same: The risks associated with cryptocurrencies, money laundering, terrorism financing, fraud, are not quite applicable to the general non-monetary uses of Blockchain. Different regulatory frameworks should be used for non-monetary uses.

Communicate legal interpretation of new regulations: Communicate regulations when they are introduced with stakeholders and incorporate a lengthy consultation period. Clarify what practices are illegal, and how companies should abide by new regulation.

Understand the technology, develop internal expertise: Not having a true understanding of the technology will lead regulators to misjudge the needs of the industry.

For new technology, iterative regulation can help update policies to changes in the technology: Regulation should be updated according to the response from the industry. The legal framework should be built in phases through examining best-practices (externally sourced) and through cooperation with Blockchain stakeholders (internally sourced).

Only introduce legislation that can be enforced: Introducing regulation that the government itself cannot assist in enforcing, for example authenticating users for KYC, will overburden businesses. Compliance with such regulation will be arduous.[xxviii]

Provide time for transition: Any legislation should provide enough time for businesses to comply with new rules. Hasty deadlines will force businesses to suspend or halt operations rather than transform operations.

Section 7: Framework

The National Innovation System[xxix] (NIS) is a theory of innovation[xxx] that frames the complex linkages between organizations, actors, and the socio-economic structures that determine the climate of innovation, the direction of development, and the rate of learning in a society.[xxxi] Innovation under this framework includes the adoption and generation of new business ideas and organizational transformations, not only technological breakthroughs. Each country's NIS is different, depending on the actors and institutions involved. As Blockchain technology matures and legitimate applications become more common, dynamic relations between industry, government, institutions, international organizations will influence innovation in each country. The NIS framework focuses on the interlinkages between actors, institutions, and the environment of innovation as a driving force for socio-technical transformation. NIS shifts the theory of innovation from a linear concept of science to technology to innovation into an interactive framework of actors engaging within policy areas. How a society learns depends not only on one institution (such as the university or tech industry) driving technological change but an interactive process of actors influencing each other in a socio-economic context. Through this interactive process, the country develops human resources, social institutions, technological breakthroughs, and regulatory advancements.

Figure 6: National Innovation System Framework
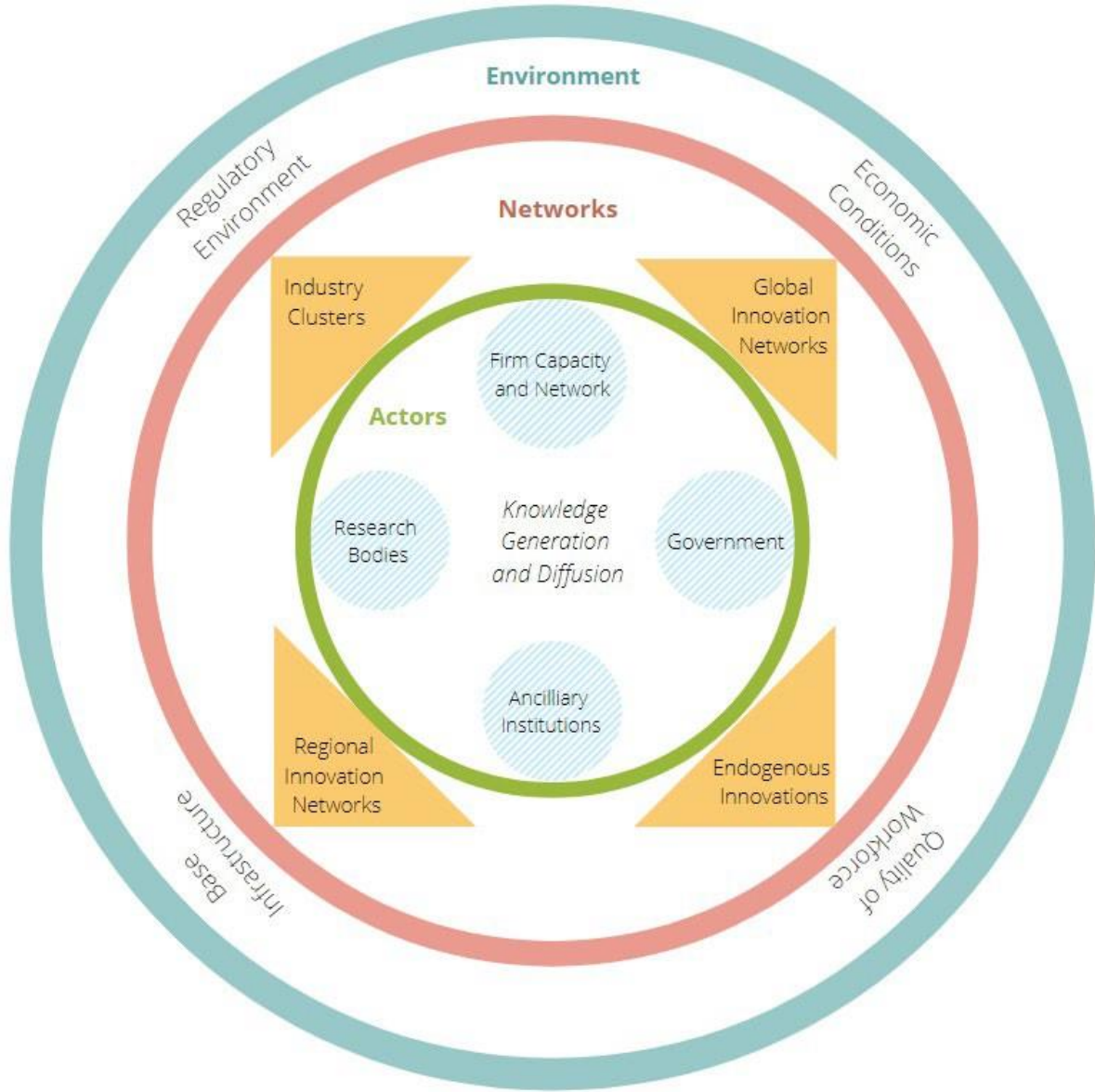
Actors

Blockchain adoption will require the coordination of different actors at the national level: regulators defining the legal framework, startups experimenting with Blockchain applications, and consumers adopting new

platforms. The actors involved in the innovations process:

Private Sector Organizations: Technological firms are the core engine for innovation with new technologies such as Blockchain.

Research Institutes and Universities: Universities and research institutes creates

synergy between academia, industry, and the innovator networks that influence the rate of socio-technical change. Universities train technologists, entrepreneurs, and familiarize new technologies to students through research. It is not unusual for technology startups to emerge out of universities.

Government: The government through regulation and incentive structures can have a substantial influence in shaping the conditions for innovation. Regulators must balance the need for regulation without stifling new ventures.

Users/Consumers: Early adopters are critical for Blockchain businesses to reach critical mass, and eventually mainstream usage.

Ancillary Organizations: International NGOs, incubators, consortiums, Blockchain foundations, and international firms can accelerate knowledge transfers, start partnerships and cooperative ventures, and facilitate pilot program to accelerate the rate of learning in Blockchain implementation.

Connections and Networks

The development of consortia (See Appendix A) for more on Blockchain consortia) in the Blockchain industry reflects the importance of cross-border and cross-industry linkages for effective development of Blockchain. Permissionless Blockchain networks may attract users from across the world, and the regulation of these networks will require regulatory harmony between different jurisdictions. For Blockchain, and other frontier technologies,

knowledge transfers are necessary for countries to improve technological and organizational capacity. For any country looking to accelerate Blockchain adoption, aligning the domestic industry with the movements of the international developments in Blockchain will be crucial.

Domestically, robust linkages between industry, academia, research, and entrepreneurs are important for a healthy innovation climate. Organizations that are well connected can adapt better to changing technological and regulatory requirements. Blockchain technology is still unregulated in most countries, and close communication between regulators, investors, and companies will be necessary to promote innovation through regulation.

These linkages are not only implied, formal agreements and foundations are emerging to facilitate cooperation in Blockchain development. The European Blockchain Services Infrastructure was launched by the European Blockchain Partnership, an agreement signed by EU member states, Lichtenstein, and Norway to improve standardization, interoperability, and security of digital assets and Blockchain applications in development (see Appendix G).[xxxii] These formalized joint ventures need not be international partnerships. Arguably, any domestic Blockchain innovation can benefit from more cross-industry and cross-sectoral connections, opening opportunities for networking, knowledge sharing, and collaboration. The Dutch Blockchain Coalition is a joint venture involving academia, industry, and government working as a "catalyst and facilitator" for the Blockchain ecosystem at large in the Netherlands.[xxxiii]

An effective innovation system requires seamless movement of ideas, people, technology, and opportunities within a network of innovators, researchers, and entrepreneurs. Governments

can ease this process, open channels of cooperation, and fund ventures that increase the cross-sectoral linkages within the country and internationally. These joint ventures can become influential actors in accelerating the adoption of Blockchain and become forums of negotiation, standards-setting, and knowledge sharing.

Environment

The adoption of Blockchain as a mainstream technology at scale depends on the climate of innovation, public support, funding resources, and entrepreneurial freedom to experiment. As the technology reaches adolescence, creating an enabling environment for the development of the technology is crucial for its future. There are several areas that influence the innovations climate for Blockchain:

These areas are: (1) Regulatory Framework, (2) Governance, (3) Access to Funding, (4) Workforce, (5) Research and Training, (6) International Cooperation, and (7) Consumer Interest.

These environmental factors are explained in Appendix J.

Section 8: Assessment Criteria

The actors, linkages, and environment together form the Blockchain ecosystem, and several policy areas within this network can influence the rate and direction of Blockchain adoption. These policy areas are identified for two reasons: they influence the rate of learning and growth in the technology industry, and secondly, policymakers can employ policy instruments to improve the rate of learning within these areas.

These is no one sequence of policy instruments or general pathway to better Blockchain adoption. Each country's diverse economic and political conditions, and more specifically the technological capacity, appetite for change, and flexibility of the tech sector will determine the necessary policy framework. Furthermore, these policy areas are not an exhaustive list; there could be edge cases and more specific recommendations for countries with unique situations. The assessment areas are meant to help policymakers think holistically about the innovation ecosystem and how each area impacts and interacts with others to impact Blockchain adoption. An effective Blockchain strategy will exercise multiple areas and invest in areas where progress is lacking.

Note: The following assessment tool contains seven areas of assessment each subdivided into "low", "medium", and "high" capacity sections. Readers can match the capacity level to their country in each policy area and examine examples of other countries either at a higher or lower level. The assessment tool is meant to help readers ascertain strengths and weaknesses in a country's National Innovation Framework as it pertains to Blockchain development. Each assessment area also contains suggestions for data collection for

further assessment within each area. A questionnaire (Appendix K) is also provided for further depth of assessment.

Assessment 1: Digital Infrastructure

Data:

- *Internet Penetration and Quality of Service Providers (Source: [Individuals using the Internet, World Bank](#))*
- *Banking Services, Access to Global Services (Source: [Firms using Banks to Finance Investment, World Bank](#))*
- *Ease of Starting Businesses (Source: [Doing Business Data](#))*
- *Intellectual Property Protection (Source: [International Property Rights Index](#))*
- *Power Supply Quality and Prices (Source: [Quality of Electricity Supply, GovData360, World Bank](#))*
- *Data Protection (Source: [Data Protection Index, DELL Technologies](#))*
- *Licensing and Approval Process (Source: [Doing Business, World Bank](#))*
- *Financial Inclusion and Internet Banking (Source: [Global Findex Database, World Bank](#))*
- *Number of Cryptocurrency Users (Source: [Triple A – Crypto Ownership](#))*

The quality of digital infrastructure, financial services, intellectual property protection, and governance comprise the infrastructure layer for Blockchain innovation and adoption. Each layer of the technology enables the knowledge, protocols, and ancillary services for the subsequent layer. The ground-layer infrastructure must operate well for frontier technologies to be implemented. Furthermore, policymakers must assess the ease of starting a business in the country. Ease of starting a business, paying taxes, insolvency regulations, and access to credit -- each constitutes part of the business climate.xxxiv Policymakers must collect data regarding infrastructure capacity (internet connectivity, data storage infrastructure, and server security), institutional capacity (access to banking services, real estate, strength of institutions, IP regulations), and secondary infrastructure (incubators, access to developers, technological parks, and ease of knowledge transfers). Developing basic infrastructure for technology startups will benefit all SMEs and create a robust business climate where entrepreneurs can work on innovation with little friction. This policy area is the most

important as well as the most difficult to transform:

Low: Sub-standard internet connectivity and technical infrastructure. Incorporating organizations, raising capital, securing patents, and recruitment processes are not streamlined. Most government operations are paper based and industry-focused digital infrastructure is limited. Filing and payments are not electronic, contracts are difficult to enforce, and getting permits is burdensome. For Blockchain entrepreneurs, there is little market for Blockchain applications, limited technologists in the country, and limited funding resources.

Medium: Digital infrastructure is well-functioning for both consumers and businesses. Dependable power and internet connections are available. Government services have online platforms and there is easy access to credit. Protection of intellectual property is reliable and regulatory structure is supportive of innovation. Ancillary services are available for tech startups, and entrepreneurs find it easy to recruit and fundraise. Technical universities have resources

for Blockchain developers, and there is a growing pool of technologists able to utilize Blockchain. Uruguay has improved its business climate markedly through reducing capital requirements for new businesses, introduction of e-tax payments, strengthening credit through the introduction of a credit bureau, and transforming bankruptcy processes.[xxxv]

High: Services such as internet connectivity, receiving permits, enforcing contracts, taxation, intellectual property, and resolving insolvency are all well-functioning. It is inexpensive and relatively easy to establish an ICO/STO. Financial sector is well-suited for startups and technology businesses have good access to credit and financial services. Government services related to business climate functions well. Universities are at the forefront of research and are equipped to train the next generation of Blockchain technologists. Regulators are welcoming of innovation and guide policies around growing a positive business climate, attracting international investors and entrepreneurs to incorporate businesses in the jurisdiction. Singapore has developed its digital government services significantly, and with a robust financial sector and innovation-friendly regulation, has become a hub for Blockchain innovation in Asia.[xxxvi]

Assessment 2: Funding Resources

Data:

- *Funding needs of Blockchain industry (Source: [Getting Credit, Doing Business, World Bank](#))*
- *Government grants for innovation in technology sector*
- *Assets Under Management/Revenue/Cash Burn Rate of Blockchain startups*
- *ICO/STO regulation (Source: [ICO regulation by country](#))*

Funding resources to produce, prototype, and deploy new Blockchain applications are one of the most important factors influencing the adoption rate. There are broadly four sources of funding: the government, domestic and international private sector capital (VCs, angel investors, hedge funds, and others), international organizations, and crowdsourced funding through Initial Coin Offerings (ICOs) or Security Token Offerings (STOs). Countries vary widely in the amount of support and funding available to startups, whether through direct financial support or regulatory support. However, Blockchain businesses have the advantage of crowdsourcing capital from any user in the world. Regulators have become more wary of ICOs due to fraudulent businesses and have been carefully exploring licensing and regulation for ICOs. The US has designated ICOs as securities and in Japan, ICOs are considered payment systems, neither of which may provide the clarity needed for more transparent and efficient ICO markets.[xxxvii] The challenge of ICO regulation is that it must protect both users and investors without encumbering legitimate businesses. For further information on trends in Blockchain financing, see [Appendix I](#).

Low: Financial system does not allow crowdsourcing of startup capital. Limited or no funding initiatives for new Blockchain

applications. ICOs are banned and no regulatory framework is being developed to replace the ban. If ICOs are allowed, firms seeking to raise capital through ICOs are isolated and have no institutional support. No funding ecosystem for the tech industry and no synergy between investors and entrepreneurs in the emerging technology field. This could be due to several reasons: legal infrastructure is not sufficiently secure to support venture capital, low visibility of isolated Blockchain startups to international funders, few examples of successful Blockchain ventures, investors not willing to fund a project that may not be profitable for a long time.

Medium: A growing number of investors are familiar with Blockchain technology. Government is working on a taxonomy for digital tokens and regulations on ICOs/STOs and exchanges. Licensing or other regulatory bodies have introduced standards to protect investors and customers. Startups have access to funding from venture capital, institutional investors, and international sources. For example, days after the Indian supreme court reversed a previous order that disallowed cryptocurrency trading the

cryptocurrency exchange Binance announced a $50 million Blockchain technology fund for new startups in India.[xxxviii] UNICEF is investing in tech companies in seven developing countries as well.[xxxix]

High: Government has programs for innovation funding, research funding, or proprietary incubators to improve Blockchain adoption. Tax-rates are low and there are clear guidelines for Blockchain startups. The STO Association was established in Japan to regulate security token offerings and ensure compliance.[xl] Zug canton in Switzerland is a hub for crypto-startups and will begin accepting cryptocurrencies up to CHF 100,000 for tax payments from February of 2021.[xli] Trade-openness as well as large tech and business community attracts foreign investment. For example, Singapore has favorable regulation, an efficient tax system, low corruption, technical talent, and a highly developed financial sector, making it favorable for foreign investments in Blockchain startups.[xlii] Government financial support usually accompanies sensible regulations that sustain an innovation-friendly environment for Blockchain investors.

Assessment 3: National Coordination

Data:

- *National Blockchain Steering Committee or Working Group Priorities*
- *National Blockchain Strategy or equivalent planning*
- *Milestones for Digital Transformation of Economy*
- *Leadership within Public Offices for Industry 4.0 Development*

A high-level vision for the public sector role in Blockchain adoption can benefit the industry and the regulatory bodies to coordinate on Blockchain innovation and development. Countries lacking a larger strategy for Blockchain implementation may fall behind in the techno-

social paradigm shift and lose first mover advantage. Although some countries have been proactive in creating government bodies to organize and align national innovation priorities around industry 4.0 (which includes Internet of things, artificial intelligence and big data, smart

industries, cloud computing, and Blockchain), most countries do not have a national-level strategy. Consumers and investors will remain wary of using Blockchain applications in a legal gray-zone, subject to changing regulation. Lack of coordinated guidance and regulation may also discourage large scale investments in the technology within a country. National Coordination not only entails establishing a Blockchain strategy, but also aligning institutions, entrepreneurs and technologists, legal and regulatory bodies, and informing the public on Blockchain.

Low: National digital strategy does not include Blockchain. No coordination between public departments regarding Blockchain technology, and no forum for public sector actors and private sector actors to work together on innovation, regulation, and Blockchain applications. The extent of government action on Blockchain may be a warning against the use of cryptocurrencies or other Blockchain applications. The relevant ministries, ICT or Finance, for example, are not given leading roles for frontier technology strategical planning. The lack of action can stem from limited understanding of the technology and its potential, or more likely, a wait-and-see approach before investing limited resources into an untested technology.

Medium: National strategy to align high-level goals is published in draft or completed form. A national forum is established to bring different stakeholders to study the on-going developments of Blockchain technology and recommend next steps for improving innovation

and adoption. Pertinent ministry within the country has leadership role for Blockchain development and is working on a unified legal framework and regulation. Nigeria recently developed a draft national program called "National Blockchain Adoption Strategy"[xliii] detailing its national strategy towards a digital economy. Although no regulatory changes have been made, the draft strategy helps to align the national priorities

regarding Blockchain adoption and shows proactive engagement with the technology and its use-cases for Nigeria.

High: Blockchain steering committee comprised of technologists, academics, and regulators involved in the creation of the National Blockchain strategy. Blockchain stakeholders are harmonizing regulation, lighthouse projects, workforce training, and infrastructure development with dense linkages between actors. Designated department or consortium of government ministries involved in coordinated efforts to boost Blockchain adoption.

Lichtenstein, for example, established the Office of Financial Market Innovation, a dedicated office for the coordinated development of Blockchain between regulators, the government, and the private sector.[xliv] Similarly, Kenya has established a task force under the Ministry of ICT to promote Blockchain startups and identify opportunities for Blockchain development in the local context.[xlv]

Assessment 4: Education, Research, and Training

Data:

- *Blockchain patents*
- *Number and Quality of Blockchain research institutes*
- *Number of Blockchain leaders/experts in industry and academia*
- *Quality/Number of Blockchain related courses/training programs*
- *Technological capability of workforce:*
    - *Cryptography*
    - *Web Development*
    - *IT Expertise*
    - *Blockchain Engineers*

Figure 7: Number of Blockchain Developers Relative to Population Size (2018)
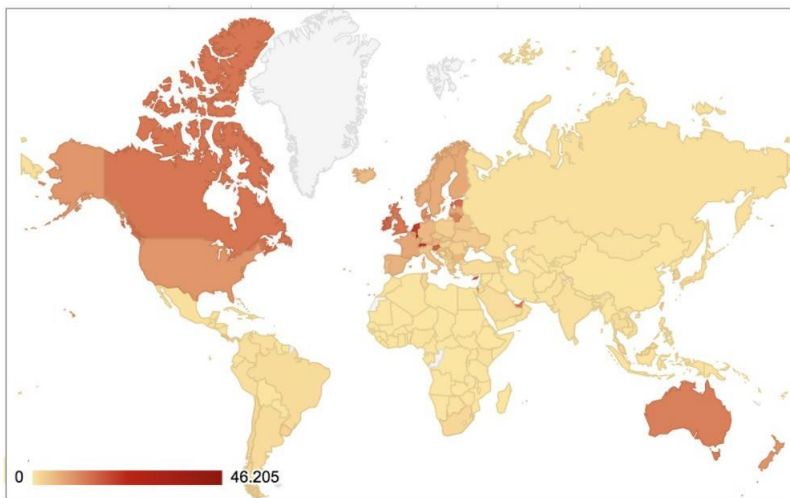
Source: James Duncan. "Blockchain Developers Worldwide Stats (Absolute vs Relative to Population)." *Dappros, London UK Blockchain Software Developers.* September 30, 2018.
https://www.dappros.com/201809/blockchain-developers-worldwide-stats-absolute-vs-relative-to-population/
Note: Blockchain development is rapidly changing and the map may not reflect the current distribution of Blockchain developers.

With banks, companies, and governments looking to expand Blockchain operations, Blockchain jobs is one of the fastest growing fields. However, Blockchain talent is in short supply compared to the growing demand – not unusual for a new technology. One estimate using LinkedIn data shows that outside of the top 17 countries, Blockchain developers number in the hundreds.[xlvi]

The development of Blockchain talent is critical to the continuing evolution of the technology and the success of Blockchain applications. Governments can take a leadership role with training opportunities in the labor force, improving STEM education in public universities, and directly investing in Blockchain research. The solving of Blockchain's current technical and operational issues as well as the growth of Blockchain business depend on the quality of the workforce. Policymakers can assess whether the

opportunities available to technology workers are suitable for developing Blockchain skills, and if not, take measures to improve opportunities for domestic talent development.

Low: Interested companies find it difficult to obtain Blockchain talent to build applications on Blockchain protocols. Companies cannot access Blockchain-as-a-service platforms due to lack of skilled technologists. Few Blockchain engineers in the country and limited resources available to train the workforce. Reasons for limited development in Blockchain talent pool include: few employment opportunities in frontier technology fields, underfunded university programs, under-developed ICT sector, and limited focus on the digital economy.

Medium: Blockchain technologists can receive training from universities and the private sector. For example, the Indian Blockchain Institute is a privately funded education-technology company that trains Blockchain developers.[xlvii] Research institutes in universities have Blockchain specific programs and labs to test new Blockchain products. Government training institutes accelerate the Blockchain training process by offering workshops targeted towards students and workers in STEM fields. The Indian

government's Ministry of Power offers Blockchain workshops under the National Power Training Institutes in several cities.[xlviii]

High: Blockchain training programs available in major universities and education platforms. The government has designated offices or supports NGOs that act as a nexus between academia, government, and the private sector for improving Blockchain talent. Forums and conferences bring together domestic Blockchain experts with the international Blockchain community. The government invests in specialized training programs to accelerate the development of Blockchain talent. The South Korean Ministry of Science and Technology invested $90 million towards a "Blockchain development technology strategy" course that hopes to train 42 enrollees in a six-month intensive training program.[xlix] The government proactively encourages Blockchain talent from other countries, easing entry visas and work permits. Malaysia implemented a "digital freelancer program" to provide work visas to Blockchain experts in two working days to attract Blockchain talent.[l] Overall, high level of synergy between academia, Blockchain technologists, private sector training, government initiatives, and engagement with international forums.

Assessment 5: Regulation

Data:

- *Taxonomy of Digital Tokens (Source: Library of Congress)*
- *ICO/STO Regulation (Source: ICO regulation by country)*
- *Legal certainty and government guidance on establishing Blockchain companies, crypto exchanges, and peripheral businesses.*
- *Taxation Regulation (Source: Library of Congress)*
- *AML, KYC, and CTF regulation (Source: Comply Advantage)*

Regulation of new technology is challenging, especially since Blockchain attributes do not resemble legacy systems and permissionless Blockchain platforms can span many countries. Similar to the emergence of the internet, the regulatory structure for cryptocurrencies, exchanges, wallets, ICOs/STOs, smart contracts, DAOs, and future Blockchain subsidiaries will need to be re-configured as the technology reaches mainstream usage. In fact, Blockchain regulation is the most effective avenue for governments to have an impact on adoption and innovation. Blockchain regulation will legitimize Blockchain platforms, remove legal gray-zones, and provide more security and protection for entrepreneurs, investors, and users. Mainstream usage of Blockchain requires the regulatory assurance and standardization. The guiding principle recommended for regulation should be to encourage innovation with Blockchain applications, which may prove to be socially valuable, while being cautious of new risks and unexpected consequences of the technology.

Low: Regulators are unprepared for cryptocurrency regulation, no taxonomy for digital tokens, and exhibit regulatory apathy towards Blockchain. Government issue of warning against cryptocurrencies or wholesale ban of cryptocurrency usage, trading, or mining without plans to update regulation. Hostile approach towards ICOs/STOs and token sales. No anti-money laundering regulation or anti-terrorism financing laws apply to cryptocurrencies. Lack of infrastructure and planning for developing taxation, licensing, public offerings, or Blockchain service provider regulation. This lack of regulation leaves the Blockchain industry vulnerable to risks. Reversal on regulatory approach or ambiguous policymaking regarding cryptocurrencies. Blockchain businesses in the U.S. are currently facing regulatory uncertainty, as the Financial Crimes Enforcement Network proposed new

burdensome reporting rules on crypto wallets, inciting criticism from crypto stakeholders.[li] The Chilean Supreme Court reversed its position on allowing crypto exchanges to avail banking services in 2018, discouraging investment in crypto businesses.[lii]

Medium: Regulatory approach has changed from defensive policies to careful examination of risks and opportunities. Regulators differentiate between banning cryptocurrencies as a currency but are open to allowing cryptocurrencies as an asset. Government has established or is working on taxonomy for cryptocurrencies and digital tokens, consumer protection laws, and are proactively working with exchanges. Banks are informed and receptive to new regulations and are working with Blockchain businesses to provide access to traditional banking services. Regulators and stakeholders of Blockchain startups have a forum to cooperate on new regulations such as through regulatory sandboxes. Regulatory clarity has improved consumer trust in Blockchain services, and investors have lower risks of entering the Blockchain industry.

High: Government has introduced a holistic legal framework and licensing infrastructure for Blockchain businesses. Regulators communicate with Blockchain stakeholders on regulatory needs and stakeholders have forums to communicate with regulators such as regulatory sandboxes, public comment processes, and consultation periods before legislation is introduced. Regulation covers AML/CTF rules without overburdening Blockchain firms with reporting or licensing requirements. There is clear guidance on establishing ICOs and STOs, crypto exchanges, wallets, and other Blockchain services. Clear guidance exists on taxation rules and reporting of profits. Malta was one of the first countries to introduce Blockchain regulation in 2018, authorizing cryptocurrency companies,

introducing auditing protocols, and establishing guidelines for ICOs, exchanges, and general Blockchain startup development.[liii] As a result of innovation-friendly regulations, the popular cryptocurrency exchange Binance moved operations to Malta from Hong Kong.[liv]

Assessment 6: Public-Private Engagement

Data:

- *Light-house Blockchain projects in government (Source: [Consensys Data on Gov Blockchain](#))*
- *Forums of engagement with private sector*
- *PPPs*

Blockchain innovation can be accelerated through government engagement in partnership with Blockchain companies. These include Blockchain pilot projects within government, Public-Private Partnerships (PPPs), and implementing Blockchain solutions through procurement. Through pilot projects in collaboration with the private sector and civil society, policymakers can better understand Blockchain technology and its implementation, build institutional knowledge, and ease the transition from legacy databases to distributed ledgers in the public sector. Blockchain consortiums, innovation labs, research centers, accelerators, and cross-industry partnerships can all become forums for aligning objectives related to Blockchain adoption for both private and public sectors. ID2020 is an initiative that brings together industry leaders and international organizations to provide digital identity strategies for the public sector.[lv] Central banks are experimenting with digital currencies as an alternative to fiat cash – an important development for the global acceptance of Blockchain technology ([Appendix](#) E). Government usage of Blockchain technology can be a powerful catalyst for innovation and implementation.

Low: Little investment in frontier technology development in the public sector, and the objectives of technological development are misaligned within the government. There are few or no pilot programs for Blockchain technology in the government. Few policymakers understand the technology and its application in the public sector. No forums, conferences, or innovation labs in the country that bring public sector and private sector together. Little collaboration with private sector to implement Blockchain based solutions to public sector challenges. No experimentation with Blockchain technology in any level of government: CBDCs, identity management, or data security.

Medium: Government is implementing Blockchain lighthouse projects. Various sectors are investigating the use of Blockchain in supply chains, data validation, identity management, land registry, or other services. Blockchain is a central focus in the national digital strategy. Government invests in partnerships with private sector or international organizations for pilot projects and plans to improve digital literacy and technological capacity in the public sector workforce. Linkages exist between the public sector and tech companies through consortiums and partnerships, enabling knowledge transfer,

coordination on use-cases, and regulatory cooperation. Hong Kong established the Fintech Center to facilitate collaboration with the private sector on new digital finance services.[lvi]

High: Blockchain technology is deeply integrated into digital government strategy, with many use-cases being piloted in the public sector. Policymakers highly engaged with private sector, NGOs, and Blockchain consortiums to advance Blockchain innovation. Blockchain implementation in government is beyond

cosmetic and Blockchain platforms are positioned to become important in government functions. The UAE, revealed in its newest Blockchain Strategy, plans to conduct half of all government transactions on Blockchain systems by the end of 2021.[lvii] In Estonia, Guardtime built the Keyless Signature Infrastructure (KSI), which uses hash-cryptography, Merkle trees, and decentralized servers[lviii], to ensure data integrity in government.[lix]

Assessment 7: International Cooperation

Data:

- *Efforts at standardization (Source: [IEEE Data](#))*
- *Interoperability focused international partnerships*
- *Knowledge transfers and consortiums (Source: [GSMI Industry Consortia list](#))*
- *Cooperation with international entities regarding the evolution of Blockchain industry*
- *Regional alliances for industry 4.0*

International coordination with state and non-state stakeholders is important for standardization, interoperability, and regulatory harmony for global permissionless platforms. The recent rise of consortiums has emerged out of the need for greater cooperation among Blockchain actors. The two largest consortiums Enterprise Ethereum Alliance (EEA) and Hyperledger are formally cooperating to improve international standards for Blockchain applications.[lx] International standard setting organizations such as IEEE and ISO are also cooperating with partner countries and observer countries to solve Blockchain's standardization challenges.[lxi] A healthy innovations system should be in conversation with global stakeholders regarding technological changes, guidance on regulation, implementation, and

successful use cases. Countries that lack technological capacity can partner with international organizations for pilot programs. Financial institutions will require cooperation on standards and interoperability for regulating permissionless Blockchain platforms. For mainstream usage of Blockchain platforms, international cooperation on interoperability, data protection, and regulatory compliance will be key.

Low: Low technology transfers across borders. Policymakers and technologists are not informed about global developments in Blockchain technology due to underdeveloped international linkages. Domestic companies do not participate in Blockchain consortiums and there are few linkages between the local tech industry

and international actors. Government does not work with regional partners on Blockchain development, regulation, and standard setting. Stakeholders are not interested in using Blockchain to advance development goals. Local SMEs are not connected to international funders, business networks, or development institutions focused on technological change.

Medium: Regional developments in Blockchain alliances are under way. For example, a BRICS country bank consortium was established in 2018 to research the development of a digital economy through Blockchain.[lxii] International partners are employed for pilot projects to assist with technical implementation. Cooperation with other countries is underway on regulatory and financial innovations with digital currency. The finance ministries of Estonia, Latvia, and Lithuania signed an MOU[lxiii] for closer cooperation on Fintech and a stronger institutional framework.[lxiv]

High: Domestic companies are active in international consortiums and are able to guide the technological and operational direction of Blockchain development. US technology giants such as IBM and Microsoft are working together with GS1 to set Blockchain platform standards in supply chain and logistics management.[lxv] Leading Blockchain companies are working with local firms on implementing Blockchain solutions. Domestic stakeholders are connected to international community of technologists, academics, regulators through forums, conferences, and Blockchain consortiums. There is ongoing cooperation among regional actors on Blockchain development through mutual investments, regulatory cooperation, and knowledge transfers (see Appendix H for an example: The Digital Europe Program). European Central Bank and the Bank of Japan have initiated project Stella to explore Blockchain enabled currencies for cross-border inter-bank transactions.[lxvi] Monetary Authority of Singapore and the Bank of Canada also explored similar possibilities in two projects established in 2016.[lxvii]

The National Innovation System at work: Malaysia

The following is an example of the National Innovation System at work in the Malaysian Blockchain space. Individual and iterative policy initiatives, through various state actors, create the conditions for future developments in the Blockchain ecosystem. Small initiatives inform and influence other initiatives, iteratively building the domestic infrastructure required to implement Blockchain technology.

The following table is not an exhaustive list of initiatives that constitute the Blockchain ecosystem in Malaysia, but rather an example of the holistic process of building the National Innovation System. The initiatives are mapped on to the assessment framework detailed in the last section. The table can function as an example of the framework in action and as a recommendation for broader strategy on Blockchain implementation.

The table shows how policymakers can identify specific policy instruments to develop a certain assessment area. The development of the innovation system is an iterative process, and these steps interact with each other to create the conditions for development for Blockchain businesses.

1) **Digital Infrastructure:**

Year	Actor	Initiative	Details
2016	Bank Negara Malaysia	Financial Consumer Alert List	Informing consumers about fraudulent businesses to improve trust in the financial market. The updated list has 438 companies.[lxviii]
2017	Cybersecurity Malaysia	Technology Security Assurance	Licensing body for ICT services to improve quality assurance consumer confidence.
2018	Cybersecurity Malaysia	National trusted Cryptographic Algorithm List (MySeal)	Licensing and vetting of cryptographic algorithms. Ensures compliance with Malaysian laws and provides list of trusted initiatives to citizens.
2019	Securities Commission Malaysia	Capital Markets and Services (Prescription of Securities) (Digital Currency and Digital Token) Order 2019	Defines digital tokens and digital currencies and prescribes them as securities.

2) **Funding Opportunities:**

Year	Actor	Initiative	Details
2020	Securities Commission Malaysia	Regulated Initial Exchange Offerings (IEOs)	Bans ICOs but enables IEOs which are tokens issued through a cryptocurrency exchange with the approval of the Securities Commission.[lxix]

3) **National Coordination:**

Year	Actor	Initiative	Details
2016	Bank Negara Malaysia	Financial Technology Enabler Group	Steering committee to facilitate the adoption of Fintech.
2018	Ministry of International Trade and Industry (MITI	National Policy on Industry 4.0	Aligning national priorities for digital economy, assessments, and calls to action.
2019	MIGHT	Malaysia Blockchain & Distributed Ledger (DLT) Outlook 2019	National level assessment, discussion of use-cases, discussion of social impacts, and recommendations for future actions.

4) Education, Research, and Training

Year	Actor	Initiative	Details
2017	Prime Minister's Office (MIGHT)	Malaysia Blockchain Conference	Forum for knowledge transfer and lateral cooperation.
2017	Malaysian Digital Economy Corporation / Ministry of Communication and Multimedia	Digital Hub Bungsar South	Co-working space to develop Blockchain applications.

5) Regulation

Year	Actor	Initiative	Details
2012	Ministry of Domestic Trade and Consumer Affairs (KDPHNHP)	Consumer Protection (Electronic Trade Transactions) Regulations 2012	Improved e-commerce and reduced reported online scams by 50 percent in one year.[lxx]
2018	Bank Negara Malaysia	Regulation for Anti-Money Laundering and Counter Financing of Terrorism (AML/CFT) for digital currencies	Improve consumer and investor security, proactive regulatory measure for cryptocurrencies.
2018	Universiti Malaya	Blockchain Regulatory Framework Report	Recommendations for regulators for designing DLT and Blockchain regulation.
2019	Securities Commission Malaysia	Conditional License for Cryptocurrencies Market Operators	Licensing provided to VASPs upon fulfillment of Securities Commission's requirements.

6) Public-Private Engagement

Year	Actor	Initiative	Details
2016	VTOS (Under Bank Negara Malaysia)	Blockchain Pilot Project: Telematics for Malaysia Motor Insurance Pool	Monitor engine data for insurance using Blockchain.
2018	Securities Commission Malaysia / Neuroware.io	Project Castor	Proof of concept using Blockchain for unlisted and over-the-counter markets.

Year	Actor	Initiative	Details
2017	Ministry of International Trade and Industry (MITI)	National Mirror Committee on Blockchain and DLT	One of the founding members of ISO/TC 307 an initiative to standardize Blockchain technologies by the International Standardization Organization.[lxxi]

The polar chart is a summation of how this assessment can be used for a holistic evaluation. The chart shows the capacity of Malaysia's Blockchain ecosystem for all seven assessment areas. The ratings are the author's own and shown more to demonstrate the tool than a referendum on the country's NIS system.

Figure 8: Use of the Assessment Tool
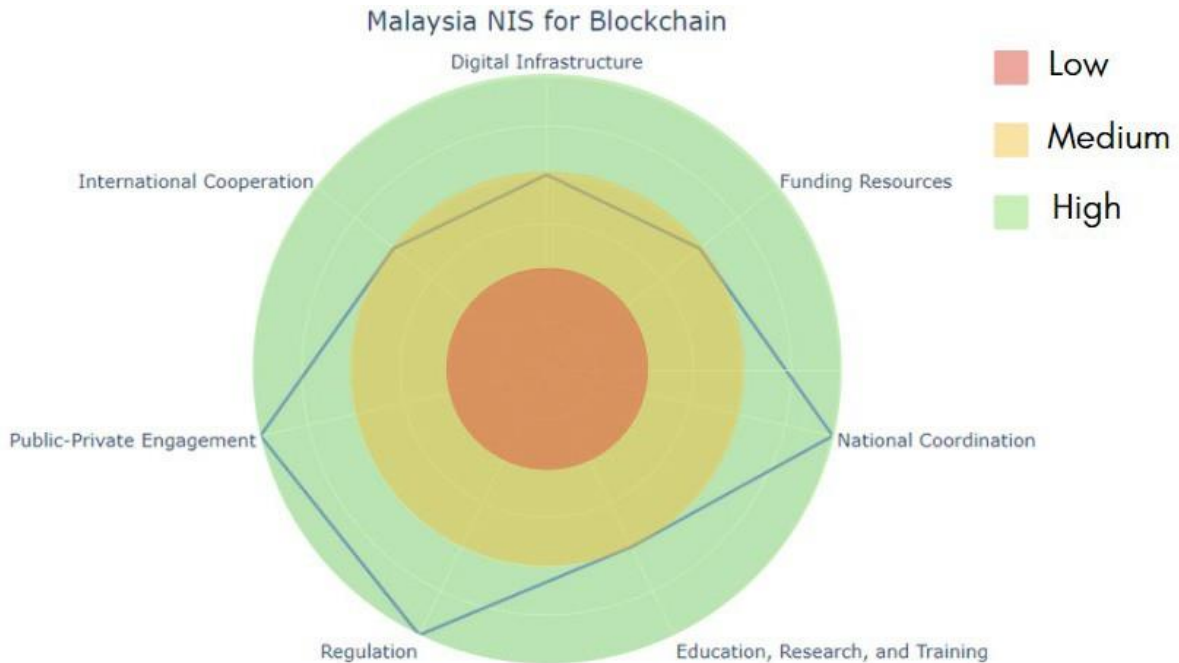
Section 9: Recommendations

The assessment tool can be used to find target areas in the innovation ecosystem where specific policy instruments can accelerate technology adoption. Completing the assessment tool, most countries will find themselves excelling in a few areas, while other areas may benefit from more investment and focus. The following recommendations will provide guidance on improving specific sectors in the innovation ecosystem to benefit the overall development of Blockchain adoption.

The policy recommendations discussed below will target each assessment area and discuss steps to improve from a low to medium to high capacity. These recommendations, by requirement, are general. Countries must decide the pathway for development for each assessment area according to the context and resources available. Although these are general categories, what readers may lose in specificity they will gain in perspective. The recommendations attempt to stimulate the national innovations system holistically. For example, improving the digital infrastructure of a maturing NIS country can also equip regulators in that country with greater enforcement capabilities on tech regulation.

In countries where the entrepreneurial ecosystem is not yet suitable for frontier technology, tech companies will benefit from strengthening base infrastructure, education, and business climate. However, this does not mean that Blockchain innovation is impossible in these countries. Maturing innovation systems may have the opportunity to "leapfrog" technological development phases, such as with

mobile banking or mobile e-commerce. Especially for Blockchain businesses, using Blockchain-as-a-Service platforms and crowdfunding costs through ICOs are distinct advantages. Countries that are at the forefront of technological innovation may develop technological breakthroughs and organizational harmony with Blockchain, but countries at all three levels can take steps to improve the implementation of Blockchain.

Digital Infrastructure:

Low: Assessment of current digital infrastructure and preparation of targeted investments is the first step. The base infrastructure, including internet connectivity, internet quality, service quality, ecommerce systems, e-banking infrastructure, mobile banking, local application development, domestic tech sector skills assessment, and finally talent development must be improved. The government must develop basic services until these systems become self-reliant and dependable. The earlier the infrastructure layer of services are functional, the sooner further advancements in innovation can take place. Investments in universities, research institutions, and innovation hubs can also jumpstart Blockchain knowledge and implementation capacity.

Medium: The available digital infrastructure should incorporate Blockchain-as-a-Service (BaaS) as a viable option for new ventures. Reducing the barriers of entry to introduce Blockchain solutions will allow organizations to experiment with Blockchain without high initial investments. Enhancing cooperation within the

ICT sector will ensure better harmony with international standards within every layer of the technology stack. Lastly, developing the identity management, authentication, and verification layers of the digital economy will allow easier deployment of applications and new technology ventures within the country. For example, Blockchain service providers (such as wallets) can better ensure KYC compliance with an existing identity authentication platform than without.

High: Improvements in frontier technology education, research, and industry linkages will benefit the entire Blockchain ecosystem. But targeted assistance may be necessary to counteract bottlenecks. For the entire Blockchain ecosystem to thrive, each layer of the technology from the base protocol to user-facing applications must function well. Policymakers can subdivide these layers and focus on areas where more assistance is required. At the basic infrastructure layer, improving training on the available enterprise platforms can boost innovation. Regulatory sandboxes can help regulators, innovators, and technologists to cooperate on improving protocols. Finally, at the application layer, policy instruments that facilitate raising capital and ease barriers to entry can encourage new ventures.

Funding Resources

Low: Friendly regulation of ICOs can facilitate Blockchain business to raise capital internationally for new ventures. ICOs allow business to raise funds without dilution of equity.[lxxii] The country may choose to allow users to hold cryptocurrency without allowing its use as legal tender, which will improve local Blockchain businesses to legally raise funds domestically. If ICOs are banned, government grants for frontier tech companies can be an important engine for growth. The government may also offer zero-interest loans to businesses

to support a target sector such as frontier technologies. Easing access to international sources[lxxiii] of funds through banking channels will also improve opportunities for local firms.

Medium: Legal certainty for cryptocurrencies and other Blockchain products will attract more legitimate investment from investors. It will also allow crypto business to invest in crypto startups, a trend that has been growing since 2019.[lxxiv] Government grants will accelerate the emergence of new businesses and new ideas in the Blockchain space. The government should also refrain from introducing cumbersome legislation, such as the New York BitLicense case that encumbered businesses with stringent compliance regulations.[lxxv]

High: Governments must cooperate with the financial services industry to prepare for the advent of digital currencies, CBDCs, and stable coins. This includes licensing and regulation of exchanges, preparing regulation of digital tokens and ICOs/STOs, Legal uncertainty around digital currencies will hinder its operations and interest in Blockchain businesses by investors. The European Commission's Fintech Action Plan[lxxvi] introduces a common taxonomy for categorizing digital currencies, which is important for taxation, AML/CTF compliance, and other regulatory compliance.[lxxvii] The development of harmonized financial regulations will reduce costs and open new opportunities for entrepreneurs.

National Coordination

Low: Blockchain experts and scholars should be identified and involved in a Steering committee for frontier technology development with the following responsibilities:

- Understand the global developments in Blockchain technology and applications.

- Identify strengths and weaknesses in the technology sector.

- Identify gaps in knowledge in the frontier technology space and promote strategies for skill development.

- Strategize government investment in education, training, and entrepreneurship.

- Incorporate Blockchain into a national digital strategy.

- Share recommendations and feedback with policymakers and Blockchain stakeholders

Medium: To engage the full innovation ecosystem through the digital economy, the regulatory, organizational, and institutional priorities of the country must be aligned. Long-term planning can ensure that the underlying infrastructure, talent development, regulatory framework, and private sector innovation can work in harmony. It can also signal to international stakeholders about the regulatory stance of the government. A national Blockchain strategy that assesses the digital infrastructure, establishes short- and long-term strategies, and provides regulatory clarity can be the first step to harmonizing different actors in the innovation system.

High: The implementation pathways of the national strategy for Blockchain must be vetted and regularly updated. For both technical and regulatory challenges, policymakers in charge of aligning the national strategy must look for policies that have hindered Blockchain development and look to other countries for guidance on balanced regulation and incentive structure. The best pathway for sustainable growth is having a long-term vision for the domestic Blockchain ecosystem while being

flexible in making changes in the short-term policy structure.

Education, Research, and Training

Low: Improving science and technology education and better linkages between universities and the private sector will make university curriculums more relevant and advance skill development for frontier technology. If instructors are available, public universities can offer programs in cryptography, databases, networking, web applications, and Blockchain programming languages. Universities can take advantage of open online courses for training. Furthermore, research institutes can become forums for innovation, prototyping, and skill development.

Medium: The government can support research, prototyping, and experimentation of Blockchain platforms and crypto-products through research institutes and innovation centers. Several countries have jointly established innovation hubs with Blockchain companies to accelerate product development and skill building. Incubators and startup accelerators can also contribute to network effects that attract more talent and innovation to a city or industry. 34 percent of Blockchain startups are concentrated in 5 cities: Silicon Valley, New York, Los Angeles, London, and Singapore, owing to the large network of investors, technologists, and early-adopters.[lxxviii]

High: Introducing grants and research opportunities for Blockchain is an important measure for high-level technical development in the new technology. Skill development should be a key goal of the science and technology policy of the country and incentivizing the growth of frontier technology labs, incubators, investments, and research must be a top priority. Public sector funding could lead to

breakthroughs in the technological bottlenecks of Blockchain, for interoperability, scale, and power consumption. Furthermore, collaboration with universities and research institutes in other countries should be encouraged for better organization around standard setting.

Regulation

Low: Develop taxonomy for digital tokens and build channels with private sector to develop policy and legal framework for Blockchain applications. Taxonomy and the regulatory guidelines will determine how digital tokens are defined and how laws and regulations apply to these assets. It is inadvisable to introduce regulation that may be cumbersome for new business to comply with. But regulation in consultation with stakeholders is important to prevent fraud, protect customers and investors, and legitimize the Blockchain businesses in the economy.

Medium: Regulators can reduce risks in Blockchain innovation with licensing for crypto exchanges and legal definition for digital assets. Developing a taxonomy is important for taxation, AML/CTF laws, and ensuring compliance. Further developments in regulation for smart contracts, mining, digital wallets, and ICOs/STOs can improve mainstream adoption of Blockchain platforms. However, there are risks of overregulation. Regulators should cooperate with industry actors, through sandboxes for example, design regulation in phases, have consultation periods with the public, and take an overall flexible approach. These measures will help stabilize the Blockchain industry in the long run and bring in institutional investors previously unwilling to invest in unregulated assets.

High: Removing legal uncertainty around Blockchain and cryptocurrencies should be the key goal in developing regulation. Regulators

will benefit from keeping an eye on changing developments in Blockchain applications and prepare a regulatory framework that can be adjusted as needed. Harmonizing regulation with major actors internationally will be necessary to regulate permissionless and borderless Blockchain platforms in the long run. In high-capacity countries, the government should start regulatory processes for new markets inspired by crypto-assets. For example, introducing regulation around the digital alternatives to certified securities, CBDCs, ICOs of different tokens, and trading venues for digital assets. Regulation of these aspects of the Blockchain ecosystem should not be hastily decided, but the government should start its process of consulting stakeholders and understanding the interaction of these systems with the broader Blockchain economy.

Public-Private Engagement

Low: Developing projects that utilizes Blockchain technology to showcase its potential, build institutional knowledge, and promote inter-departmental cooperation with frontier technology. With Blockchain-as-a-Service platforms, Blockchain solutions can be deployed cost effectively. Pilot projects could involve non-sensitive services that could benefit from the attributes of Blockchain platforms, such as non-sensitive data sharing, information delivery etc. Successful pilot projects that showcase the benefits of the technology can inform policymakers and users alike. Pilot projects could involve improving existing services by integrating distributed ledgers to address specific challenges. For example, Peru is working with a startup to improve data integrity in its procurement process using Blockchain technology.[lxxix]

Medium: Public offices can help users familiarize themselves with Blockchain applications by

implementing Blockchain solutions in public services. The government can develop institutional knowledge about Blockchain implementation through applying Blockchain solutions to internal operations, for example, a private Blockchain for secure data sharing. Blockchain-as-a-Service can be used within government for cost-effective pilot programs. The Maharashtra state government in India, under the Information Technology Directorate, has appropriated $1.4 million for Blockchain adoption in various government departments.[lxxx] The initiatives include a regulatory sandbox, implementations in health, supply chains, and data security of official documents.[lxxxi]

High: For high-capacity actors, the government should plan on long term investments in the technology. Blockchain's potential is in building core platforms to leverage its security and transparency features. The public sector can outlive the cycles of growth and retrenchment and develop Blockchain platforms for long-term use. Furthermore, building a public service workforce that can navigate frontier technology both technically and organizationally will help the government transition to changes in Blockchain application and future technology waves more seamlessly.

International Cooperation

Low: Firms should be encouraged to leverage international organizations for funding pilot projects and international tech firms for partnerships on building infrastructure and workforce development. A first step may be to establish bilateral partnerships on narrow use-cases: using Blockchain in cross-border payments, energy, or trade. Regional agreements can also foster easier knowledge transfers and better trust in new platforms. Research forums and conferences can put technologists and practitioners in touch with

international stakeholders, sparking new projects and ventures. Inviting experts to Blockchain workshops can also inspire opportunities for learning. Lastly, governments should engage with development organizations that are experimenting with Blockchain. Institutions that are already involved in international collaborations can also be engaged to start lighthouse projects.

Medium: Blockchain adoption can be facilitated by the improvement of foundational services such as identity authentication, data storage, data sharing. These services should be interoperable with other country's platforms so that better harmony can be achieved in regulation. For example, the FATF's travel rule[lxxxii] can be better implemented with interoperable identity management systems across borders. India Stack is an open digital infrastructure upon which other applications are built, including digital id, electronic KYC service, and e-signature.[lxxxiii] These platforms can be more sustainable if built with the consultation of the larger Blockchain international community. Standardization early on with the emerging global Blockchain industry will save time and cost on building interoperability layers in the future.

High: The usability and reach of operations will be determined by the standards accepted by each country. Moreover, the platform which becomes the default standard will have an industry advantage over newer protocols. It is imperative that regulators and technologists keep abreast of the development in industry standards in Blockchain and adjust domestic developments accordingly. It is also important to recognize the challenges in privacy, data governance, security, and compliance and cooperating with international stakeholders to resolve these issues. The European Commission is working with standard-setting bodies, the

International Organization for Standardization (ISO) and the European Committee for Standardization, to improve interoperability.[lxxxiv] See [Appendix G](#) for an example of regional cooperation on interoperability: European Blockchain Services Infrastructure. The ISO is working with participant countries and observer countries to solve interoperability challenges through an initiative called ISO/TC 307.[lxxxv]

The ISO has published standardization protocols for taxonomy, privacy and data protection, smart contracts interoperability, and security management of digital asset custodians,[lxxxvi] and has established working groups for further work on standardization.

Section 10: Conclusion

In March 2021, PayPal enabled payments with cryptocurrencies on the platform, another signal of cryptocurrencies reaching mainstream usage.[lxxxvii] Policymakers must prepare to respond to the socio-technological shift in how data is stored and shared. Blockchain platforms have the potential to bring more efficient, transparent, cost-effective innovations. They also feature significant risks, both to entrepreneurs experimenting with novel technology, and users who avail services in legal ambiguity. A strategic, national-level approach to Blockchain development can mitigate risks and attract new innovations to fintech, health, supply chains, and government.

The assessment tool presents a framework for Blockchain adoption through the National Innovation System. An effective Blockchain strategy will engage the innovation system in a holistic way, with advances in education and training, regulation, digital financing, and the digital infrastructure. The innovation system can also benefit from clear and aligned strategic priorities at the national level. Moreover, improving linkages to the international innovation ecosystem will ease technical and organizational knowledge transfers.

The integration and governance of a path breaking technology is complex, especially one that does not restrict itself to national borders. This paper analyzes this complexity using a national-level holistic framework and proposes recommendations to advance innovation and implementation.

Appendix:

Appendix A: Blockchain Consortia:

Permissionless Blockchain platforms can have users from anywhere in the world, and harmony between different jurisdictions will be required to regulate Blockchain. Blockchain consortia have emerged as a response, providing a platform for industry leaders to share pain points, create use-cases, collaborate on standardization, and develop strategies to address collective challenges. Standardization in the industry will consolidate the development of the technology and improve usability and interoperability between different services for all stakeholders. These processes will be easier with businesses cooperating through shared forums and consortia. For a consortium to perform fairly, the rules of governance, responsibility, intellectual property, and revenue must be well-designed and equitably enforced.

There are primarily two kinds of Blockchain consortia: technology focused and business focused consortia. Enterprise Ethereum Alliance (EEA) is a technology focused consortium that seeks to improve scalability, security, and accessibility of both private and public Blockchain applications on the Ethereum network.[lxxxviii] R3 and Hyperledger are other well known technology focused consortia. Business focused consortia focus on specific use-cases of Blockchain technology, especially for a particular industry. Hashed Healthcare Collective, for example, is a consortium that serves the healthcare industry incorporate Blockchain.[lxxxix]

Blockchain consortia are necessary to solve some of the governance issues of permissionless global platforms. Some of Blockchain's barriers to adoption comprise regulation issues, standardization challenges, and interoperability.

The rise of Blockchain consortia has begun to address some of these challenges within industries and between countries.

Appendix B: Stable Coins

Stable coins are cryptocurrencies that are backed by an asset such as a fiat currency, gold, or an index of assets. Stable coins were created as a response to the price volatility of vanilla cryptocurrencies. Whereas a cryptocurrency like Bitcoin is treated more as an asset than a payment currency, due to its volatility, stable coins can be used for payments because their price are stabilized. Although just like fiat currency, the price of stable coins may change over time, the day-to-day volatility of regular cryptocurrencies is not an issue with stable coins. Some stable coins such as Dai take other cryptocurrencies as Ether as collateral.

Most recently, Visa has approved payments with the stable coin USDC which is backed by the US dollar.[xc] This development has important implications for the use of stable coins for commerce. USDC users now can pay a vendor directly through Visa. Stable coins may encourage crypto-adoption among users looking to use cryptocurrencies, not as an investment but to make payments and transactions. Stable coins may also allow much faster and cost-effective cross border payments.

Appendix C: Privacy Coins

In Bitcoin transactions, any user on the network can view the transactions between Bitcoin addresses, and although the Bitcoin addresses are not linked to the users, users may have to disclose addresses to receive goods and services they purchase. Furthermore, even though a process is untraceable in the present does not

mean it cannot be traced in the future (for example by linking identities of owners to Bitcoin addresses).[xci] To acquire greater anonymity, cryptocurrency users may use mixing services[xcii] that relay the currency through several addresses before sending it to the recipient address. But other cryptocurrencies provide greater anonymity through clever cryptographic solutions.

Monero was created in 2014. A hard fork of a previous cryptocurrency called Bytecoin, Monero uses the ring signature system, where each transaction is signed by one member of a group of senders. It is infeasible to determine which sender from the group signed the transaction. The receiver's wallet address is also not used in the transaction as a one-time public key is used to send the value. The receiver can use their private key to access the transaction and remain anonymous throughout the process. Similarly, Zcash also provides anonymous transactions on the Blockchain through "zero knowledge proofs" where two parties can validate a transaction without each party knowing any of the transaction details. Both cryptocurrencies allow added anonymity to cryptocurrency transactions.

Appendix D: The Need for Regulation

Central banks are concerned about cryptocurrencies exacerbating money laundering. A 2018 report says that over $2.5 billion has been laundered through cryptocurrencies since 2009 and that over 97 percent of this value is moved to countries with tolerant anti-money laundering (AML) regulations.[xciii] Cryptocurrencies still constitute a small portion of money laundered compared to fiat currencies. Blockchain's immutable and public ledgers also leave more room for investigators to uncover laundered money than by traditional means. Although regulators may

not have user data connected to money-laundering cryptocurrency accounts currently, this data may be revealed when there are data leaks or hacks from cryptocurrency exchanges and wallets. Over a million users' emails were leaked from a data breach of Ledger, a cryptocurrency wallet service provider in December 2020.[xciv] Money launderers use coin mixing services and privacy coins (See Appendix C) to obfuscate payments and create complicated financial paper trails. Since these services make tracking difficult, regulators will need to regulate end-points such as exchanges to prevent illegal activity. Anti-Money Laundering/Know-Your-Customer (AML/KYC) regulations can mitigate these issues as well as equip ancillary Blockchain services to protect user data.

The purchase of illicit goods using cryptocurrencies is also a point of concern for policymakers. Due to the popularity of Bitcoin in the use of online illegal markets, regulators are understandably cautious about legally recognizing cryptocurrencies. As mainstream investors and businesses engage with cryptocurrencies, the use of cryptocurrencies for illicit activity is likely to fall. One study by Chain Analysis shows that the proportion of cryptocurrency transactions used to purchase illegal products and services has decreased in the last year, from 2.1 percent ($21.4 billion) of all transfers in 2019 to 0.34 percent ($10 billion) in 2020.[xcv]

More governments are realizing the importance of introducing regulation, not only to protect consumers from fraudulent practices, but also to provide regulatory support for legitimate businesses. Through international coordination, knowledge transfers of best practices in regulation, and increasing scrutiny and oversight from regulators, Blockchain regulation will mature and stabilize. Illicit transactions will

become more difficult, and institutions will strengthen their ability to monitor and secure Blockchain and cryptocurrency platforms.

Appendix E: Central Bank Digital Currencies:

The most important development for legal use of cryptocurrencies has come out of central banks. Central banks are considering introducing proprietary digital currencies, called Central Bank Digital Currencies (CBDCs). CBDCs will operate as the digital counterpart to central bank reserves or fiat cash. Proponents argue that CBDCs can reduce operating time, costs, ease cross-border transactions, and facilitate trade finance. However, in countries that already have a mature banking sector, the benefits of a CBDC may not be worth the technological and cost investments.[xcvi] This is most true for domestic operations. CBDCs still may provide benefits of efficiency and cost-effectiveness in cross-border transactions that are currently inefficient through interbank payment networks.[xcvii]

CBDCs may not all be built on Blockchain platforms. Non-decentralized or "account-based"[xcviii] CBDCs can be created using legacy technology but cannot overcome the double-spend problem of centralized digital currencies. On the other hand, Blockchain based CBDCs may have the associated risks of a new technology being implemented on a large scale. The race to develop a CBDC among technologically frontier countries has regulators anxious about the consequences in domestic markets and monetary policy. However, any risks that a foreign CBDC may impose for the citizens of a country can be mitigated through regulation and restrictions. [xcix] CBDCs could also help emerging economies to leapfrog technologically to a more accessible digital economy. Moreover, programmable currencies have the advantage of having second-layer applications built on top of them, using smart contracts for example.

Policymakers must carefully examine the role that CBDCs can play in their respective countries and be aware of successful implementation of CBDCs in other central banks.

Appendix F: The Malta Digital Innovation Authority

The Malta Digital Innovation Authority was introduced to regulate the emergence of decentralized technologies such as DLT, Blockchain, smart contracts, and related applications. The innovation authority office was created because Blockchain, if used in scale, could create a technological paradigm shift from previously centralized applications.[c] It also centralizes the regulatory responsibilities under one roof, potentially saving public resources, the difficulties of coordination, and time for regulators. The Malta regulators also established a voluntary certification process that allows innovative entrepreneurs to be vetted, allowing them to earn more institutional support and consumer trust. System auditors, independent auditors with no affiliation to the developers, can examine and certify the software before it is deployed.[ci] Technical auditors will support post-deployment issues, which will require that they have editing (forking) capabilities, and perhaps even an option to terminate the program if the program is violating laws and causing harm to consumers.[cii] Although this is controversial, it may be necessary to ensure credibility and create a necessary failsafe. The last policy noted is a *forensic node* in the network that will be responsible for recording the runtime behavior of the software including transactions on the network.[ciii] This will be useful for both developers and regulators in monitoring the software and ensuring that the program is working as intended. Malta has taken pioneering steps to offer positive regulation for Blockchain applications that will benefit from the credibility and oversight options the regulation provides.

Malta's regulatory innovations may influence long-term industry standards in Blockchain regulation.

Appendix G: European Blockchain Services Infrastructure (EBSI)

EBSI is a cross-border Blockchain backbone platform to enhance public services and improve interoperability with private sector platforms over time.[civ] Each European Blockchain Partnership (EBP) member states will have at least one node in the network. EBSI will unlock new potential for public and private services built on the platform, with cooperative oversight and shared responsibility over the network. The initial use-cases involve data integrity applications such as digital notarization, Blockchain-backed verification such as diplomas, decentralized identity system, and secure data sharing.[cv] More applications are in the pipeline: including a cross-border welfare service built using the European Social Security Number, SME financing, and cross-border asylum management.[cvi]

Appendix H: The Digital Europe Program

The Digital Europe Program budgeted 7.5 billion in funding from 2021 to 2027 to improve frontier technology through a shared vision among the EU member countries. The program will invest in 2.2 billion Euros for supercomputing, 2.1 billion to Artificial Intelligence, 1.7 billion for cybersecurity, 580 million for advanced digital skills, as well as 1.1 billion for wider implementation of frontier technologies which include Blockchain.[cvii] Closer cooperation for digital transformation works well with decentralized technologies. The ideal future for Europe's Blockchain implementation is using a few protocols for seamless transactions between all member states. On top of a private or Hybrid blockchain platform, member states can manage

identity systems, certifications, travel documents, trade documentation, and others. The developments in AI and supercomputing, and directly in education, will prepare users for transformations in the decentralized database market as well.

Appendix I: Trends in Blockchain Financing

Most Blockchain funding came from the US (51 percent), Europe, and China (18 percent) from 2015 – 2019 although deal activity is shifting to China.[cviii] However, with ICOs, entrepreneurs are not limited to local funders, which gives Blockchain startups an advantage. The ICO boom of 2018 ($7.8 billion total raised) has largely subsided because of new regulations ($371million raised in 2019).[cix] Equity funding has filled that gap ($2.8 billion) in 2019.[cx] 2019 also saw the entry of crypto-focused hedge funds. Only 15 percent of funding was from traditional hedge funds.[cxi] Although enterprise Blockchain funding is rising, it is still dwarfed by funding for cryptocurrencies. Almost half of the funding came from one deal: Ripple which raised $200m.[cxii] Crypto—infrastructure is still getting funded while first movers are expanding their scope of operations. Furthermore, traditional financial services have started to offer cryptocurrency dealing on their platforms.

2019 funding fell while deal activity held relatively steady
Annual VC-backed deals and financing, 2015 – 2019 ($M)
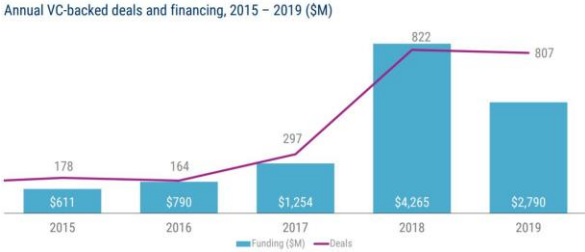
Source: CBInsights. "The Blockchain Report 2020" https://www.cbinsights.com/research/report/blockchain-report-2020/

Appendix J Environmental Factors of the National Innovation System

Regulatory Framework: The regulatory climate for each country varies widely regarding Blockchain. Some countries have banned cryptocurrencies and do not find value in investing in Blockchain. Others, such as China, have banned cryptocurrencies but continue to invest heavily in the technology and are actively developing new decentralized services. Yet other countries have classified cryptocurrencies as assets, or utility tokens, or securities. As the technology develops and becomes more usable by mainstream consumers, the regulatory climate will converge, with pioneering countries establishing which guidelines endure this phase of development. Regulatory sandboxes can facilitate prototyping and experimentation with Blockchain products. They can also help regulators strategize how legacy systems will interoperate with Blockchain products and services, and the necessary regulatory changes to enable this transformation.

Governance: Focused governance priorities regarding Blockchain can benefit adoption. Countries like Germany[cxiii] and Australia[cxiv] have issued national Blockchain strategies that aim to align inter-departmental objectives, clarify regulatory guidelines, and establish principles for secure fintech development. Governance is not only about regulation. It also involves orchestrating the innovation climate for Blockchain, catalyzing technological and organizational breakthroughs with funding opportunities, investments in research, and enabling entrepreneurs to prototype with minimal risks.

Access to Funding: Funding opportunities are crucial for start-ups and innovators. Governments can provide seed funding for proof-of-concepts and facilitate networking between investors and startups. New ventures can fail not because the idea or the execution is flawed but because of insufficient funding available to iterate or build to scale. For Blockchain applications, funding does not necessarily have to be obtained from traditional sources. Through digital tokens, Blockchain businesses can crowdsource capital. Moreover, having a decentralized network means any user in the world can potentially join the platform, adding to its value.

Workforce: Blockchain is developed by a niche field of engineers, computer scientists, cryptographers, and web designers that can deploy the technology and build on the core infrastructure. However, the Blockchain developer pool is increasing fast, especially when Blockchain development skills are in high demand by companies.[cxv] The opportunity to acquire skills in highly technical fields is necessary to build a pool of experts and practitioners. This can benefit the technological industry directly and can benefit the research and development capacity of the country indirectly. Investing in education and training is key to a healthy innovation climate.

Research and Development: Companies and researchers around the world are attempting to solve some of Blockchain's technological issues, issues that prevent Blockchain applications from operating at scale, work in harmony with legacy systems, and being applicable to more use-cases. Although much of Blockchain's technological innovations have come from private developers or groups of developers working independently, the government can greatly accelerate this process with public funding, institutional support, active recruitment of researchers and practitioners, and regulatory support for Blockchain innovation.

International Cooperation: As previously mentioned, the emergence of consortia, international agreements, joint ventures, and knowledge-sharing forums is an auspicious sign of Blockchain's growing importance in the next generation of industry and its likelihood of being a mainstream core technology. It is important for a dynamic innovation climate to have linkages with the international Blockchain community and engage in collective problem-solving of the regulatory and technical challenges of Blockchain applications.

Consumer Interest: Lastly, the government can influence the public usage of Blockchain applications by informing and educating citizens of the benefits of the technology. Government institutions are already involved in this process; for example, central banks have issued warnings against buying volatile and unregulated cryptocurrencies. Citizen participation can help inform and improve understanding of Blockchain and accelerate mainstream adoption.

Appendix K: Questionnaire

1. Digital Infrastructure

   Questions:

   - What is the quality of internet connection and power supply, especially in tech-focused neighborhoods and cities?
   - How easy is it for companies to open bank accounts? Receive credit? Receive money and send money abroad?
   - What is the incorporation, licensing, and approval process for a new tech company? Are there institutions to facilitate entrepreneurs and startups?
   - How would you rate the intellectual property rights of the country? Where does it fall in IP indexes (such as internationalpropertyrightsindex.org)?
   - Are there regulations for data protection of citizens?
   - Are there protections against investor fraud or consumer fraud?

2. Funding Resources

   Questions:

   - Are there government grants or private grants for Blockchain startups?
   - Are citizens allowed to buy cryptocurrencies and potentially fund startups through ICOs?
   - Are promising ventures failing to scale due to funding issues?
   - What are the constraints of private equity financing for Blockchain companies?
   - Are there regulatory restrictions or cumbersome bureaucracy regarding raising capital?
   - Can startups access funding from international sources? Is there a way to improve visibility for local startups?

3: National Coordination

   Questions:

- What is the strategic program regarding the digital economy?
    - What are the focus areas? And how can Blockchain technology further development in these areas?
- What are the resource constraints in achieving the above stated goals? Will the deployment of Blockchain solutions exacerbate these constraint issues?
- What is the knowledge and technological skill base that can implement Blockchain technologies in the country?
    - Are there policy and legal experts, technologists, regulators, and business leaders that can form a Blockchain planning committee?
- Is there a public department that can take leadership role in designing a Blockchain innovation policy? Which offices should participate in this project? How will the responsibilities be managed?
- If so, what should be the priorities of an initial Blockchain strategy? Can the committee identify opportunities for pilot projects?

4. Education, Research, and Training

Questions:

- Do universities have the resources to offer courses on Blockchain? If not, why not?
- Can developers find resources to teach themselves Blockchain coding languages?
- Is there available funding for Blockchain research? Are there any government funds towards frontier technology research?

- Are there any funded workshops and training programs for interested developers?
- What are the starting wages for new graduates in the technology industry? Are firms offering positions for frontier technology development such as AI and Blockchain?

5: Regulation

Questions:

- What ministry/department will be responsible for developing regulation regarding Cryptocurrencies and Blockchain businesses?
- What are the risks that the government is trying to minimize? What are the opportunities in Blockchain technology that can be encouraged through regulation? What are the industry's fears regarding legal and regulatory gray zones?
- How are digital tokens classified?
- Are regulations that are underway or introduced clearly communicated to stakeholders? Is there a public comment period? How is feedback handled?
- What regulations pertain to fintech applications or Blockchain technology?
    - Are some of these potential blockers for Blockchain innovators?
    - Will the financial regulatory framework work for digital currencies?
    - How are digital tokens defined?
- How will cryptocurrency gains be taxed? (Depends on the taxonomy)

- How will ICOs/STOs be registered? What provisions can be used to protect investors? Is an auditing process possible to implement?

6: Public-Private Engagement

Questions:

- What ministry/department can be in charge of forming lighthouse projects that use Blockchain?
- Are the private sector actors that can provide Blockchain solutions identified?
- Are there opportunities for public-private partnerships on Blockchain adoption?
- Is the central bank planning on experimenting with digital currencies? What are the benefits and risks of implementing digital currencies?

7: International Cooperation

Questions:

- What kind of international partnerships is available to advance Blockchain and other frontier technology knowledge transfers?
- Is the government an observant or participant of international standardization measures? Such as through the ISO?
- Is the central bank cooperating with other banks on CBDCs?
- Is the private sector involved in international partnerships on Blockchain standardization?

Bibliography

"About – IndiaStack." *IndiaStack*. Accessed February 3, 2021. https://www.indiastack.org/about/

"Blockchain Platform - Pricing," *IBM*. January 18, 2021. https://www.ibm.com/cloud/blockchain-platform/pricing.

"Blockchain Strategy of the Federal Government." *Federal Ministry of Economic Affairs and Energy, Government of France*. September 2019. *https://www.bmwi.de/Redaktion/EN/Publikationen/Digitale-Welt/blockchain-strategy.html*

"Blockchain Technology: A Global Startup Hub Analysis." Accessed January 27, 2021. https://www.startus-insights.com/innovators-guide/blockchain-a-global-startup-hub-analysis/

"Case Studies." *Hyperledger*. Accessed February 22, 2021. https://www.hyperledger.org/learn/case-studies

"Crypto Crime Summarized: Scams and Darknet Markets Dominated 2020 by Revenue, But Ransomware Is the Bigger Story." Chainanalysis. January 19, 2021. https://blog.chainalysis.com/reports/2021-crypto-crime-report-intro-ransomware-scams-darknet-markets.

"Cryptocurrency Exemption Colorado Digital Token Act." SB19-023. Colorado General Assembly. 2019 Regular Session. https://leg.colorado.gov/bills/sb19-023

"Digital Europe Programme: A Proposed €7.5 Billion of Funding for 2021-2027 | Shaping Europe's Digital Future." Accessed April 1, 2021. https://digital-strategy.ec.europa.eu/en/library/digital-europe-programme-proposed-eu75-billion-funding-2021-2027

"Doing Business 2020: Comparing Business Regulation in 190 Economies." *World Bank*. 2020. *https://openknowledge.worldbank.org/handle/10986/32436*

"Emirates Blockchain Strategy 2021 - The Official Portal of the UAE Government." *Government of UAE*. Accessed January 24, 2021. https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/emirates-blockchain-strategy-2021

"European Blockchain Services Infrastructure." *European Commission*. September 23, 2020. https://ec.europa.eu/digital-single-market/en/european-blockchain-services-infrastructure

"Financial Consumer Alert: List of Unauthorised Companies and Websites Has Been Updated. - Bank Negara Malaysia." 28 May, 2019. https://www.bnm.gov.my/-/financial-consumer-alert-list-of-unauthorised-companies-and-websites-has-been-updated.-45

"FinTech Action plan: For a more competitive and innovative European financial sector" European Commission. 2018. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0109

"How Has Estonia Applied Blockchain Technology to the E-Government System?" *Lina Network*. September 7, 2020. https://lina.network/how-has-estonia-applied-blockchain-technology-to-the-e-government-system/

"ISO - ISO/TC 307 - Blockchain and Distributed Ledger Technologies." *International Organization for Standardization*. Accessed February 8, 2021. https://committee.iso.org/committee/6266604.html?view=participation.

"ISO - ISO/TC 307 - Blockchain and Distributed Ledger Technologies." *International Organization for Standardization.* Accessed February 5, 2021.
https://www.iso.org/committee/6266604/x/catalogue/p/1/u/0/w/0/d/0.

"JPM Coin Goes into Production, Launches JP Morgan Onyx Blockchain Unit." *Ledger Insights*. October 27, 2020.
https://ledgerinsights.com/jpm-coin-goes-into-production-launches-jp-morgan-onyx-blockchain-unit/

"Malaysia Releases New Guidelines for Crypto Blockchain Industry," *Unlock Blockchain*. January 22, 2020.
https://www.unlock-bc.com/news/2020-01-22/malaysia-releases-new-guidelines-for-crypto-blockchain-industry

"Malaysia's New 'Blockchain Visa' Explained | Work in Malaysian Country," *Visas Malaysia*. August 2, 2019.
https://www.visasmalaysia.com/blockchain-visa-explained/

"National Blockchain Adoption Strategy: Streamlining into a Digital Future." Federal Ministry of Communication and Digital Economy, Government of Nigeria. 2020. tps://nitda.gov.ng/wp-content/uploads/2020/10/DRAFT-NATIONAL-BLOCKCHAIN-ADOPTION-STRATEGY.pdf

"Peru's Government Looks to Blockchain to Fight Corruption." *PeruReports*. Accessed February 8, 2021.
https://perureports.com/perus-government-looks-to-blockchain-to-fight-corruption/9045/

"Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on Markets in Crypto-assets, and amending Directive" *European Union*. 2019. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0593

"STELLA – joint research project of the European Central Bank and the Bank of Japan: Synchronised cross-border payments." European Central Bank and Bank of Japan. June, 2019.
https://www.ecb.europa.eu/paym/intro/publications/pdf/ecb.miptopical190604.en.pdf

"SWIFT Announces R3 Enterprise Blockchain Payments Trial." *Ledger Insights.* January 30, 2019.
https://www.ledgerinsights.com/swift-announces-r3-enterprise-blockchain-payments-trial/

"The Blockchain Report 2020: Financing, Themes, Coronavirus, and the Year Ahead." *CBInsights.* 2020.
https://www.cbinsights.com/research/report/blockchain-report-2020/

"The National Blockchain Roadmap: Progressing Towards a Blockchain-Empowered Future." *Department of Industry, Science, Energy and Resources, Government of Australian.* February, 2020.
https://www.industry.gov.au/sites/default/files/2020-02/national-blockchain-roadmap.pdf

"UNICEF Funding Opportunity for Blockchain Startups." UNICEF Innovation. Accessed April 26, 2021.
https://www.unicef.org/innovation/applyBlockchainCrypto.

"Vnesheconombank and BRICS Development Banks Will Research the Implementation of Blockchain Technology." *Bloomberg.* July 26, 2018. https://www.bloomberg.com/press-releases/2018-07-26/vnesheconombank-and-brics-development-banks-will-research-the-implementation-of-blockchain-technology

"Who We Are » IBI," *IBI*. August 15, 2020. https://indianblockchaininstitute.com/get-to-know-us/what-is-ibi/

"Why World Leader Crypto Exchange Binance Moved to Malta." *MaltaToday*. February 22, 2019.
http://www.maltatoday.com.mt/business/business_news/93170/why_world_leader_crypto_exchange_binance_moved_to_malta

Alhattab, Sara. "Cryptocurrency Fund Announces Its Largest Investment of Startups in Developing and Emerging Economies." *UNICEF*. June 19, 2020. https://www.unicef.org/press-releases/unicef-cryptocurrency-fund-announces-its-largest-investment-startups-developing-and

Aristidou, Christiana, and Evdokia Marcou. "Blockchain Standards and Government Applications." *Journal of ICT Standardization* 7, no. 3 (September 30, 2019): 287–312. https://doi.org/10.13052/jicts2245-800X.736.

Balllard, Barclay. "Crypto Wallet Data Breach Compromises Hundreds of Thousands of Users." *TechRadar.* Dec 21, 2020. https://www.techradar.com/news/crypto-wallet-data-breach-compromises-hundreds-of-thousands-of-users.

Beedham, Matthew. "South Korea Launches Training to Create the next Generation of Blockchain Experts." *Hard Fork | The Next Web*, September 4, 2018. https://thenextweb.com/hardfork/2018/09/04/south-korea-blockchain-training/.

Behlendorf, Brian and Ron Resnick. "Growing the Enterprise Blockchain Ecosystem Through Open Standards and Open Source Code." Enterprise Ethereum Alliance, October 25, 2018. https://entethalliance.org/growing-the-enterprise-blockchain-ecosystem-through-open-standards-and-open-source-code/

Berman, Ana. "Chile: Crypto Exchange Loses Ongoing Legal Battle in Supreme Court Ruling." *Cointelegraph*. 2018. https://cointelegraph.com/news/chile-crypto-exchange-loses-ongoing-legal-battle-in-supreme-court-ruling.

Boar, Codruta, and Andreas Wehrli. "Ready, steady, go? – Results of the third BIS survey on central bank digital currency." Bankfor International Settlements. Monetary and Economic Dept. BIS Papers no. 114. January 2021. https://www.bis.org/publ/bppdf/bispap114.pdf

Brühl, Volker. "Libra — A Differentiated View on Facebook's Virtual Currency Project." *Inter Economics* 55, no. 1. 2020. 54-61.

Brummer, Christopher J., Trevor Kiviat, and Jai Ruhi Massari. "What Should Be Disclosed in an Initial Coin Offering?". *Cryptoassets: Legal and Monetary Perspectives, OUP Press Forthcoming*. November 29, 2018. Available at SSRN: https://ssrn.com/abstract=3293311

Canellis, David. "Criminals Used Bitcoin to Launder $2.5B in Dirty Money, Data Shows." *The Next Web*. October 10, 2018. https://thenextweb.com/hardfork/2018/10/10/bitcoin-money-laundering/.

Casey, Michael J. "Regulators Are Slowly Starting to Get It: Utility Tokens Are Real". *CoinDesk.* 2018. https://www.coindesk.com/regulators-are-slowly-starting-to-get-it-utility-tokens-are-real.

CEF Digital. "EBSI." 2020. https://ec.europa.eu/cefdigital/wiki/cefdigital/wiki/display/CEFDIGITAL/EBSI

CoinMarketCap. "Cryptocurrency Prices, Charts And Market Capitalizations - Page 45." Accessed March 29, 2021. https://coinmarketcap.com/.

Comben, Christina "Malaysia Bans Initial Coin Offerings." Coin Rivet, January 16, 2020. https://coinrivet.com/malaysian- regulation-bans-initial-coin-offerings/.

ComplyAdvantage. "Crypto Regulations in Japan." Accessed April 3, 2021. https://complyadvantage.com/knowledgebase/crypto-regulations/cryptocurrency-regulations- japan/

Daniel D. "Baltic Countries Sign Memorandum to Develop Blockchain Technology." *WorldCoinIndex*. Nov 2017. https://www.worldcoinindex.com/news/baltic-countries-sign-memorandum-to-develop-blockchain-technology.

Davis, Steve et al. "PWC's Global Blockchain Survey 2018." PWC. 2018. https://www.pwccn.com/en/research-and-insights/publications/global-blockchain-survey- 2018/global-blockchain-survey-2018-report.pdf

Dharmaraj, Samaya. "Maharashtra, India to Adopt Blockchain Tech for Governance." *OpenGov Asia*. August 20, 2019. https://opengovasia.com/maharashtra-india-to-adopt-blockchain-tech-for-governance/

Dillet, Romaine. "Visa Supports Transaction Settlement with USDC Stablecoin." *TechCrunch*. Mar 29, 2021. https://social.techcrunch.com/2021/03/29/visa-supports-transaction-settlement-with-usdc-stablecoin/

Dotson, KYT. "ODH and Hashed Health Join Forces to Build Healthcare Blockchain." *Silicon Angle*. February 20, 2018. https://siliconangle.com/2018/02/20/odh-hashed-health-join-forces-build-market-centric-healthcare-blockchain/

Dutch Blockchain Coalition. "About the Dutch Blockchain Coalition - Blockchain." *Dutch Blockchain Coalition*. 2021 https://dutchblockchaincoalition.org/en/about-dbc.

Dutta, Sachin. "Switzerland Crypto Regulations: KYC, Taxes & FINMA." *Coinfirm*. Jan 12, 2021. https://www.coinfirm.com/blog/switzerland-crypto-regulations/

e-Estonia. "KSI Blockchain." Accessed February 11, 2021. https://e-estonia.com/solutions/security-and-safety/ksi-blockchain/

Ellul, Joshua, Galea, J., Ganado, M. *et al.* "Regulating Blockchain, DLT and Smart Contracts: a technology regulator's perspective." *ERA Forum* 21, 209–220. 2020. https://doi.org/10.1007/s12027-020-00617-7

Ellul, Joshua, Jonathan Galea, Max Ganado, Stephen Mccarthy, and Gordon J. Pace. "Regulating Blockchain, DLT and Smart Contracts: A Technology Regulator's Perspective." *ERA Forum* 21, no. 2. 2020. 209–20. https://doi.org/10.1007/s12027-020 00617-7.

Evander, Pierre. "Enterprise Ethereum Alliance Launches." *Enterprise Ethereum Alliance*. February, 2017. https://entethalliance.org/enterprise-ethereum-alliance-launches/

Handagama, Sandali and Jaspreet Kalra. "BitLicense at 5: A Timeline of New York's Landmark Cryptocurrency Regulation," CoinDesk. June 24, 2020. https://www.coindesk.com/bitlicense-timeline.

Hansen, Patrick. "New Crypto Rules in the European Union – Gateway for Mass Adoption, or Excessive Regulation?" SLS Blogs, Stanford Law School. January 12, 2021 https://law.stanford.edu/2021/01/12/new-crypto-rules-in-the-eu-gateway-for-mass-adoption-or-excessive-regulation/.

Helmes, Kevin. "Indian Government's Institute Offers Blockchain Training in Multiple Cities." Bitcoin News. December 29, 2019. https://news.bitcoin.com/indian-governments-institute-offers-blockchain-training-in-multiple-cities/

Helms, Kevin. "Japan Implements Significant Changes to Cryptocurrency Regulation Today," *Bitcoin News*. May 1, 2020. https://news.bitcoin.com/japan-changes-cryptocurrency-regulation/

Hendry, Scott, and Sopnendu Mohanty. "Enabling Cross-Border High Value Transfer Using Distributed Ledger Technologies." *Accenture*. https://www.accenture.com/_acnmedia/PDF-99/Accenture-Cross-Border-Distributed-Ledger-Technologies.pdf

Hofer, Lukas. "What Is Liechtenstein's Unit for Financial Center Innovation," ICO.li. December 19, 2019. https://www.ico.li/what-is-liechtensteins-unit-for-financial-center-innovation/.

Hollerith, David. "Kenya's Government Task Force to Explore Blockchains for Land and Education." Bitcoin Magazine: Bitcoin News, Articles, Charts, and Guides. March 7, 2018. https://bitcoinmagazine.com/business/kenyas-government-task-force-explore-blockchains-land-and-education.

ID2020. "ID2020 | Manifesto." Accessed April 2, 2021. http://id2020.org/manifesto

James Duncan. "Blockchain Developers Worldwide Stats (Absolute vs Relative to Population)." *Dappros, London UK Blockchain Software Developers* (blog), September 30, 2018. https://www.dappros.com/201809/blockchain-developers-worldwide-stats-absolute-vs-relative-to-population/.

Jenkinson, Gareth "Forks in the Road: 2017 Bitcoin Forks." *Cointelegraph.* January 03, 2018. https://cointelegraph.com/news/forks-in-the-road-2017-bitcoin-forks

Kot, Ivans. "Blockchain Standards: Are We There Yet?" *itransition*. August 06, 2020. https://www.itransition.com/blog/blockchain-standards.

Kozak, Tim. "Corda and Real Businesses Built on Top of This Framework." *Intellectsoft Blockchain Lab*. August 23, 2019. https://blockchain.intellectsoft.net/blog/corda-and-real-businesses-built-on-top-of-this-framework/

Kudovich, Yruiy. "How Cryptocurrency Mixers and Anonymous Wallets Work." *Decenter.* 2018. https://decenter.org/en/how-cryptocurrency-mixers-and-anonymous-wallets-work

Kuznetsov, Nikolai. "SegWit, Explained." Cointelegraph. September 29, 2019. https://cointelegraph.com/explained/segwit-explained

Lam, Eric. "What the World's Central Banks Are Saying about Cryptocurrencies." Livemint. January 29, 2018. https://www.livemint.com/Industry/4UdMBlxKj3bqyMygErZ03H/What-the-worlds-central-banks-are-saying-about-cryptocurren.html

Lannquist, Ashley, Sheila Warren, and Richard Samans. "Central Bank Digital Currency Policy-Maker Toolkit" Insight Report, Center for Fourth Industrial Revolution, World Economic Forum. January, 2020. http://www3.weforum.org/docs/WEF_CBDC_Policymaker_Toolkit.pdf

Law Library of Congress. "Regulation of Cryptocurrency around the World." *Law Library of Congress, Global Legal Research Center,* 2018.

Livni, Ephrat. "What's Next for Crypto Regulation." *The New York Times*, sec. Business. January 30, 2021, https://www.nytimes.com/2021/01/30/business/dealbook/crypto-regulation-blockchain.html.

Lundvall, Bengt-Åke. "National Innovation Systems-Analytical Concept and Development Tool." *Industry and Innovation* 14, no. 1. 2007.

Lundvall, Bengt-Åke. "National Systems of Innovation." Vol. 1. *Anthem Other Canon Economics*. London: NBN International, 2010.

Lyles, Taylor. "PayPal Will Let US Users Pay with Bitcoin, Ethereum, and Litecoin Starting Today." *The Verge* Mar 30, 2021. https://www.theverge.com/2021/3/30/22357246/paypal-buy-with-bitcoin-litecoin-ethereum-crypto-checkout.

Mazlan. "Malaysian Regulation and Consumer Protection of ECommerce and Online Business." *ToughNickel - Money*. June 15, 2020. https://toughnickel.com/business/Changes-to-the-Law-on-Ecommerce-and-Online-Business-in-Malaysia

Morel, Robert. "Use Case and Applications of Ripple (XRP)," *BISS Research*. 2020. https://www.bissresearch.com/use-case-and-applications-of-ripple-xrp/

Moskowitz, David. "How Singapore Became a Hot ICO Destination," *VentureBeat*. September 3, 2017. https://venturebeat.com/2017/09/03/how-singapore-became-a-hot-ico-destination/.

NFT "Everydays" by the artist Beeple sold for $69 million in 2021. Kastrenakes, Jacob. "Beeple Sold an NFT for $69 Million." The Verge, March 11, 2021. https://www.theverge.com/2021/3/11/22325054/beeple-christies-nft-sale-cost-everydays-69-million.

Pawczuk, Linda, Jonathan Holdowsky, Rob Massey, and Brian Hansen. "2020 Global Blockchain Survey" Deloitte Insights, Deloitte. 2020. https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain survey/DI_CIR%202020%20global%20blockchain%20survey.pdf.

Pillai, Shalina, "Indian Startups Raise Funds through Cryptocurrencies" The Times of India. Mar5, 2018. https://timesofindia.indiatimes.com/trend-tracking/startups-raise-funds-cryptocurrency/articleshow/63128709.cms.

PricewaterhouseCoopers. "Malta's New Regulatory Framework Built for Blockchain Technology." PwC. Accessed February 11, 2021. https://www.pwc.com/mt/en/publications/technology/pwc-malta-blockchain-alert.html

Prinsloo, Loni and Roxanne Henderson. "Poor Regulation Pushing South Africa's Crypto Firms to Relocate." Al Jazeera. March 9, 2021. https://www.aljazeera.com/economy/2021/3/9/bpoor-regulation-pushing-south-africas-crypto-firms-to-relocate

Puel, Jean-Marc, David Chreng-Messembourg, and Baptiste Cota. "Enterprise Blockchain 2020: Data driven insights into the uncharted Enterprise Blockchain World & Data Economy." *LeadBlock Partners.* July, 2020. http://leadblockpartners.com/docs/Enterprise%20Blockchain%202020%20-%20LeadBlock%20Partners.pdf

Rahman, Hafiz. "The First Documented Purchase Using Bitcoin: 10,000 BTC For 2 Pizzas." *Eyerys*, February 9, 2020. https://www.eyerys.com/articles/timeline/first-documented-purchase-using-bitcoin-10000-btc-2-pizzas.

Robinson, Tom. "Bitcoin Is Not Anonymous." *Elliptic*. 2015. https://www.elliptic.co/blog/bitcoin-transactions-money-laundering

Sharon, Alita. "HKSTP Launches Fintech Centre." OpenGov Asia. January 21, 2021. https://opengovasia.com/hkstp-launches-fintech-centre/

Shrivastava, Aditi. "Binance Labs: Cryptocurrency Exchange Binance Sets up $50 Million Indian Blockchain Fund." *The Economic Times*. May 17, 2020. https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/cryptocurrency-exchange-binance-sets-up-50-million-indian-blockchain-fund/articleshow/74665232.cms?from=mdr

Steele, Anne. "Musicians Turn to NFTs to Make Up for Lost Revenue." *Wall Street Journal*, March 23, 2021, sec. Business. https://www.wsj.com/articles/nfts-are-music-industrys-latest-big-hit-11616491801.

Sygna. "FATF Travel Rule and AML/KYC Guide For VASPs," January 8, 2020. https://www.sygna.io/blog/fatf-crypto-travel-rule- vs-aml-know-your-customer-kyc/.

Thomson, Greg. "Ethereum 2.0 Will Walk and 'Roll' for Two Years before It Can Run." *Decrypt*. 2020. https://decrypt.co/34204/ethereum-2-0-will-walk-and-roll-for-two-years-before-it-can-run.

Turner, Wright. "Japan STO Association Releases New Regulatory Guidelines." *CoinTelegraph*. April 21, 2020. https://cointelegraph.com/news/japan-sto-association-releases-new-regulatory-guidelines

United Nations Conference on Trade and Development. "World Investment Report 2020: International Production Beyond the Pandemic." UNCTAD: 30th Anniversary Edition. Jun, 2020. https://unctad.org/webflyer/world-investment-report-2020

Warren, Tom. "Tesla to Accept Bitcoin as Payment in 'near Future' after $1.5 Billion Investment." *The Verge*. February 9, 2021. https://www.theverge.com/2021/2/8/22272103/tesla-bitcoin-investment-1-5-billion-cryptocurrency-payments.

Wey, Alexandra "'Crypto Valley' Canton to Accept Bitcoin for Tax Payments." *SWI swissinfo.ch*. September 3, 2020. https://www.swissinfo.ch/eng/-crypto-valley--canton-to-accept-bitcoin-for-tax-payments/46010364

Endnotes:

[i] Rahman, Hafiz. "The First Documented Purchase Using Bitcoin: 10,000 BTC For 2 Pizzas." *Eyerys*, February 9, 2020. https://www.eyerys.com/articles/timeline/first-documented-purchase-using-bitcoin-10000-btc-2-pizzas.

[ii] Warren, Tom. "Tesla to Accept Bitcoin as Payment in 'near Future' after $1.5 Billion Investment." *The Verge*. February 9, 2021.https://www.theverge.com/2021/2/8/22272103/tesla-bitcoin-investment-1-5-billion-cryptocurrency-payments.

[iii] Boar, Codruta, and Andreas Wehrli. "Ready, steady, go? – Results of the third BIS survey on central bank digital currency."Bank for International Settlements. Monetary and Economic Dept. BIS Papers no. 114. January 2021. https://www.bis.org/publ/bppdf/bispap114.pdf

[iv] Steele, Anne. "Musicians Turn to NFTs to Make Up for Lost Revenue." *Wall Street Journal*, March 23, 2021, sec. Business.https://www.wsj.com/articles/nfts-are-music-industrys-latest-big-hit-11616491801.

[v] NFT "Everydays" by the artist Beeple sold for $69 million in 2021. Kastrenakes, Jacob. "Beeple Sold an NFT for $69 Million."The Verge, March 11, 2021. https://www.theverge.com/2021/3/11/22325054/beeple-christies-nft-sale-cost-everydays-69- million.

[vi] Respondents were senior executives from 14 countries with a broad understanding of Blockchain technology.

[vii] Pawczuk, Linda, Jonathan Holdowsky, Rob Massey, and Brian Hansen. "2020 Global Blockchain Survey" Deloitte Insights,Deloitte. 2020. https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain survey/DI_CIR%202020%20global%20blockchain%20survey.pdf.

[viii] For a collection of reactions from central banks regarding Diem (previously Libra), see: Brühl, Volker. "Libra — A Differentiated View on Facebook's Virtual Currency Project." *Inter Economics* 55, no. 1. 2020. Pg. 1.

[ix] Puel, Jean-Marc, David Chreng-Messembourg, and Baptiste Cota. "Enterprise Blockchain 2020: Data driven insights into theuncharted Enterprise Blockchain World & Data Economy." *LeadBlock Partners.* July, 2020. http://leadblockpartners.com/docs/Enterprise%20Blockchain%202020%20-%20LeadBlock%20Partners.pdf

[x] Ibid.

[xi] Prinsloo, Loni and Roxanne Henderson. "Poor Regulation Pushing South Africa's Crypto Firms to Relocate." Al Jazeera. March9, 2021. https://www.aljazeera.com/economy/2021/3/9/bpoor-regulation-pushing-south-africas-crypto-firms-to-relocate

[xii] The survey polls 1,488 senior executives from 14 countries: Brazil, Canada, China, Germany, Hong Kong, Ireland, Israel, Mexico, Singapore, South Africa, Switzerland, UAE, UK, and USA. Pawczuk, Linda, Jonathan Holdowsky, Rob Massey, and Brian Hansen. "2020 Global Blockchain Survey" Deloitte Insights, Deloitte. 2020. https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain survey/DI_CIR%202020%20global%20blockchain%20survey.pdf.

[xiii] Ibid.

[xiv] Ibid.

[xv] Chart from survey conducted by PWC of 600 executives from 15 territories. Full report: Davis, Steve et al. "PWC's GlobalBlockchain Survey 2018." PWC. 2018. https://www.pwccn.com/en/research-and-insights/publications/global-blockchain- survey-2018/global-blockchain-survey-2018-report.pdf

[xvi] "Regulation of Cryptocurrency around the World." *Law Library of Congress, Global Legal Research Center*. 2018.https://www.loc.gov/law/help/cryptocurrency/world-survey.php

[xvii] A collection of responses from central banks: Lam, Eric. "What the World's Central Banks Are Saying about Cryptocurrencies." Livemint. January 29, 2018. https://www.livemint.com/Industry/4UdMBlxKj3bqyMygErZ03H/What-the-worlds-central-banks-are-saying-about-cryptocurren.html.

[xviii] Ellul, J., Galea, J., Ganado, M. *et al.* "Regulating Blockchain, DLT and Smart Contracts: a technology regulator'sperspective." *ERA Forum* 21, 209–220. 2020. https://doi.org/10.1007/s12027-020-00617-7

[xix] "Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on Markets in Crypto-assets, andamending Directive" *European Union*. 2019/1937. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0593

[xx] Hansen, Patrick. "New Crypto Rules in the European Union – Gateway for Mass Adoption, or Excessive Regulation?" SLS Blogs, Stanford Law School. January 12, 2021. https://law.stanford.edu/2021/01/12/new-crypto-rules-in-the-eu-gateway-for-mass-adoption-or-excessive-regulation/.

xxi "Cryptocurrency Exemption Colorado Digital Token Act." SB19-023. Colorado General Assembly. 2019 Regular Session.https://leg.colorado.gov/bills/sb19-023

xxii Casey, Michael J. "Regulators Are Slowly Starting to Get It: Utility Tokens Are Real". *CoinDesk*. 2018. https://www.coindesk.com/regulators-are-slowly-starting-to-get-it-utility-tokens-are-real.

xxiii Dutta, Sachin. "Switzerland Crypto Regulations: KYC, Taxes & FINMA." *Coinfirm*. January 12, 2021.https://www.coinfirm.com/blog/switzerland-crypto-regulations/

xxiv Casey, Michael J. "Regulators are Slowly Starting to Get It: Utility Tokens Are Real". *Coindesk*. 2018.https://www.coindesk.com/regulators-are-slowly-starting-to-get-it-utility-tokens-are-real

xxv ComplyAdvantage. "Crypto Regulations in Japan." Accessed April 3, 2021. https://complyadvantage.com/knowledgebase/crypto-regulations/cryptocurrency-regulations-japan/

xxvi Helms, Kevin. "Japan Implements Significant Changes to Cryptocurrency Regulation Today," *Bitcoin News*. May 1, 2020.https://news.bitcoin.com/japan-changes-cryptocurrency-regulation/

xxvii Law Library of Congress. "Global Legal Research Directorate Issuing Body. Regulation of Cryptocurrency around the World." *Law Library of Congress, Global Legal Research Center*. 2018.

xxviii From interview: Nelly Chateu-Diop, CEO of Ejara.

xxix Detailed explanation of the National Innovation System: Lundvall, Bengt-Åke. "National Systems of Innovation." Vol. 1. *Anthem Other Canon Economics*. London: NBN International, 2010.

xxx NIS is a framework to analyze the process of innovation which focuses on interactive learning from national level actors: firms, universities, research institutes, funding actors, and the government. The framework focuses on actors, interlinkages, and the innovations environment.

xxxi Lundvall, Bengt-Åke. "National Innovation Systems-Analytical Concept and Development Tool." *Industry and Innovation* 14,no. 1. 2007.

xxxii CEF Digital. "EBSI." 2020. https://ec.europa.eu/cefdigital/wiki/cefdigital/wiki/display/CEFDIGITAL/EBSI

xxxiii Dutch Blockchain Coalition. "About the Dutch Blockchain Coalition - Blockchain." *Dutch Blockchain Coalition*. 2021https://dutchblockchaincoalition.org/en/about-dbc.

xxxiv See World Bank's *Doing Business* framework: World Bank. "*Doing Business 2020 : Comparing Business Regulation in 190 Economies*." Washington, DC: World Bank, 2020.

xxxv "*Doing Business 2020: Comparing Business Regulation in 190 Economies.*" World Bank. 2020.https://openknowledge.worldbank.org/handle/10986/32436

xxxvi Moskowitz, David. "How Singapore Became a Hot ICO Destination," *VentureBeat*. September 3, 2017.https://venturebeat.com/2017/09/03/how-singapore-became-a-hot-ico-destination/.

xxxvii Brummer, Christopher J., Trevor Kiviat, and Jai Ruhi Massari. "What Should Be Disclosed in an Initial Coin Offering?". *Cryptoassets: Legal and Monetary Perspectives, OUP Press Forthcoming*. November 29, 2018. Available at SSRN: https://ssrn.com/abstract=3293311

xxxviii Shrivastava, Aditi. "Binance Labs: Cryptocurrency Exchange Binance Sets up $50 Million Indian Blockchain Fund." *The Economic Times*. May 17, 2020. https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/cryptocurrency-exchange-binance-sets-up-50-million-indian-blockchain-fund/articleshow/74665232.cms?from=mdr

xxxix Eight companies received awards in cryptocurrencies, which cost less than $20 and took less than 20 minutes. Alhattab, Sara. "Cryptocurrency Fund Announces Its Largest Investment of Startups in Developing and Emerging Economies." *UNICEF*. June 19, 2020. https://www.unicef.org/press-releases/unicef-cryptocurrency-fund-announces-its-largest-investment-startups-developing-and

xl Turner, Wright. "Japan STO Association Releases New Regulatory Guidelines." *CoinTelegraph*. April 21, 2020.https://cointelegraph.com/news/japan-sto-association-releases-new-regulatory-guidelines

xli Wey, Alexandra "'Crypto Valley' Canton to Accept Bitcoin for Tax Payments." *SWI swissinfo.ch*. September 3, 2020.https://www.swissinfo.ch/eng/-crypto-valley--canton-to-accept-bitcoin-for-tax-payments/46010364

xlii Singapore is the 5th largest FDI destination, more than half in financial and insurance. See: United Nations Conference on Trade and Development. "World Investment Report 2020: International Production Beyond the Pandemic." UNCTAD: 30th Anniversary Edition. Jun, 2020. https://unctad.org/webflyer/world-investment-report-2020

xliii See full document: "National Blockchain Adoption Strategy: Streamlining into a Digital Future." Federal Ministry of Communication and Digital Economy, Government of Nigeria. 2020. ttps://nitda.gov.ng/wp-content/uploads/2020/10/DRAFT-

NATIONAL-BLOCKCHAIN-ADOPTION-STRATEGY.pdf

xliv Hofer, Lukas. "What Is Liechtenstein's Unit for Financial Center Innovation," ICO.li. December 19, 2019.https://www.ico.li/what-is-liechtensteins-unit-for-financial-center-innovation/.

xlv Hollerith, David. "Kenya's Government Task Force to Explore Blockchains for Land and Education." Bitcoin Magazine: BitcoinNews, Articles, Charts, and Guides. March 7, 2018. https://bitcoinmagazine.com/business/kenyas-government-task-force- explore-blockchains-land-and-education.

xlvi Top 17 countries with highest number of Blockchain developers are, in order: U.S., India, U.K., Canada, France, Germany, Netherlands, Australia, Spain, Brazil, Italy, Singapore, Switzerland, China, Ukraine, South Korea, and the UAE. James Duncan. "Blockchain Developers Worldwide Stats (Absolute vs Relative to Population)." *Dappros, London UK Blockchain Software Developers* (blog), September 30, 2018. https://www.dappros.com/201809/blockchain-developers-worldwide-stats-absolute-vs-relative-to-population/.

xlvii "Who We Are » IBI," *IBI*. August 15, 2020. https://indianblockchaininstitute.com/get-to-know-us/what-is-ibi/

xlviii Helmes, Kevin. "Indian Government's Institute Offers Blockchain Training in Multiple Cities." Bitcoin News. December 29,2019. https://news.bitcoin.com/indian-governments-institute-offers-blockchain-training-in-multiple-cities/

xlix Beedham, Matthew. "South Korea Launches Training to Create the next Generation of Blockchain Experts." *Hard Fork | TheNext Web*, September 4, 2018. https://thenextweb.com/hardfork/2018/09/04/south-korea-blockchain-training/.

l "Malaysia's New 'Blockchain Visa' Explained | Work in Malaysian Country," *Visas Malaysia*. August 2, 2019.https://www.visasmalaysia.com/blockchain-visa-explained/

li Livni, Ephrat. "What's Next for Crypto Regulation." *The New York Times*, sec. Business. January 30, 2021,https://www.nytimes.com/2021/01/30/business/dealbook/crypto-regulation-blockchain.html.

lii Berman, Ana. "Chile: Crypto Exchange Loses Ongoing Legal Battle in Supreme Court Ruling." *Cointelegraph*. 2018.https://cointelegraph.com/news/chile-crypto-exchange-loses-ongoing-legal-battle-in-supreme-court-ruling.

liii PricewaterhouseCoopers. "Malta's New Regulatory Framework Built for Blockchain Technology." PwC. Accessed February 11,2021. https://www.pwc.com/mt/en/publications/technology/pwc-malta-blockchain-alert.html

liv "Why World Leader Crypto Exchange Binance Moved to Malta." *MaltaToday*. February 22, 2019. http://www.maltatoday.com.mt/business/business_news/93170/why_world_leader_crypto_exchange_binance_moved_to_malta

lv ID2020. "ID2020 | Manifesto." Accessed April 2, 2021. http://id2020.org/manifesto

lvi Sharon, Alita. "HKSTP Launches Fintech Centre." OpenGov Asia. January 21, 2021. https://opengovasia.com/hkstp-launches-fintech-centre/

lvii "Emirates Blockchain Strategy 2021 - The Official Portal of the UAE Government." *Government of UAE*. Accessed January 24,2021. https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/emirates- blockchain-strategy-2021

lviii There is disagreement in whether the attributes shared by KSI and Blockchain platforms such as Bitcoin entail that KSI is aBlockchain platform. I use this example to showcase its utility, rather than attempt to resolve the argument.

lix e-Estonia. "KSI Blockchain." Accessed February 11, 2021. https://e-estonia.com/solutions/security-and-safety/ksi-blockchain/lx Behlendorf, Brian and Ron Resnick. "Growing the Enterprise Blockchain Ecosystem Through Open Standards and Open Source Code." Enterprise Ethereum Alliance, October 25, 2018. https://entethalliance.org/growing-the-enterprise-blockchain- ecosystem-through-open-standards-and-open-source-code/

lxi IEEE: Institute of Electrical and Electronics Engineers (https://blockchain.ieee.org/); ISO: International Organization forStandardization (https://www.iso.org/committee/6266604.html)

lxii "Vnesheconombank and BRICS Development Banks Will Research the Implementation of Blockchain Technology." *Bloomberg*. July 26, 2018. https://www.bloomberg.com/press-releases/2018-07-26/vnesheconombank-and-brics-development-banks-will-research-the-implementation-of-blockchain-technology

lxiii Daniel D. "Baltic Countries Sign Memorandum to Develop Blockchain Technology." *WorldCoinIndex*. Nov 2017.https://www.worldcoinindex.com/news/baltic-countries-sign-memorandum-to-develop-blockchain-technology. lxiv From interview with Edgars Ozolins Ozols, Digital Team Lead, Ministry of Economy, Latvia

lxv Kot, Ivans. "Blockchain Standards: Are We There Yet?" *itransition*. August 06, 2020.https://www.itransition.com/blog/blockchain-standards.

lxvi "STELLA – joint research project of the European Central Bank and the Bank of Japan: Synchronised cross-border payments."European Central Bank and Bank of Japan. June, 2019.

https://www.ecb.europa.eu/paym/intro/publications/pdf/ecb.miptopical190604.en.pdf

lxvii Hendry, Scott, and Sopnendu Mohanty. "Enabling Cross-Border High Value Transfer Using Distributed Ledger Technologies." *Accenture*. https://www.accenture.com/_acnmedia/PDF-99/Accenture-Cross-Border-Distributed-Ledger-Technologies.pdf

lxviii "Financial Consumer Alert: List of Unauthorised Companies and Websites Has Been Updated. - Bank Negara Malaysia." 28May, 2019. https://www.bnm.gov.my/-/financial-consumer-alert-list-of-unauthorised-companies-and-websites-has-been-updated.-45

lxix IEOs prevent risky and unviable projects to issue tokens and provides more protection to retail investors. See: Comben, Christina "Malaysia Bans Initial Coin Offerings." Coin Rivet, January 16, 2020. https://coinrivet.com/malaysian-regulation-bans-initial-coin-offerings/.

lxx Mazlan. "Malaysian Regulation and Consumer Protection of ECommerce and Online Business." *ToughNickel - Money*. June15, 2020. https://toughnickel.com/business/Changes-to-the-Law-on-Ecommerce-and-Online-Business-in-Malaysia

lxxi "ISO - ISO/TC 307 - Blockchain and Distributed Ledger Technologies." Accessed February 8, 2021.https://committee.iso.org/committee/6266604.html?view=participation.

lxxii Indian Blockchain companies are raising funds from Europe through ICOs. Pillai, Shalina, "Indian Startups RaiseFunds through Cryptocurrencies" The Times of India. Mar5, 2018. https://timesofindia.indiatimes.com/trend- tracking/startups-raise-funds-cryptocurrency/articleshow/63128709.cms.

lxxiii International funding resources such as: "UNICEF Funding Opportunity for Blockchain Startups." UNICEFInnovation. Accessed April 26, 2021. https://www.unicef.org/innovation/applyBlockchainCrypto.

lxxiv "The Blockchain Report 2020: Financing, Themes, Coronavirus, and the Year Ahead." *CBInsights*. 2020.https://www.cbinsights.com/research/report/blockchain-report-2020/

lxxv Handagama, Sandali, and Kalra, Jaspreet. "BitLicense at 5: A Timeline of New York's Landmark CryptocurrencyRegulation," CoinDesk. June 24, 2020. https://www.coindesk.com/bitlicense-timeline.

lxxvi "FinTech Action plan: For a more competitive and innovative European financial sector" European Commission. 2018. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0109

lxxvii Ibid.

lxxviii "Blockchain Technology: A Global Startup Hub Analysis." Accessed January 27, 2021. https://www.startus-insights.com/innovators-guide/blockchain-a-global-startup-hub-analysis/

lxxix "Peru's Government Looks to Blockchain to Fight Corruption." *PeruReports*. Accessed February 8, 2021.https://perureports.com/perus-government-looks-to-blockchain-to-fight-corruption/9045/

lxxx Dharmaraj, Samaya. "Maharashtra, India to Adopt Blockchain Tech for Governance." *OpenGov Asia*. August 20, 2019.https://opengovasia.com/maharashtra-india-to-adopt-blockchain-tech-for-governance/

lxxxi Ibid.

lxxxii The Financial Action Task Force (FATF) introduced the travel rule which requires that financial institutions provide the beneficiary and originator's personally identifiable information (PII) to recipient institutions for transfers over $1000. The FATF travel rule mirrors the travel rule of the Banking Secrecy Act of the United States. See: Sygna. "FATF Travel Rule and AML/KYC Guide For VASPs," January 8, 2020. https://www.sygna.io/blog/fatf-crypto-travel-rule-vs-aml-know-your-customer-kyc/.

lxxxiii "About – IndiaStack." *IndiaStack*. Accessed February 3, 2021. https://www.indiastack.org/about/

lxxxiv Ibid.

lxxxv "ISO - ISO/TC 307 - Blockchain and Distributed Ledger Technologies." *International Organization for Standardization*. Accessed February 8, 2021. https://committee.iso.org/committee/6266604.html?view=participation.

lxxxvi "ISO - ISO/TC 307 - Blockchain and Distributed Ledger Technologies." *International Organization for Standardization*. Accessed February 5, 2021. https://www.iso.org/committee/6266604/x/catalogue/p/1/u/0/w/0/d/0.

lxxxvii Lyles, Taylor. "PayPal Will Let US Users Pay with Bitcoin, Ethereum, and Litecoin Starting Today." *The Verge* Mar 30, 2021.https://www.theverge.com/2021/3/30/22357246/paypal-buy-with-bitcoin-litecoin-ethereum-crypto-checkout.

lxxxviii Evander, Pierre. "Enterprise Ethereum Alliance Launches." *Enterprise Ethereum Alliance*. February, 2017.https://entethalliance.org/enterprise-ethereum-alliance-launches/

lxxxix Dotson, KYT. "ODH and Hashed Health Join Forces to Build Healthcare Blockchain." *Silicon Angle*. February 20, 2018.https://siliconangle.com/2018/02/20/odh-hashed-health-join-forces-build-market-centric-healthcare-blockchain/

xc Dillet, Romaine. "Visa Supports Transaction Settlement with USDC Stablecoin." *TechCrunch*. Mar 29, 2021.https://social.techcrunch.com/2021/03/29/visa-supports-transaction-settlement-with-usdc-stablecoin/

xci This was the case in the Ross Ulbricht case, the owner of Silk Road, the largest online marketplace for illegal goods andservices. Ulbricht's Bitcoin wallet in his laptop was shown to be receiving a large amount of Bitcoin from Silkroad's Bitcoinwallet. See: Robinson, Tom. "Bitcoin Is Not Anonymous." *Elliptic.* 2015. https://www.elliptic.co/blog/bitcoin-transactions- money-laundering

xcii Mixing services relays transactions through many accounts to obfuscate the sender and receiver of the transaction. See: Kudovich, Yruiy. "How Cryptocurrency Mixers and Anonymous Wallets Work." *Decenter.* 2018. https://decenter.org/en/how-cryptocurrency-mixers-and-anonymous-wallets-work

xciii Canellis, David. "Criminals Used Bitcoin to Launder $2.5B in Dirty Money, Data Shows." *The Next Web.* October 10, 2018.https://thenextweb.com/hardfork/2018/10/10/bitcoin-money-laundering/.

xciv Balllard, Barclay. "Crypto Wallet Data Breach Compromises Hundreds of Thousands of Users." *TechRadar.* Dec 21, 2020.https://www.techradar.com/news/crypto-wallet-data-breach-compromises-hundreds-of-thousands-of-users.

xcv "Crypto Crime Summarized: Scams and Darknet Markets Dominated 2020 by Revenue, But Ransomware Is the Bigger Story."Chainanalysis. January 19, 2021. https://blog.chainalysis.com/reports/2021-crypto-crime-report-intro-ransomware-scams- darknet-markets.

xcvi interviews: Ashley Lannquist, Project Lead, Blockchain and Digital Currencies, WEF.

xcvii Lannquist, Ashley, Sheila Warren, and Richard Samans. "Central Bank Digital Currency Policy-Maker Toolkit" Insight Report,Center for Fourth Industrial Revolution, World Economic Forum. January, 2020. http://www3.weforum.org/docs/WEF_CBDC_Policymaker_Toolkit.pdf

xcviii Ibid.
xcix Interview: Ashley Lannquist, Project Lead, Blockchain and Digital Currencies, WEF.

c Ellul, Joshua, Jonathan Galea, Max Ganado, Stephen Mccarthy, and Gordon J. Pace. "Regulating Blockchain, DLT and Smart Contracts: A Technology Regulator's Perspective." *ERA Forum* 21, no. 2. 2020. 209–20. https://doi.org/10.1007/s12027-020 00617-7.

ci Ibid.
cii
Ibid.
ciii
Ibid.
civ "European Blockchain Services Infrastructure." *European Commission.* September 23, 2020.
https://ec.europa.eu/digital-single-market/en/european-blockchain-services-infrastructure
cv Ibid.
cvi Ibid.
cvii "Digital Europe Programme: A Proposed €7.5 Billion of Funding for 2021-2027 | Shaping Europe's Digital Future." Accessed April 1, 2021. https://digital-strategy.ec.europa.eu/en/library/digital-europe-programme-proposed-eu75-billion-funding-2021-2027
cviii "The Blockchain Report 2020: Financing, Themes, Coronavirus, and the Year Ahead." *CBInsights.*
2020.https://www.cbinsights.com/research/report/blockchain-report-2020/
cix Ibid., 4
cx Ibid.
cxi Ibid., 14.
cxii Ibid., 19.
cxiii "Blockchain Strategy of the Federal Government." *Federal Ministry of Economic Affairs and Energy, Government of France.*
September 2019. *https://www.bmwi.de/Redaktion/EN/Publikationen/Digitale-Welt/blockchain-strategy.html*
cxiv "The National Blockchain Roadmap: Progressing Towards a Blockchain-Empowered Future." *Department of Industry, Science,Energy and Resources, Government of Australian.* February, 2020. https://www.industry.gov.au/sites/default/files/2020-02/national-blockchain-roadmap.pdf
cxv Pawczuk, Linda, Jonathan Holdowsky, Rob Massey, and Brian Hansen. "2020 Global Blockchain Survey" Deloitte Insights,Deloitte. 2020. https://www2.deloitte.com/content/dam/insights/us/articles/6608_2020-global-blockchain survey/DI_CIR%202020%20global%20blockchain%20survey.pdf