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Harnessing blockchain for sustainable development: prospects and challenges

Report of the Secretary-General

Summary

This report discusses how countries and the international community could harness blockchain technology to contribute to development priorities and the Sustainable Development Goals. The great potential of blockchain technology to contribute to sustainable development is illustrated. Currently, however, most innovation has focused on financial applications and speculative gains in cryptoassets. This situation, combined with a lack of regulation and the fast pace of innovation, is a formula for financial bubbles and bursts. Blockchain technology is potentially a key technology in a new technological paradigm of increasing automation and integration of physical and virtual worlds, together with technologies such as artificial intelligence, robotics and gene editing. Similar moments in past technological revolutions offered windows of opportunity for some developing countries to catch up and for others to forge ahead. Governments and other stakeholders in developing countries should therefore seek to strengthen innovation systems to guide blockchain technology innovation towards inclusive and sustainable applications and strategically position their countries to benefit from this new wave of technological change.

Introduction

1. At its twenty-third session, in May 2020, the Commission on Science and Technology for Development of the United Nations selected "Harnessing blockchain for sustainable development: prospects and challenges" as one of its priority themes for the 2020–2021 intersessional period.

2. In an increasingly digitalized economy and society, security and accountability in relation to data transactions are critical for creating trust and enabling breakthrough innovations in the digital world. In this regard, blockchain technology could be a game changer, with the potential to revolutionize processes from finance to pharmaceutical industries, from government public services to humanitarian work and development aid. Blockchain technology serves as the base technology for cryptocurrencies, enabling open (peer-to-peer), secure and fast transactions. The application of blockchain technology has expanded to include various financial transactions (e.g., online payments and exchange platforms), the Internet of things, health systems and supply chains.

3. However, issues associated with scalability, privacy concerns, uncertain regulatory standards and difficulties posed by the integration of technology into existing applications are some of the potential market constraints. There is also a risk that the potential of blockchain technology for solving developmental problems has been inflated by its early adopters and media writing about technology, and that it may not be as applicable for developing and least developed countries.

4. The secretariat of the Commission on Science and Technology for Development convened an intersessional panel from 17 to 22 January 2021 to better understand this theme and assist the Commission in deliberations at its twenty-fourth session. This report is based on the issues paper prepared by the Commission secretariat, the findings and recommendations of the intersessional panel, country case studies contributed by Member States of the Commission, relevant literature and other sources.[1]

I. Blockchain technology

5. Blockchain technology was invented to create bitcoin and serves as the base technology for other cryptocurrencies, enabling secure and peer-to-peer transactions recorded in a distributed ledger (i.e. electronically distributed registers of transactions).[2] Blockchain technology implements a secure distributed ledger through a combination of blocks of data, cryptography and an algorithm for the network nodes to "reach consensus" on transactions (see figure).

6. While the bitcoin network only records cryptocurrency transactions, second-generation blockchain technologies, such as Ethereum,[3] expand use of blockchain technology by recording "smart contracts"[4] in the ledger, which are executed automatically when the conditions of the contract are met. The latest advances are led by consortiums of

[1] The issues paper and contributions cited in this report are available at https://unctad.org/meeting/cstd-2020-2021-inter-sessional-panel. Contributions from the Governments of Austria, Belgium, Cuba, Finland, the Islamic Republic of Iran, Kenya, Latvia, Portugal, Romania, the Russian Federation, Saudi Arabia, Switzerland, Thailand, Turkey and the United Kingdom of Great Britain and Northern Ireland, as well as from the Economic Commission for Europe, Economic and Social Commission for Asia and the Pacific, Economic and Social Commission for Western Asia, Food and Agriculture Organization of the United Nations, International Trade Centre, International Telecommunication Union, United Nations Industrial Development Organization, World Food Programme and World Intellectual Property Organization, are gratefully acknowledged.

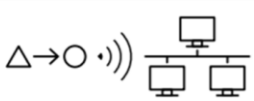
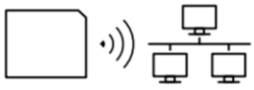
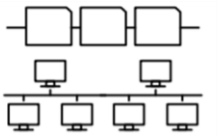
[2] Nakamoto S, 2008, Bitcoin: a peer-to-peer electronic cash system. White paper, available at https://bitcoin.org/bitcoin.pdf.

[3] https://ethereum.org/en/.

[4] Contracts implemented by computer code that are executed automatically in the blockchain when the conditions are met.

firms and other stakeholders, such as Hyperledger, Enterprise Ethereum Alliance and R3, to address shortcomings of previous implementations of blockchain technology, such as performance, scalability and interoperability.

How blockchain technology works

1	A transaction is submitted to a blockchain network		Users constantly send transactions to a blockchain network
2	All network nodes receive notification of a transaction		The transactions are received by the network nodes and their validity is verified
3	A new block of data is created and distributed in the blockchain (a chain of blocks of data)		One network node then groups the transactions into a new block
4	The blockchain is updated and the transaction, completed		The network node adds the newest block to the chain of blocks, and the transactions are confirmed

Source: UNCTAD, based on United Nations Innovation Network (2019). A practical guide to using blockchain within the United Nations, available at https://atrium.network/guide.

A. Applications and trends

7. According to some estimates, the market for blockchain technology solutions and applications was approximately $708 million in 2017; it is expected to exceed $60 billion in 2024.[5] Blockchain technology can be used in essentially any application. Currently, the prominent uses are in online payments, finance, international trade and global value chains.

1. Cryptocurrencies, tokens and online payments

8. The first use of and best-known blockchain technology application is for building cryptocurrencies and online payment systems with rapid, low-cost and secure transactions and no intermediaries. In addition to cryptocurrencies such as bitcoin, libra and monero, cryptocurrencies also include protocol tokens (e.g., ether), utility tokens, securities tokens (e.g., cryptoequities and cryptobonds), natural asset tokens, cryptofiat currencies and stablecoins.

9. In October 2020, there were more than 1,000 cryptocurrencies. Many still have a negligible market capitalization. Only 46 cryptocurrencies had a market capitalization higher than $100 million, and 17 cryptocurrencies had a market capitalization higher than $1 billion. The total capitalization of the 100 most valued cryptocurrencies was $330 billion, of which bitcoin accounted for $200 billion.[6]

10. The number of bitcoin transactions per day was more than 300,000 in October 2020;[7] 25 million bitcoin (electronic) addresses held bitcoins by the end of 2018.[8] By comparison, the credit card company Visa handles over 5.6 trillion transactions per day, and there were 3.3 billion Visa cards worldwide in 2018.[9]

[5] https://www.marketwatch.com/press-release/blockchain-market-size-analytical-overview-demand-trends-and-forecast-to-2024-2019-04-05.
[6] https://coinmarketcap.com/.
[7] https://www.blockchain.com.
[8] https://blog.chainalysis.com/reports/bitcoin-addresses.
[9] https://usa.visa.com/dam/VCOM/download/corporate/media/visanet-technology/aboutvisafactsheet.pdf.

2. Decentralized finance

11. Decentralized finance is an area of rapid innovation. It refers to financial instruments based on blockchain technology implemented through smart contracts. In November 2020, there were 251 decentralized finance projects listed in DeFiprime.com, a media outlet for the decentralized finance community. The market capitalization of the top 100 decentralized finance tokens was $12.7 billion, and the market value of the top 10 decentralized finance tokens was $9.1 billion, or 71 per cent of the total.[10]

12. Users have demonstrated trust in placing an increasing amount of funds into smart contracts smart contracts that sustain the decentralized finance ecosystem, suggesting growing confidence in these new financial tools. By the end of 2020, there were $11.06 billion invested in decentralized finance projects, with the top 10 projects representing 94 per cent of the total.[11]

3. International trade

13. In international trade, use of smart contracts allows for automatic, swift and timely issuance of customs invoices, permits, licences and certificates generated after fees and duties are paid. This can reduce back-office costs, consignment clearance time and the potential for corruption.

14. Numerous companies and governments are forming alliances to deploy blockchain technology in international trade. The Global Shipping Business Network[12] has already started testing the technology to increase efficiency.[13] Tradelens,[14] the IBM and Maersk-led consortium of leading firms in the shipping and maritime industry, has successfully trialled an electronic bill of lading.[15] These efforts are increasing rapidly, with more shipping and maritime industry leaders collaborating on increasing efficiency.

4. Value chains

15. Blockchain technology can improve transparency, traceability and reliability throughout global value chains. Several successful proof-of-concept implementations suggest that blockchain technology will likely lead to disruptive transformations, ranging from cost savings and increased efficiencies to new operational models. Two promising applications are the tracking of goods through the production and delivery process, to ensure quality and authenticity, and automated compliance with freight and trade regulations. For instance, the Walmart blockchain technology solution which uses IBM Hyperledger Fabric has reduced time for tracking the origins of mangoes from seven days to 2.2 seconds and promoted greater transparency across the Walmart food supply chain.[16]

B. System of innovation of blockchain technology

16. The blockchain system of innovation is more global than for other frontier technologies, such as artificial intelligence. Blockchain technology innovations have drawn on programmers from developed and developing countries, currency exchanges in several markets, “cryptomining” (distributed across the world) – in places with low-cost energy resources – and a user base of retail traders and financial institutions from all over the

[10] https://coinmarketcap.com/defi/.
[11] https://defipulse.com.
[12] https://www.cargosmart.ai/en/solutions/global-shipping-business-network/.
[13] https://smartmaritimenetwork.com/2019/07/16/global-shipping-business-network-agreements-signed/.
[14] https://www.tradelens.com/.
[15] https://worldmaritimenews.com/archives/277649/cma-cgm-msc-to-become-members-of-tradelens-blockchain-platform/.
[16] Kamath R, 2018, Food traceability on blockchain: Walmart’s pork and mango pilots with IBM, *The Journal of British Blockchain Association* 1(1):1–12.

world.[17] The fact that blockchain technology innovation has been directed mainly towards financial and payment solutions further contributes to the globalization of the system of innovation of blockchain technology.

17. A key feature of this system is that many of the blockchain technology initiatives involve open-source, free and readily available software. Many of them are funded or supported by not-for-profit foundations (e.g. Bitcoin Foundation, Ethereum Foundation, the Libra Foundation and the Blockchain Charity Foundation).

18. Multinational companies operating in traditional sectors have also entered this sector with different initiatives.[18] Given their international operations, these companies also contribute to global innovation and deployment of blockchain technology applications.

19. New non-governmental organizations and research institutes specializing in blockchain technology are being established; an example is the Blockchain Research Institute,[19] a think tank funded by international corporations and government agencies. This could become a leading trend in integrating the technology into the work of non-governmental organizations and increasing efficiency in the non-profit sector.

20. An increasing number of universities have designed courses specifically to study blockchain. Several blockchain technology companies are collaborating with academic institutions on research and development and product design.[20] It is expected that a new ecosystem will emerge with academics, advisers, programmers, financial analysts and cryptoeconomists at its core.

C. Financing blockchain technology innovation

21. A particularity in the blockchain technology ecosystem is the significant use of crowdfunding to finance innovations. Initial coin offerings and other innovative forms of distributed finance allow for fast ways to raise money for blockchain technology innovation (and for emergence of bubbles). This sets blockchain technology innovation apart from innovation in other technologies that rely more heavily on traditional finance sources (e.g., Venture Capital).

22. Through initial coin offerings, a team of developers sells tokens to finance the development of a solution. Usually, a share of the tokens is distributed to the development team and initial investors. After the bitcoin price bust in 2017, initial coin offerings were scrutinized by regulators in the United States of America, and some of the initial coin offerings were considered to breach securities regulations.[21]

23. More recently, other forms of decentralized finance have taken advantage of cryptocurrency valuation, such as bitcoin, to finance the development of new applications.

II. Potential impact of blockchain technology on the achievement of the Sustainable Development Goals

24. As with any technology, blockchain technology can be applied in solutions that contribute to the achievement of the Sustainable Development Goals. There are several examples of such applications, both in developed and developing countries. Many are still in the pilot phase or have been deployed but no impact assessment is available.

[17] For example, see Riasanow T et al., 2018, The generic blockchain ecosystem and its strategic implications, 24th Americas Conference on Information Systems; and Zalan T, 2018, Born global on blockchain. *Review of International Business and Strategy*, 28(1):19–34.

[18] Chang Y, Iakovou E and Shi W, 2020, Blockchain in global supply chains and cross border trade: a critical synthesis of the state-of-the-art, challenges and opportunities, *International Journal of Production Research*, 58(7):2082–2099.

[19] https://www.blockchainresearchinstitute.org/.

[20] For example, see Wang Y et al., 2019, A review of fast-growing blockchain hubs in Asia, *The Journal of The British Blockchain Association*, 2(2):83–98.

[21] https://www.sec.gov/ICO.

- Sustainable Development Goal 1.4 (equal rights to ownership, basic services, technology and economic resources). In Thailand in 2019, the Government initiated a digital identity project to develop a nationwide digital identification platform using blockchain technology to authenticate and verify the digital identities of Thai citizens.[22]
- Sustainable Development Goal 2.1 (end hunger and ensure access by all people, in particular the poor and people in vulnerable situations). The World Food Programme has created the "Building Blocks" voucher delivery platform to simplify voucher transactions by removing the need to create virtual custodial accounts with financial services providers. The initiative benefited 700,000 people in 2020.[23]
- Sustainable Development Goal 6.4 (increase water use efficiency and ensure freshwater supplies). In Australia, the Government of the State of New South Wales built a proof-of-concept that uses blockchain technology to make the water trading system more reliable, transparent and efficient to manage.[24]
- Sustainable Development Goal 7.3 (double the improvement in energy efficiency). A Russian power company has implemented a pilot project to use blockchain technology for electric power metering to ensure efficiency in the system and transparency in data exchange between electricity companies and consumers.[25]
- Sustainable Development Goal 10.3 (ensure equal opportunity). The United Nations Children's Fund (UNICEF) Project Connect is a blockchain technology-based platform to map every school in the world and each school's connectivity, which provides real-time data on the quality of each school's Internet connectivity.[26]
- Sustainable Development Goal 17.3 (mobilize financial resources for developing countries). The United Kingdom launched a blockchain-enabled platform to coordinate and trace international aid using smart contracts. This solution can improve the overall speed, cost and transparency of funds across the financial supply chain.[27]

25. In principle, there are no limits to the application of blockchain technology in technological solutions for the Sustainable Development Goals. A well-designed blockchain technology application can help store information, track value exchange and automate rules and smart contracts.[28]

26. However, examining the full potential impact of blockchain technology on the achievement of the Sustainable Development Goals requires sufficient information, which is not available at this stage. Hence, a forward-looking approach is used in the present document to analyse the impact of blockchain technology in the context of different scenarios. Some potential unintended consequences are also analysed.

A. Forward-looking scenarios

27. This section focuses on how forward-looking scenarios could play out and the impact of each scenario on sustainable development. These scenarios are non-mutually

[22] Contribution of Thailand, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c30_B_Thailand_en.pdf.

[23] Contribution of the World Food Programme, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c41_B_WFP_en.pdf.

[24] https://www.arup.com/projects/water-trading-with-blockchain

[25] Contribution of the Russian Federation, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c25_B_Russia_en.pdf.

[26] https://www.projectconnect.world

[27] Contribution of the United Kingdom of Great Britain and Northern Ireland, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c34_B_UK_en.pdf.

[28] United Nations Innovation Network, 2019, A practical guide to using blockchain within the United Nations, available at https://atrium.network/guide.

exclusive and highlight visions that society in general attributes to blockchain technology based on many facets of applying the technology that are still in the early stages.

28. A past example is the Internet. An initial vision that society had about Internet technology was that it would create a "global village" that would spread equity, justice and democracy. These were expectations based on technical characteristics of the Internet (e.g. inexpensive, instantaneous and two-way communication). Still, they did not foresee unintended consequences, such as the digital divide, misinformation and data privacy and security.

29. Currently, blockchain technology is similarly in its infancy. There are many different visions of how it will develop, which products will emerge and the potential consequences of their use.

1. Scenario: decentralized applications overtake centralized ones

30. In this scenario, blockchain technology is seen as a tool to create decentralized applications that replace centralized ones (based on centralized databases) for more security and transparency.

31. There is also an expectation of lower transaction costs when using blockchain technology solutions. However, there is nothing in the technology that requires transaction costs to be low. For example, the so-called "gas" (fee) in the Ethereum platform, which users pay for miners to register user transactions in a blockchain, reached high levels in September 2020, with some users paying $11 per transaction.[29] It is not clear whether blockchain technology applications will be systematically more affordable than centralized ones.

32. If indeed decentralized applications overtake centralized ones, it could have a severe negative impact on the environment due to the use of "proof-of-work" in the blockchain as a consensus mechanism, which is energy inefficient, as discussed later in this report.

33. There are several heuristics proposed to guide the decision between a traditional database and blockchain technology.[30] Usually, the default choice is for central databases, and only when the risk of centralized solutions is considered too high by the users, is a blockchain solution proposed.

34. Thus, blockchain could facilitate innovation for the Sustainable Development Goals when they enable solutions that otherwise would not exist as centralized applications. However, the roadblocks for implementing technological solutions for the Sustainable Development Goals are usually not in the technologies themselves but on the access to these technologies, including availability, affordability, awareness, accessibility and ability to use.[31]

35. If blockchain technologies replace centralized ones in technological solutions for the Sustainable Development Goals, use of blockchain technologies still requires universal Internet access, digital skills, and laws and regulations related to data privacy and security, as well as reliable and affordable electricity from non-climate change contributing sources.

2. Scenario: applications are developed for financial inclusion

36. In this scenario, see blockchain technology is seen as a tool that will allow people to have access to financial services at low costs, banking those connected but unbanked, for example, by creating blockchain technology versions of mobile digital transfers and microcredit services that charge lower fees.

37. Mobile digital transfer applications, such as M-Pesa in Kenya, have the advantage of being low cost and easy to use, and operated with mobile applications and a distributed

[29] https://coinjournal.net/news/ethereum-price-eth-usd-eyes-400-as-miner-fees-hit-new-highs/.

[30] For example, see United Nations Innovation Network, 2019, A practical guide to using blockchain within the United Nations, available at https://atrium.network/guide.

[31] UNCTAD, 2021, *Technology and Innovation Report 2021: Catching Technological Waves – Innovation with Equity* (United Nations publication, Sales No. E.21.II.D.8, Geneva).

network of agents that manage the cash to digital money exchange. Cryptocurrencies have a higher technological barrier to entry.

38. Cryptocurrencies that are more suitable for financial inclusion maintain relative price stability, the so-called stablecoins.[32] If the price of a cryptocurrency is volatile, such as in the case of bitcoin, it becomes useless as a means of exchange.

39. Decentralized finance can contribute to financial inclusion, creating decentralized versions of microfinance and other inclusive financial mechanisms. However, the decentralized finance innovation system is currently not targeting the unbanked; inclusiveness is not one of the drivers of innovation in this area.

40. For the vision of blockchain technology as a tool for financial inclusion to materialize, there must be a push for inclusive financial innovations. It is unlikely that the private sector will drive this process due to its focus on solutions for wealthier users. Governments, civil society organizations and international organizations need to steer the incentives for innovation towards inclusive finance and away from speculation, in a "casino economy," on the valorization of cryptoassets.

41. Even if blockchain technology applications complement other digital versions of inclusive financial applications, it is not clear how much blockchain technology would add beyond what those other inclusive financial applications already offer.

3. Scenario: efficiency increases in international digital transactions

42. In this scenario, the main role of blockchain technology is considered to be to increase efficiency in international digital transactions, reducing the costs of remittances and payment transactions in supply chains and increasing electronic commerce.

43. In the first quarter of 2019, the global average cost of sending a remittance was 7 per cent of the total amount, and it can be as high as 10 per cent in many African and Pacific island countries.[33] Mobile digital transfer applications are not a solution for international transactions, given that they are usually valid only for transactions in the local fiat currency. Cryptocurrencies can reduce both transaction time and costs for remittances and pressure traditional channels to provide competitive prices.

44. If indeed blockchain increases efficiency in international payment and digital transactions, the use of blockchain technology could boost trade. Who benefits from that increase in trade depends on many other factors, such as countries' productive structure and policies to harness trade for development. Increasing trade does not automatically or necessarily change the structure of an economy. If most people in low-income developing countries continue to live on subsistence agriculture and low-wage services due to lack of policies encouraging structural transformation, gains from increased trade are likely to be only seen as lower prices for foreign clients.[34] The impact of blockchain technology on sustainable development under this scenario should not be expected to be significant.

4. Scenario: cryptocurrency replaces fiat money

45. Another vision of blockchain technology is of cryptocurrencies complementing or replacing fiat currencies. How well cryptocurrencies serve as a medium of exchange, store of value and unit of account would determine cryptocurrencies' prospects for replacing fiat money.

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[32] A stablecoin is any cryptocurrency whose value is pegged to a stable asset, such as a fiat currency or gold. Therefore, it is an asset that offers price stability characteristics, as it is measured against a known amount of an asset not subject to high fluctuation.

[33] https://www.worldbank.org/en/news/press-release/2019/04/08/record-high-remittances-sent-globally-in-2018.

[34] UNCTAD, 2019, *The Least Developed Countries Report 2019: The Present and Future of External Development Finance – Old Dependence, New Challenges* (United Nations publication, Sales No. E.20.II.D.2, Geneva); UNCTAD, 2018, *The Least Developed Countries Report 2018: Entrepreneurship for Structural Transformation – Beyond Business as Usual* (United Nations publication, Sales No. E.18.II.D.6, New York and Geneva).

46. Some cryptocurrencies serve as a medium of exchange, but both in terms of performed transactions and the number of users, cryptocurrencies are far from challenging the dominant usage of sovereign currencies, and no Government accepts them as a legal tender.

47. The function of cryptocurrency as a store of value depends on mechanisms to regulate the supply of that cryptocurrency. If too much of a cryptocurrency is created (faster than the average productivity increase of the economy sectors), the cryptocurrency will lose its value. If too little is created, people will prefer not to use it for day-to-day transactions as it may gain much more value in the future. Taking bitcoin as an example, on 22 May 2010, the first real-world transaction was recorded in which bitcoin served the function of a medium of exchange by buying two pizzas for 10,000 bitcoins,[35] which is equivalent to over $560 million in February 2021.

48. To satisfy a unit of account function, the value of money should be stable over time; sudden and frequent fluctuations of money value diminish its usage as a unit of account.

49. If a cryptocurrency is widely adopted, allowing that cryptocurrency to replace fiat money, the impact on achieving the Sustainable Development Goals would be through the effect on monetary policy. Private entities' decisions concerning the money supply of cryptocurrencies could impact the ability of central banks to conduct monetary policies, such as managing the money supply and interest rates. Stablecoins with worldwide expansion expose small and economically weak States to macroeconomic risks if these stablecoins substitute a country's national currency.

50. Central banks have started to develop their own digital currencies. China has started developing a central bank digital currency, and pilot projects have started in some limited cities.[36] The European Central Bank is also looking into launching its own digitized euro.[37]

5. Scenario: blockchain becomes the "new Internet"

51. Another vision still of blockchain technology is to consider it as a general-purpose technology on the scale of and comparable in scope to the Internet. Blockchain technology would become the "Internet of value."

52. Blockchain technology is expected to reduce transaction costs and create markets that do not require a trusted third-party actor to design and enforce rules.[38] However, with blockchain technology, trust is simply shifted from one-third party to another – people must trust the proper functioning of cryptocurrency exchanges, and the developers that code blockchain technology applications and smart contracts. Such trust is ensured outside of the blockchain technology, through reputation, code and smart contract's auditing, and so on.

53. Another way to view blockchain technology as the new Internet is to consider it as part of "Industry 4.0" technologies (such as artificial intelligence, robots, Internet of things, etc.). Thus, blockchain technology is in the installation period of a new "technological revolution", and rapid innovation and insufficient knowledge about the real potential of blockchain technology tends to create a frenzy of investment in the new technology. The result is speculation and the emergence of "money creating money" schemes, and the gradual decoupling of the real economy and the financial sector, leading to financial bubbles and crises.[39]

54. The way that blockchain technology innovation is self-financed could expedite this process and create a series of financial bubbles particular to blockchain technology innovation. For example, it could be said that, up until 2017, there was a period of installation of blockchain technology focusing on cryptocurrencies (particularly bitcoin).

[35] https://www.coindesk.com/bitcoin-pizza-day-celebrating-pizza-bought-10000-btc.

[36] http://www.xinhuanet.com/english/2020-05/26/c_139089462.htm.

[37] https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr201002~f90bfc94a8.en.html.

[38] Berg C, Davidson S and Potts J, 2020, *Understanding the Blockchain Economy: An Introduction to Institutional Cryptoeconomics*, Edward Elgar Publishing, Cheltenham, United Kingdom.

[39] Perez C, 2002, *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*, Edward Elgar Publishing, Cheltenham, United Kingdom.

The frenzy about the new technology fuelled the bitcoin bubble in 2017. The emergence of blockchain technology platforms, such as Ethereum, smart contracts and decentralized finance, could create the conditions for a new frenzy and a potential bubble. Regulators may be constantly behind the curve, ever pressed to understand how to deal with the latest bust while a new one is already in gestation.

55. A new "techno-economic revolution" driven by blockchain and other "Industry 4.0" technologies also offers a window of opportunity for some countries to catch up and others to forge ahead, if they could strategically diversify their economies into sectors associated with the new paradigm. Catching up would increase real incomes and government revenues that could be used to accelerate the progress towards the Sustainable Development Goals.

B. Potential unintended consequences

56. Under these scenarios, some potential unintended consequences require immediate attention:

(a) High energy consumption is a main unintended consequence of blockchain technology (particularly in bitcoin). Estimates suggest that, in 2020, users of bitcoins consumed as much energy as Switzerland, and consumption has been growing in recent years.[40] This consumption generates carbon dioxide emissions that pose a threat to the environment. There is also considerable variation in energy consumption due to the number of transactions. For example, energy consumption first peaked during the 2017 cryptocurrency boom.[41]

(b) Cryptocurrency has a special appeal for criminals to exploit its semi-anonymous and decentralized characteristics for money-laundering and illegal fundraising, hacking and to take advantage of vulnerable people and people who are not digitally savvy. Estimates suggest that the share of illicit cryptocurrency activities rose in 2019, reaching 1.1 per cent of all activities (around $11 billion).[42] As blockchain technology evolves, crimes involving cryptocurrencies will likely continue to increase in both scope and technological sophistication.

(c) Inequality among cryptocurrency holders is high. Half of all bitcoin addresses hold less than 0.01 bitcoin, and almost 90 per cent hold less than 1 bitcoin; 95 per cent of bitcoins is held by only 3 per cent of all addresses.[43]

III. Harnessing blockchain technology for sustainable development

57. The following sections suggest actions that countries at different levels of development could take to strengthen their national innovation systems to harness blockchain technology for sustainable development, recognizing that their innovation systems have characteristics that require targeted policy advice.

A. Low-income and lower middle-income developing countries

58. Low-income and lower middle-income developing countries generally have poor and costly Internet services and lack digital know-how, hindering the deployment of blockchain technology. Harnessing blockchain technology initially requires improving digital infrastructure and skills. Governments should encourage innovation and create opportunities for skill development through pilot projects, to kickstart blockchain diffusion.

[40] https://cbeci.org/.
[41] Cambridge Bitcoin Electricity Consumption Index available at https://cbeci.org/.
[42] https://go.chainalysis.com/2020-Crypto-Crime-Report.html.
[43] https://bitinfocharts.com/top-100-richest-bitcoin-addresses.html.

Identify and form groups of blockchain experts

59. Governments could identify and invite experts in law and technology from academia and industry to join an advisory board to inform the regulatory process and strategies to attract technical talent and investment in blockchain ventures. For example, South Africa has established the South African National Blockchain Alliance between Government, industry and researchers to develop blockchain implementation in the national context.[44]

Invest in research institutions and graduate programmes

60. Universities should improve training in cryptography, data structures and other fields related to blockchain technology. Research institutions can strengthen the links between research, young talent and industry. For example, Austria and Malaysia have established research institutes to provide a low-stakes environment for firms and researchers to experiment with blockchain solutions and Daegu, Republic of Korea, allocated $6 million to promote education in blockchain and artificial intelligence.[45] Grants, scholarships and competitive awards can inspire talent development and help universities develop qualified practitioners.

Establish associations, laboratories, incubators and consultancies for the blockchain industry

61. National blockchain associations and laboratories can assist blockchain innovation by building capacity in the technology and the policy implications, economic impacts and regulatory frameworks. The Institute of Cryptography, University of Havana; the Blockchain Association of Kenya; and the Blockchain Association of Latvia promote research in and national deployment of blockchain technology.[46] Technical, organizational and managerial services can support initial developments in blockchain technology in the Government and the private sector. In Romania, Modex Blockchain Labs provides a marketplace for smart contracts, community tools for developers and blockchain database solutions for enterprises.[47]

Establish pilot programmes to build trust in blockchain technology

62. Pilot programmes to offer public services provide an opportunity to experiment with blockchain solutions, demonstrate their value and develop institutional knowledge. For example, Georgia, Ghana and India are working to incorporate blockchain-based land registry databases within existing land title systems; Kenya has implemented its first blockchain and smart contract-based retail bond M-Akiba, a government bond that can be purchased without a bank account; Turkey is implementing a project on the use of blockchain technology in digital identification systems; and Uganda has established a free zone to focus on blockchain and emerging technologies.[48]

[44] https://cointelegraph.com/news/south-african-national-blockchain-alliance-holds-online-launch.

[45] https://www.coindesk.com/austrian-government-backs-new-blockchain-research-institute; https://www.coinspeaker.com/magic-with-mba-has-launched-blockchain-researcher-lab-program-in-malaysia/; https://cointelegraph.com/news/this-south-korean-city-is-spending-millions-to-turn-people-into-blockchain-experts.

[46] Contributions of Cuba, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c04_HB_Cuba_es.pdf; Kenya, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c17_HB_Kenya_en.pdf; and Latvia, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c21_B_Latvia_en.pdf.

[47] Contribution of Romania, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c24_HB_Romania_en.pdf; https://modex.tech/.

[48] M Kaczorowska, 2019, Blockchain-based land registration: Possibilities and challenges, *Masaryk University Journal of Law and Technology*, 13(2):339–360; https://www.m-akiba.go.ke; contribution of Turkey, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c33_B_Turkey_en.pdf; www.unlock-bc.com/news/2019-09-17/uganda-announces-blockchain-freezone.

B. Upper middle-income developing countries

63. Upper middle-income developing countries are more likely to have the technical foundations and the human resources needed for rapid technological adoption. The challenge in many of these countries is to connect domestic innovation systems with the global system of innovation. The rapid pace of technological change and the long time frame for capacity development require strategic efforts to build blockchain technology capabilities.

Establish a national blockchain strategy

64. A national blockchain strategy is needed for long-term planning and coordinated development, defining the vision of the Government of how the technology will contribute to national priorities, clarifying the regulatory stance and eliminating ambiguity in public development. The process of preparing the strategy allows Governments and the private sector to work together and ease the adoption of blockchain technology in both the public and private sectors. Many countries include blockchain technology in national innovation strategies. For example, in the Russian Federation, the development of blockchain technology is part of the digital technologies project under the national digital economy programme; in Saudi Arabia, the Vision 2030 road map aims for the adoption of advanced technologies for economic growth and national development, including development of a blockchain laboratory to improve the quality of government services provided to citizens using the technology; the Thailand 4.0 scheme to transform the country into a value-based and innovation-driven economy identified areas for blockchain application in transport and logistics, banking and finance and digital identity; and in Turkey, the 2023 Industry and Technology Strategy includes the development of national blockchain infrastructure.[49]

Establish blockchain incubators, innovation hubs and networks

65. Incubators and networks can accelerate the rate of blockchain innovation, becoming the foundation for building technical knowledge and accelerating the development of enterprise-ready applications. Research institutions can boost the general understanding of blockchain technology and trust in related applications and provide an environment for experimentation and design testing. For example, Japan, Malaysia and Singapore have created sandbox policy environments to test the limits of blockchain technology, in particular cryptocurrencies, and its interactions with other digital systems.[50]

Establish a specialized blockchain task force

66. Multi-stakeholder blockchain task forces can help develop technical understanding among Governments and monitor international developments, including regulatory practices and potentially harmful cryptofinancial activities. Task forces can also verify whether blockchain technology usage is necessary for specific tasks and whether easier ways to accomplish the tasks are available. Some countries have established working groups, such as the federation of banks in Brazil, which is tasked with examining blockchain technology and its impact on the banking sector.[51]

[49] Contributions of the Russian Federation, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c25_B_Russia_en.pdf; Saudi Arabia, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c27_B_Saudi%20Arabia_en.pdf; Thailand, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c30_B_Thailand_en.pdf; and Turkey, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c33_B_Turkey_en.pdf.

[50] https://www.forbes.com/sites/japan/2019/06/26/japans-blockchain-sandbox-is-paving-the-way-for-the-fintech-future/#254e5ac93279; https://www.researchgate.net/publication/338304841_Regulating_FinTech_Businesses_The_Malaysian_Experience; https://www.mas.gov.sg/development/fintech/sandbox; see https://cointelegraph.com/news/south-koreas-fintech-sandbox-creates-380-new-blockchain-jobs.

[51] https://www.rvo.nl/sites/default/files/2018/02/brazils-beginning-blockchain-business.pdf.

Develop blockchain technology guidelines and principles

67. Government stakeholders can develop best practices and principles to guide blockchain technology integration, helping to identify the operations that can benefit from blockchain solutions and those for which traditional digital services are more suitable. Guiding principles can signal future developments in the regulatory space, such as policies on privacy, interoperability, cryptocurrencies, taxation and smart contracts.

Establish standards for interoperability

68. Establishing common encryption and data standards can facilitate interoperability and create systems in which blockchain services can work together to provide greater value, lower the barrier to entry for new ventures and encourage investment in the technology. However, setting standards that are too rigid before the technology has stabilized can result in expensive transitions in the future. Governments need to balance the promotion of the establishment of standards for faster adoption with flexibility to account for rapid technological change.

Identify key use cases and form strategic collaborations

69. Policymakers can identify key areas in which blockchain applications can provide real value through public services. For example, in India, the think tank Niti Aayog has identified areas in which blockchain technology can build on national public digital infrastructure; and in Thailand, the Office of the Courts of Justice aims to use blockchain to manage court records and other judicial information by 2021.[52] National-level assessments can identify potential use cases of blockchain technology and set short-term to medium-term milestones. Once identified, the use cases can be implemented with partners with technical expertise. For example, IBM is working in India and South Africa to establish blockchain-based industrial supply chain systems.[53] Partnerships can increase the rate of knowledge transfer and help build successful models for blockchain technology integration. Implementation in public services can signal institutional endorsement, generating interest and trust in blockchain technology.

Establish channels of collaboration with the international community

70. Creating and participating in forums at which local and international practitioners can meet and share their work allows for collaboration and learning opportunities. Supporting blockchain experts, policymakers and technologists to attend conferences and training opportunities can create linkages between local innovation systems and the international community working on blockchain applications. Governments can set up scholarships for students in domestic and foreign universities working on frontier technologies. Such initiatives can help develop the professional workforce that can use blockchain technology to its full potential.

C. High-income developed countries

71. High-income developed countries have higher levels of technological and regulatory capacities to create a supportive environment for blockchain innovations. However, questions on interoperability, scalability, privacy, transparency and regulation remain unanswered and the rate of change of the technology is as rapid as the results are uncertain. Governments should develop legal and policy frameworks that allow the real economy and the public to benefit from blockchain technology while minimizing risks and protecting users.

[52] https://niti.gov.in/sites/default/files/2020-01/Blockchain_The_India_Strategy_Part_I.pdf; https://dailyhodl.com/2020/08/22/thailand-judicial-system-planning-big-shift-to-blockchain-will-migrate-records-to-distributed-ledger/.

[53] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3265654; www.engineeringnews.co.za/article/ibm-in-broad-partnership-to-develop-supply-chain-blockchain-2019-02-22.

Establish a blockchain development committee

72. A blockchain development committee can serve as a high-level forum at which decision makers can communicate with stakeholders and identify viable blockchain development pathways and advise on public projects. In this regard, a transdisciplinary approach engaging data and social scientists, engineers, policymakers, regulators, industry and civil society is essential.

Provide incentives for sustainable innovation

73. Governments can incentivize blockchain innovation that contributes to achieving the Sustainable Development Goals and tackling the potential unintended consequences of the technology. Key areas of research are the following: environmental implications of blockchain; user-friendly methods and tools to manage private keys; and the use of blockchain technology in decentralized identity and self-sovereign identity systems. For example, in 2018, the United States set up grants of up to $800,000 for firms working on anti-counterfeiting blockchain solutions.[54]

Provide support for start-ups and jobs

74. Through research investment, support for start-ups, academic scholarships, hackathons and workshops, high-income countries can also attract and foster national blockchain systems and develop the related future blockchain workforce. For example, Latvia incentivizes local blockchain start-ups through a flexible tax system, tax benefits for early mover companies with the need for funding and special visas for founders to become residents.[55]

Establish regulatory sandboxes

75. Regulatory sandboxes are special allowances for testing an innovation under the supervision of regulators. Setting up a sandbox can reduce entry barriers, create a supportive network for innovation and improve the chances for successful implementation. For example, Singapore has created the Smart Financial Centre and invested $225 million to develop financial technology products in a sandbox environment.[56] The sandbox allows for cryptofinancial technology applications in a controlled environment, in which legal regulations are relaxed, allowing for experimentation with new products.

IV. Supporting blockchain innovation while addressing potential risks

76. The governance of blockchain technology is a significant challenge, as the decision-making process should involve those who build the technology and those who will ultimately use it and be affected by the decisions.[57] Shared governance approaches can ensure that the perspectives of all stakeholders are considered, regardless of whether they are part of the geographic territory of the sovereign decision maker.[58]

77. Standardization in blockchain technology offers a form of a self-regulating mechanism. It incentivizes innovation, ensures interoperability and creates a common understanding of ways to address security, privacy and resilience. Proponents of this approach to regulation state that it can create tentative, non-binding norms in a new landscape while stricter forms of legislation may stifle innovation or create entry barriers. It is assumed that the industry will converge towards the most optimal standard for the welfare of all stakeholders. However, standardization can also become an area of contention between innovators and technology users.

[54] https://www.coindesk.com/us-government-offering-up-to-800k-for-anti-forgery-blockchain-solutions.
[55] Contribution by Latvia, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c21_B_Latvia_en.pdf.
[56] https://www.mas.gov.sg/development/fintech/regulatory-sandbox.
[57] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2709713.
[58] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2309772.

78. The pace of technological change challenges the commercial organizations and legal system entrusted to regulate the market. There is a need for careful consideration of whether the current legal system can accommodate or mitigate legal risks presented by smart contracts or whether changes are required in response to the new technology.

79. Despite rapid advances in technology, many aspects of sophisticated commercial agreements are not subject to automation, including matters requiring human judgment and the resolution of disputes. Intermediaries will continue to play an important role, socially and legally. Regulators need to stay alert to misconduct by digital platforms in their roles as gatekeepers. Regulations should focus on the duty of platforms to monitor and verify the information of their vendors.

A. Security, privacy and data protection

80. Like many web-based services operating worldwide, blockchain applications may have users scattered across several jurisdictions. The data protection rules of several jurisdictions therefore apply to the use of blockchain technology.

81. Different territorial jurisdictions may have different laws in place, with some taking the lead in shaping the future application of security, privacy and data protection concerning the technology, such as, among others, European Union regulation 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, also known as the general data protection regulation. As the most advanced regulation at the supranational level, it is likely to be the legal benchmark for privacy and data protection in the digital economy. However, there are challenges in identifying the legal role and responsibility of each user and how data protection laws may apply. The general data protection regulation states that the controller, that is, the entity that, alone or jointly with others, determines the purposes and means of the processing of personal data, is responsible for compliance with the regulation (article 4). In the platform economy, with large intermediaries such as Amazon and Google it is possible to identify the controller but with a public blockchain there is no central point of control.

82. As blockchain technology is set to disrupt existing business models, further consideration is needed of how to regulate it. As many concrete deployment cases are not yet available, it is difficult to foretell all of the impacts that the technology may have on society and therefore how the regulation is likely to be shaped.

B. Financial regulations

83. The regulatory approach to the use of blockchain technology in financial markets varies considerably in different countries or jurisdictions. Some develop ad hoc regulations adapted to technology, such as those in Malta, Gibraltar and the State of New York, and others state that existing regulations apply to new activities, such as in Switzerland. In addition, a few countries have a more restrictive approach, such as by prohibiting certain blockchain-related investments, for example in Algeria and the Plurinational State of Bolivia. Many other countries have not yet taken a position.

84. A key consideration is the need to prevent systemic risk with regard to cryptocurrency and financial markets. If investors accumulate debt to purchase large sums of cryptocurrency using fiat money and there is a devaluation in the exchange rate, this could lead to payment defaults in the respective fiat currency.[59] This systemic risk can be accentuated by speculative activities that create asset bubbles, as seen in the past decade with the bitcoin cryptocurrency.

85. Taxation is another regulatory issue that raises several questions. The involvement of different tax jurisdictions creates legal ambiguity. Questions arise about whether cryptocurrency mining activities constitute taxable income or whether value-added tax

[59] https://www.researchgate.net/publication/332641100_Blockchains_Smart_Contracts_Decentralised_Autonomous_Organisations_and_the_Law.

should be applicable to mining services rendered. In the United States, the payment received from the mining of a virtual currency is considered taxable income.[60] Other countries such as Canada and Sweden take a similar approach but differentiate tax treatment based on whether the mining is classified as a leisure or business activity. Another possibility is to consider a tax treatment that mirrors that for investments in shares or bonds.[61]

C. Intellectual property regulations

86. The relationship between blockchain and intellectual property rights can be viewed from two perspectives, namely, that of the developer and that of the user. Although largely based on open-source software, the development of blockchain-based applications may be subject to intellectual property rights. Copyrights, patents and trademarks play an important role in the consolidation or dissemination of the technology and could either potentially curb innovation by limiting access to newcomers or enable its diffusion. Therefore, it is important to consider how intellectual property rights will most stimulate the use and development of new blockchain applications.

87. Blockchain technology can provide defensive protection of intellectual property assets, that is, in litigating, proving ownership rights, tracking original products and ensuring greater revenue for authors and other creators, among others. It can also serve as a decentralized ledger for works protected by copyright. The use of smart contracts using blockchain technology increases the prospect of eliminating or reducing the need for intellectual property registration, as they do not require the intervention of national or regional intellectual property offices.

88. Blockchain technology already operates in the intellectual property system, given that the use of open source is based on copyright law, which allows for the widespread use of blockchain applications. The Ethereum and bitcoin trademarks and logos are also based on an open licence and can be freely used by legitimate users such as businesses accepting payment in cryptocurrency, thereby enabling different players to enter markets.[62] Blockchain technology could potentially help with intellectual property management in technology transfer and commercialization by allowing patent owners to find potential licensees for related know-how and trade secrets in connection with a patented invention.

89. However, blockchain can equally enable rights holders to enact restrictive measures, which could negatively influence blockchain technology development and use, particularly if it is to be used for anti-competitive practices. There are also differences in different jurisdictions as to what can be protected under different forms of intellectual property using blockchain technology. For example, software can be patented in the United States but not in the European Union. This can create legal complexities between different geographical regions in which blockchain technologies operate.

V. International collaboration

A. Sharing knowledge and information and conducting research

90. Several United Nations agencies have worked on research, policy analysis and data collection with regard to potential economic and social impacts and policy and regulatory responses. UNCTAD examined the impact of frontier technologies, including blockchain, in *Technology and Innovation Report 2018* and in *Technology and Innovation Report 2021*, which focuses on the impact on inequalities. The Economic and Social Commission for Asia and the Pacific has reviewed, collected and documented examples in Asia and the

[60] https://www.irs.gov/publications/p525.

[61] https://www.researchgate.net/publication/332641100_Blockchains_Smart_Contracts_Decentralised_Autonomous_Organisations_and_the_Law.

[62] https://www.researchgate.net/publication/332641100_Blockchains_Smart_Contracts_Decentralised_Autonomous_Organisations_and_the_Law.

Pacific of where blockchain has had the greatest developmental impact. The World Intellectual Property Organization has explored the use of blockchain technology in providing intellectual property rights protection.

B. Helping to set guidelines, norms and standards

91. There is a growing need for policy guidance, training, global regulation and standard-setting to guarantee fair and responsible technology adoption in developing countries. Some initiatives have started to address specific aspects of this issue, such as the United Nations Centre for Trade Facilitation and Electronic Business guidelines for the interoperability of message exchanges between blockchain solutions and International Organization for Standardization Technical Committee 307 on the standardization of blockchain and distributed ledger technologies.[63]

C. Helping to build the capacity of Governments to play their role in the blockchain system, including in terms of oversight capabilities

92. International organizations can support developing countries in building their national capacities in engaging with blockchain innovation. In this regard, UNCTAD offers a range of technical cooperation and capacity-building activities that can integrate blockchain innovation, such as science, technology and innovation policy reviews; rapid eTrade readiness assessments; and information and technology policy reviews. The Economic Commission for Europe has an active project focusing on enhancing transparency and traceability in the garment and footwear sector through blockchain technology and, along with the International Labour Organization and the International Trade Centre, is launching a pilot project to create a digital identity for cotton clothing by connecting it to sustainability certificates.[64] The Economic and Social Commission for Western Asia has explored the provision of policy advice and policy support in blockchain technology. The United Nations Industrial Development Organization has developed a methodological framework to assess the readiness of a commodity value chain to adopt blockchain technology.

D. Using blockchain in the United Nations system and transferring knowledge and skills to Member States

93. The United Nations system has recently developed projects based on blockchain technology to keep up to date with technological developments and apply them to concrete solutions for development challenges, as follows:

(a) Public registries. The United Nations Human Settlements Programme has implemented a system to record land ownership in a digital registry, serving as the basis for other government services such as urban planning, citizen engagement and revenue generation;[65]

(b) Supply chains. The United Nations Development Programme is piloting a project in which the buyer of a chocolate bar receives an impact token as a discount for other purchases or a donation to cocoa farmers to expand plantations;[66]

(c) Digital finance. The United Nations Entity for Gender Equality and the Empowerment of Women and the World Food Programme have used blockchain in refugee

[63] Contribution of Economic Commission for Europe, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c35_B_UNECE_en.pdf; https://www.iso.org/committee/6266604.html.

[64] https://unece.org/trade/traceability-sustainable-garment-and-footwear.

[65] https://reliefweb.int/report/afghanistan/city-all-investing-sustainable-urbanization-afghanistan.

[66] https://www.fastcompany.com/90413242/this-new-blockchain-chocolate-bar-is-brought-to-you-by-the-un.

camps to track the disbursement of cash entitlements. The project currently coordinates the delivery of food assistance for over 100,000 refugees from the Syrian Arab Republic;[67]

(d) Start-up investment. UNICEF established the cryptocurrency fund to invest in start-ups using bitcoin or ether, providing transparency with regard to the source and destination of the fund and allowing UNICEF to leverage donations in cryptocurrency;[68]

(e) Small and medium-sized enterprise financing. The United Nations Industrial Development Organization uses blockchain in the Sustainable Development Goal Impact Investment Platform, an accelerator fund to streamline financial opportunities to small and medium-sized enterprises moving towards the circular economy;[69]

(f) Sustainability maps. In 2019, the International Trade Centre explored the use of blockchain technology in improving the visualization of transparency, traceability and accountability on voluntary sustainability standards.[70]

94. Such projects contribute to the aims in the *Report of the Secretary-General: Road Map for Digital Cooperation*, which include promoting digital trust and security and providing digital public goods for a more equitable world.

95. The United Nations Innovation Network has set up a blockchain group and the online platform Atrium to raise awareness within the United Nations system and share experiences in implementing blockchain applications.[71] An underlying private permission blockchain has been set up to enable the use of Remix, a smart contract development and deployment tool, and the provision of tokens through the Bounties network.[72]

96. The United Nations Centre for Trade Facilitation and Electronic Business has led a United Nations inter-agency round table titled Blockchain for the Sustainable Development Goals since May 2019, to update each agency on ongoing work with regard to blockchain technology and to share know-how. The round table brings together entities such as the following: Economic Commission for Europe, International Organization for Migration, International Telecommunication Union, International Trade Centre, Joint Inspection Unit, Joint United Nations Programme on HIV/AIDS, UNCTAD, Universal Postal Union, Sustainable Development Goals Lab, World Food Programme, World Health Organization, World Intellectual Property Organization, World Trade Organization.

VI. Suggestions for consideration

97. Blockchain technology can contribute to sustainable development but, to date, most innovation has focused on financial applications and speculative gains in cryptoassets instead of creating real value. All stakeholders should seek to strengthen national and international blockchain innovation systems to guide innovation towards inclusive and sustainable solutions and to strategically position developing countries to benefit from this new wave of technological change.

98. Member States may wish to consider the following suggestions:

(a) Develop national blockchain innovation strategies to give policy direction for the development of national blockchain innovation systems;

(b) Continue the development of digital infrastructure and skills;

(c) Encourage innovation and create opportunities for skill development to kick-start the diffusion of blockchain technology;

[67] https://innovation.wfp.org/project/building-blocks.

[68] https://www.unicef.org/press-releases/unicef-launches-cryptocurrency-fund.

[69] https://www.unido.org/siip.

[70] Contribution of International Trade Centre, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c14_B_ITC_en.pdf.

[71] https://www.uninnovation.network/blockchain.

[72] Contribution of World Food Programme, available at https://unctad.org/system/files/non-official-document/CSTD_2020-21_c41_B_WFP_en.pdf.

(d) Connect domestic systems with the global system of innovation, including through incubators and networks;

(e) Develop legal and policy frameworks in order that the real economy can benefit from blockchain technology, while minimizing risks and protecting users.

99. The international community may wish to consider the following suggestions:

(a) Strengthen research cooperation and science and policy interfaces to ensure that blockchain is harnessed for inclusiveness and sustainability;

(b) Compile, analyse and disseminate information on the use of blockchain for Sustainable Development Goals-related solutions to raise awareness and inform the application of blockchain technology for sustainable development;

(c) Promote the development of standards, recommendations and regulations on blockchain technology, to harness its potential, including by promoting security and privacy;

(d) Promote international best practices, international guidelines and legal frameworks governing blockchain technology;

(e) Develop training programmes for countries and institutions planning to implement blockchain-related solutions to provide them with relevant information about the capabilities and limitations of the technology;

(f) Implement knowledge-sharing programmes between system actors from developed and developing countries;

(g) Support Governments with decision-making tools to increase preparedness to adopt and adapt new technologies;

(h) Continue exploring the use of blockchain in technological solutions to achieve the Sustainable Development Goals;

(i) Promote inclusive debate on blockchain technology for achieving the Sustainable Development Goals. Developing countries, in particular the least developed countries, not engaged in the development of frontier technologies but likely to be affected by their consequences need to be part of the international debate on blockchain and the Goals.

100. The Commission is encouraged to take the following steps:

(a) Share experiences in national strategies for harnessing blockchain technology for sustainable development;

(b) Compile and share examples of the use of blockchain technology for sustainable development;

(c) Facilitate regional and international partnerships for blockchain innovation and system development;

(d) Develop synergies between the efforts of United Nations entities with regard to blockchain technology for inclusive and sustainable development.