Journal of Informatics Education and Research
ISSN: 1526-4726
https://doi.org/10.52783/jier.v3i2.301
Vol 3 Issue 2 (2023)

A Study of Blockchain Applications and Challenges in the Contemporary Business World

K. R. Ramprakash[1], Kishore Kunal[2]*
[1]Assitant Professor- LIBA Online, Loyola institute of Business Administration, Chennai,
Email: krramj@gmail.com
Professor- Business Analytics,
Dean-Online Education, Loyola institute of Business Administration, Chennai.
Email: kishore.sona@gmail.com

Abstract

The underlying mechanism of many digital currencies is referred to as blockchain technology. This entails a decentralized and distributed block network that preserves data using digital signatures. The unique features of blockchain technology, including decentralization, transparency, immutability, and auditability, make transactions more secure and resistant to tampering. Blockchain technology has many applications beyond cryptocurrencies, including managing security, healthcare, financial, and social services. Numerous studies have focused on the potential that blockchain technology offers in different fields of applications. This paper compares various consensus mechanisms, explains the taxonomy and architecture of blockchain, and discusses challenges like scalability, privacy, interoperability, energy consumption, and regulatory issues. It also shows a comparative study of the tradeoffs of blockchain. The future application of blockchain technology is also mentioned in this study.

1. Introduction

Blockchain allows for direct peer-to-peer exchange of digital assets, in contrast to more conventional approaches (Aste et al., 2017). According to (Salah et al., 2019), "A blockchain is essentially a network of blocks that stores every committed transaction using a public ledger. Whenever additional blocks are added to the chain, it keeps expanding. Digital signatures, cryptographic hashes, and distributed consensus methods are essential technologies allowing blockchain to operate in a randomized environment. No middlemen are needed to confirm and authenticate the transactions because they all take place in a decentralized fashion". Decentralization, openness, permanence, and auditability are some of the major features of the blockchain (Kouhizadeh et al., 2018). According to (Al-Jaroodi et al., 2019), blockchain technology has expanded beyond its original purpose and is now being used in various industries, such as banking, healthcare, government, manufacturing, and distribution. According to (Casino et al., 2019), "the blockchain is poised to innovate and transform a wide range of applications, such as distributed credentialing, moving computing to data sources, remote service delivery, and the transfer of goods (supply chain). Blockchain technology may also be used for distributed resources (such as the production and distribution of electricity), crowdsourcing, electronic voting, identity management, and the control of public documents".

While blockchain technology has the potential to replace many existing digital platforms, it also has technical limitations. One major issue is scalability, as Zheng et al. (2016) highlighted. According to Bano et al. (2017), one aspect of Bitcoin's scalability is the restricted size and periodicity of the blocks and the number of operations the network can handle. The network's throughput is hampered by the 1-megabyte block size constraint and the 10-minute median creation of blocks time in Bitcoin (Gervais et al., 2016). Various problems will raise concerns, including the blockchain congestion issue, transaction delays, and rising transaction costs. As a result of these limitations, it may not be practical to establish an official or privately owned business model on the blockchain platform.

Journal of Informatics Education and Research
ISSN: 1526-4726
https://doi.org/10.52783/jier.v3i2.301
Vol 3 Issue 2 (2023)

Blundell (2014) highlighted that the propagation time of larger blocks across the blockchain network is slower, and their storage requires more space. As users attempt to manage and maintain a larger blockchain, this can lead to centralization and a lack of trust. As a result, it has become increasingly challenging to balance the size of the blockchain with its trustworthiness. Interoperability, privacy, energy use, egotistic mining, security, and regulatory policy are other problems with blockchain. The lack of a standardized framework for adopting and integrating blockchain-based solutions among businesses is the cause of the interoperability issue. While the blockchain system is designed to be highly secure, and transactions are conducted using encrypted digital signatures with public-private keys, there is still a risk of privacy breaches within the system, as Biryukov and colleagues (2014) noted.

In addition, the user's actual IP address may be exposed. In addition, substantial concerns surround consensus mechanisms like proof-of-work (PoW) and proof-of-stake (PoS). PoW, which involves miners competing to create blocks by solving complex mathematical problems, is notorious for consuming large amounts of electrical energy. (Wang et al., 2019). The probability of receiving a block in a PoS system relies on the stake size of the miners (King et al., 2012). Hence, the wealthy get steadily wealthier. Selfish mining is another downside of blockchain technology, where miners might profit more than they should by keeping their blocks secret (Heilman, 2014).

Blockchain is vulnerable to 51 percent attacks, which occur when a single node takes control of most of the network and exploits it. Moreover, the uncertainties surrounding potential government regulations may hinder blockchain technology from achieving its full potential or widespread adoption by stakeholders, as noted by Kiviat (2015). The decentralized nature of blockchain technology, which is bad news for governments, may be one of the leading underlying causes. This is because central banks can no longer be controlled by intermediaries thanks to blockchain. As a result, various initiatives must be made to solve these blockchain-related problems. The current state of blockchain research, including blockchain applications and problems, is the topic of this survey report.

2. Literature Review

2.1. Transaction procedures of Blockchain

A small portion of a work recorded in public records might be called a Blockchain transaction. According to (Tschorsch et al.., 2016), “These records are also known as blocks. All miners working on the blockchain network execute, put into place, and store these blocks for further confirmation”. Individuals may review each past transaction at any moment but cannot edit (Castillo et al., 2017). The decentralized peer-to-peer global network of transactions is made possible by the blockchain, the technology that underpins Bitcoin. As a result, Bitcoin qualifies as a global, censorship-resistant digital money. Regarding conventional centralized systems, like banks, where users must place their solemn trust in the system, trust may generally be the main worry. Public blockchain technology is particularly well-suited for transferring ownership of digital assets between peers, as no trust is required in the process. The services that spread information about all network actions in the trustless blockchain system give that trust (Glaser, 2017).

2.2. Characteristics of Blockchain

Persistency **-** Blockchain offers the framework for measuring the veracity of information and enables data producers and users to demonstrate the accuracy and integrity of their data (Shrier et al., 2016).

Anonymity - One can access the blockchain network using a randomly generated address. In a Blockchain network, a person may use several addresses in order to conceal his identity. Since it's a decentralized system, nobody in charge keeps track of or records its users' personal data. Through its trustless environment, blockchain offers some anonymity (Wang et al., 2018).

Efficiency **–** Any node in an open blockchain can join or depart the network, which greatly enhances its scalability. However, the flexibility of new nodes' network access and the mining process's growing complexity lead to lower throughput and longer latency. Private and consortium blockchains have the potential to enhance their efficiency and energy usage by utilizing a smaller number of validators and employing consensus processes that have been specifically chosen for their needs, as noted by (Alharby and colleagues, 2017).

Journal of Informatics Education and Research
ISSN: 1526-4726
https://doi.org/10.52783/jier.v3i2.301
Vol 3 Issue 2 (2023)

2.3. Applications of Blockchain

Blockchain technology is used for a wide range of purposes. Blockchain technology is not the same as Bitcoin; rather, bitcoin represents one of the most frequently utilized implementations of blockchain technology (Crosby et al., 2016). It is crucial to note that Bitcoin is a cryptocurrency that relies on a publicly accessible and anonymous blockchain network for trading. Nevertheless, specialists argue that this technology has the potential to tackle various issues, including those about government, distribution networks, voting, identity management, healthcare, and energy sources. Some futurists even believe that blockchain could impact the digital world similarly to the World Wide Web. (Twesige, 2015).

Blockchain in the Healthcare sector – Healthcare might change due to distributed ledger technology (McGhin et al., 2019). Managing patient data and medicine provenance are potential areas where blockchain technology can be utilized. According to the Health Research Funding organization, the pharmaceutical industry is experiencing a major problem with counterfeit drugs, with approximately 10% to 30% of drugs distributed in developing nations estimated to be fake (Glass, 2014). According to the WHO, 17% of counterfeit medications have an improper quantity of crucial ingredients, and 16% contain incorrect components. One of the top issues facing the healthcare sector is managing the integrity of patient data (Azaria et al., 2016). A treatment plan for a prevalent illness varies based on the situation because each patient has a different physical variability. The whole medical history of each patient must thus be accessed in order to provide individualized care. Medical data, however, must be shared securely as they are sensitive (Shen et al., 2018).

Blockchain in the Energy Sector – "One of the main uses of blockchain in energy-related applications is in microgrids. A microgrid is a localized set of electric power sources and loads integrated and managed to enhance energy production and consumption efficiencies and reliabilities", according to (Lasseter et al., 2004). Distributed power plants, renewable energy facilities, and energy storage units located in various buildings owned by different companies or energy suppliers can be utilized to acquire electricity sources. One of the key benefits of microgrid technology is that it enables homeowners and other electricity users, such as companies, to receive the required energy and create and sell extra energy to the grid. In microgrids, blockchain can expedite, record, and confirm power-related transactions (Cohn et al., 2017).

Blockchain in Stock Market - "Interoperability, trust, and transparency are problems that blockchain technology may be able to address for fragmented market systems" (Lee, 2015). Because of intermediaries, regulatory procedures, and operational trade clearance, each transaction in the stock market requires at least three days to finalize and complete. Consequently, all parties involved in the stock market, including traders, brokers, regulators, and the stock exchange, must undergo a time-consuming process. Decentralization and automation enabled by blockchain technology may provide a solution to the challenges the stock exchange faces. This has been suggested by Tapscott et al. (2018).

Blockchain in Identity Management –

To confirm someone's identity in the physical world, they can present documents like a passport, driver's license, or national ID card. There is not an effective similar strategy for protecting online identities. Blockchain could be able to offer a workaround for this problem. By using this technology, a platform that reduces fraudulent activity and eliminates identity theft may be made available. Blockchain-based systems for managing identities may enable users to use and authenticate payments via the internet by just utilizing an app instead of requiring a password, user name, or biometrics for identification (Jacobovitz et al., 2016). (Dunphy et al., 2018). Propose a distributed ledger technology strategy to enhance decentralization, transparency, and user autonomy in managing identities.

Blockchain in Insurance - The insurance industry can use blockchain technology to manage transactions between policyholders, clients, and insurance providers. With blockchain, reinsurance transactions among insurance companies can be made more efficient, and claims processing, registration, and negotiation for insurance policies can be streamlined. Many insurance plans can be automated by utilizing smart contracts, leading to significant cost savings in administrative expenses. (Gatteschi et al., 2018).

Blockchain in Financial Trade - A letter of credit (LC), which is effective for risk mitigation, is used by banks to expedite the trade finance process (Harfield, 1982). Even though it still accounts for more than a fifth of all trade, the procedure is complex, costly, and subject to delays caused by contracts. A smart contract on a blockchain can be programmed to execute the terms agreed upon between the supplier and customer, ensuring payment when the traded goods are delivered.

Journal of Informatics Education and Research
ISSN: 1526-4726
https://doi.org/10.52783/jier.v3i2.301
Vol 3 Issue 2 (2023)

This approach can reduce uncertainties related to information and contracts, resulting in faster and less costly contract modifications. (Fridgen et al., 2018).

2.4. Challenges of Blockchain Technology

Currently, blockchain is a widely used term in both business and technology. It is thought that this technology, which can operate without a centralized authority or middleman, would revolutionize the financial industry. Because of its capacity to store data that cannot be altered and manage a massive trail of records effectively, it is also thought that blockchain could prove helpful for other sectors. Ahmed et al. (2019) stated that blockchain, like other contemporary technologies, has limitations and may not be practical for many business models.

Scalability and Performance **–** Solutions for various business models based on cryptocurrencies and blockchains are becoming increasingly well-liked. Concerns exist. Ahmed et al. (2019) suggest that blockchain may not be suitable for certain business models due to limitations, including concerns about scalability and performance issues such as throughput and latency. Researchers have recently been investigating scalability issues related to the number of replicas in the network, according to Vukoli (2015). This raises questions about the ability of blockchain to handle the increasing demand from various industries and government sectors. Increasing the replica count may harm throughput and latency because the network must handle the additional message processing and exchange.

Privacy **–** Since users can conduct transactions on the primary platform for blockchain technology, blockchain technology is believed to protect and keep private, sensitive personal data. Although the lack of connectivity gives blockchain developers the freedom to write code in various programming languages, all these networks are closed off and unable to communicate (Li et al., 2017). As a result, standardization is needed for businesses to work together on application development to share blockchain-based solutions and connect them with current systems (Karame et al., 2016).

Consumption of Energy **–** Bitcoin's proof-of-work (PoW) protocol has made it possible to conduct peer-to-peer transactions in a dispersed, untrusted environment. However, miner computers use significant electricity while performing this task (O'Dwyer et al., 2014). The bitcoin consumption of energy index was developed to shed light on this unsustainable aspect of the PoW algorithm. According to research by International Energy, According to Vranken et al. (2017), the energy consumed by the Bitcoin network is greater than that of many countries.

Security and Fairness **–** Some weaknesses leave people vulnerable to criminality because of how young the technology is. One of the most well-known blockchain security vulnerabilities is 51 percent attacks. A 51% assault occurs when one or more malevolent organizations control most of a blockchain's hash rate. They may commit double-spends by reversing transactions using the dominant hash rate, which stops fellow miners from validating blocks. Another unfair strategy used by mining pools to raise block rewards is known as selfish mining, which compromises the trustworthiness of a blockchain network (Göbel et al., 2016According to Eyal et al. (2018), their proposed blockchain network is susceptible to compromise by a malicious actor with a relatively low amount of hashing power, which challenges the common belief that rogue nodes must possess a majority (over 51%) of computing resources to seize control of the network.

Existing problems **-** Problems frequently plague coins and other blockchain technology. This is because the decentralized nature of this system makes it more difficult for central banks to regulate economic policy, which makes the government wary of blockchain technology (Kakavand et al., 2017). As an illustration, many nations have threatened or even outright prohibited the usage of cryptocurrencies inside their borders. Many countries have banned Bitcoin, including Pakistan, Iran, Ecuador, Morocco, etc. Bangladesh has detained several Bitcoin owners. Figure 1 shows the legality of Bitcoin around the world. It was shown how problematic regulatory issues are for new networked technologies, particularly in the EU and the USA. (Yeoh et al., 2017).

Journal of Informatics Education and Research
ISSN: 1526-4726
https://doi.org/10.52783/jier.v3i2.301
Vol 3 Issue 2 (2023)

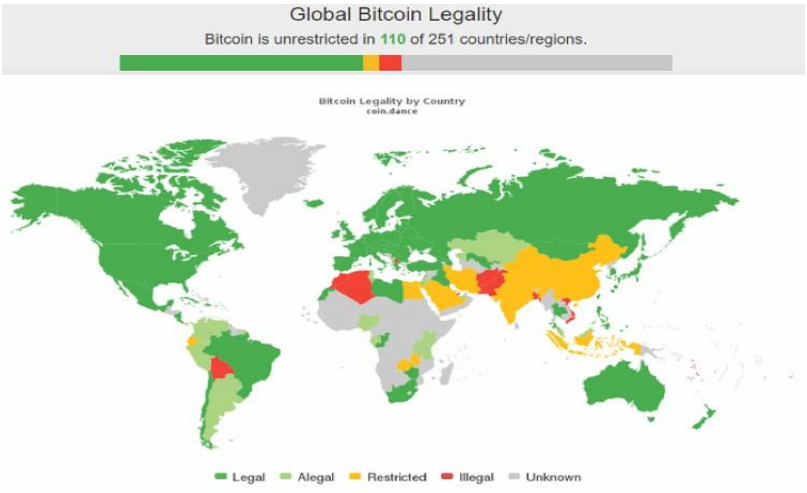

Figure 1: Global Bitcoin Legality (Ahmed et al., 2019).

Notwithstanding the introduction of such beneficial applications, policymakers and regulators have expressed reservations about blockchain technology's striking resemblance to bitcoins due to the latter's alleged links with money-laundering operations. Since the technology may unintentionally increase systemic threats in the financial system, regulatory strategies must be deftly harmonious against its innovative spirit (Heilman et al., 2014).

3. Discussion

According to the researchers, Blockchain holds enormous potential for use in both academics and business. We've covered a variety of potential uses for blockchain technology in the future in this area, including standardization, safeguarding assets, big data, and smart contracts, among others. Blockchain performance can entice investors with the promise of a significant reward. Before incorporating this technology into a business solution, it is imperative to ascertain whether it satisfies the requirements. In order to assess the value of a blockchain-based solution and the tradeoffs, there ought to be an established testing procedure. There ought to be a few tests and standardizing procedures to assess the processing speed, capability, and responsiveness of the purchased solution platform. When new inventions, proof-of-concepts, and designs are registered, blockchain technology enables businesses to create a digital trail of their records. This certificate can demonstrate any IP asset's legitimacy, existence, and control. All notarized information, including copyright claims and trade secrets, could be kept secure and private by utilizing the particular cryptographic layer.

4. Conclusion

In order to evaluate the possible applications, benefits, and downsides of the blockchain, this investigation integrates survey responses from several sources. In-depth coverage is given on the blockchain's consensus structures, application areas, system architecture, and transactions part.

Although blockchain technology holds significant potential, several obstacles must be overcome through further research and analysis to develop more efficient and effective industrial applications. Challenges such as security, privacy, scalability, energy consumption, integration with other systems, and regulatory compliance remain unsolved and require attention. Addressing these issues is essential for developing more efficient blockchain industrial applications. This survey will provide valuable insights into the trade-offs associated with blockchain consensus mechanisms and potential application areas. It can be a useful reference for researchers and practitioners exploring new research directions that can yield promising results in related fields.

References

1. Kakavand H., Kost De Sevres N., and Chilton B., ‘‘The blockchain revolution: An analysis of regulation and technology related to distributed ledger technologies,’’ Tech. Rep., Jan. 2017.

2. Yeoh P., ‘‘Regulatory issues in blockchain technology,’’ J. Financial Regulation Compliance, vol. 25, no. 2, pp. 196–208, 2017.
3. Eyal I. and Sirer E. G., ‘‘Majority is not enough: Bitcoin mining is vulnerable,’’ Commun. ACM, vol. 61, no. 7, pp. 95–102, 2018.
4. Heilman E., ‘‘One weird trick to stop selfish miners: Fresh bitcoins, a solution for the honest miner,’’ in Proc. Int. Conf. Financial Cryptogr. Data Secur. Berlin, Germany: Springer, 2014, pp. 161–162.
5. Ahmed Afif Monrat, Olov Schelén, Karl Andersson. (2019). A Survey of Blockchain From the Perspectives of Applications, Challenges, and Opportunities. IEEE Access. 10.1109/ACCESS.2019.2936094
6. Göbel J., Keeler H. P., Krzesinski A. E., and Taylor P. G., ‘‘Bitcoin blockchain dynamics: The selfish-mine strategy in the presence of propagation delay,’’ Perform. Eval., vol. 104, pp. 23–41, Oct. 2016.
7. Vranken H., ‘‘Sustainability of bitcoin and blockchains,’’ Current Opin- ion Environ. Sustainability, vol. 28, pp. 1–9, Oct. 2017.
8. O’Dwyer K. J. and Malone D., ‘‘Bitcoin mining and its energy footprint,’’ in Proc. 25th IET Irish Signals Syst. Conf., Jun. 2014, pp. 280–285.
9. Karame G. O. and Androulaki E., Bitcoin Blockchain Security. Norwood, MA, USA: Artech House, 2016.
10. Li W., Andreina S., Bohli J.-M., and Karame G., ‘‘Securing proof-of- stake blockchain protocols,’’ in Data Privacy Management, Cryptocurrencies and Blockchain Technology. Cham, Switzerland: Springer, 2017, pp. 297–315.
11. M. Vukolić, ‘‘The quest for scalable blockchain fabric: Proof-of-work vs. BFT replication,’’ in Proc. Int. Workshop Open Problems Netw. Secur. Cham, Switzerland: Springer, 2015, pp. 112–125.
12. H. Harfield, ‘‘Identity crises in letter of credit law,’’ Ariz. L. Rev., vol. 24, p. 239, 1982.
13. G. Fridgen, S. Radszuwill, N. Urbach, and L. Utz, ‘‘Cross-organizational workflow management using blockchain technology-towards applicabil- ity, auditability, and automation,’’ Tech. Rep., 2018.
14. V. Gatteschi, F. Lamberti, C. Demartini, C. Pranteda, and V. Santamaría, ‘‘Blockchain and smart contracts for insurance: Is the technology mature enough?’’ Future Internet, vol. 10, no. 2, p. 20, Feb. 2018.
15. P. Dunphy and F. A. P. Petitcolas, ‘‘A first look at identity management schemes on the blockchain,’’ IEEE Security Privacy, vol. 16, no. 4, pp. 20–29, Jul./Aug. 2018.
16. O. Jacobovitz, ‘‘Blockchain for identity management,’’ Dept. Comput. Sci., Ben-Gurion Univ., Beersheba, Israel, Tech. Rep., 2016.
17. D. Tapscott and A. Tapscott, ‘‘How blockchain will change organiza- tions,’’ MIT Sloan Manage. Rev., vol. 58, no. 2, p. 10, 2017
18. Cohn, T. West, and C. Parker, ‘‘Smart after all: Blockchain, smart contracts, parametric insurance, and smart energy grids,’’ Georgetown Law Technol. Rev., vol. 1, no. 2, pp. 273–304, 2017.
19. R. H. Lasseter and P. Piagi, ‘‘Microgrid: A conceptual solution,’’ in Proc. IEEE 35th Annual Power Electron. Spec. Conf., vol. 6, Jun. 2004, pp. 4285–4291.
20. B. Shen, J. Guo, and Y. Yang, ‘‘MedChain: Efficient healthcare data sharing via blockchain,’’ Appl. Sci., vol. 9, no. 6, p. 1207, Dec. 2018.
21. Azaria, A. Ekblaw, T. Vieira, and A. Lippman, ‘‘MedRec: Using blockchain for medical data access and permission management,’’ in Proc. 2nd Int. Conf. Open Big Data (OBD), Aug. 2016, pp. 25–30.
22. D. Glass, ‘‘Counterfeit drugs and medical devices in developing coun- tries,’’ Res. Rep. Tropical Med., vol. 2014, pp. 11–22, 2014.
23. T. McGhin, K.-K. R. Choo, C. Z. Liu, and D. He, ‘‘Blockchain in healthcare applications: Research challenges and opportunities,’’ J. Netw. Comput. Appl., vol. 135, pp. 62–75, Jun. 2019.
24. R. L. Twesige, ‘‘A simple explanation of bitcoin and blockchain technol- ogy,’’ Tech. Rep., 2015.
25. M. Crosby, P. Pattanayak, S. Verma, and V. Kalyanaraman, ‘‘Blockchain technology: Beyond bitcoin,’’ Appl. Innov., vol. 2, nos. 6–10, p. 71, 2016.
26. M. Alharby and A. van Moorsel, ‘‘Blockchain-based smart contracts: A systematic mapping study,’’ 2017, arXiv:1710.06372. [Online]. Avail- able: https://arxiv.org/abs/1710.06372.
27. Q. Wang, X. Li, and Y. Yu, ‘‘Anonymity for bitcoin from secure escrow address,’’ IEEE Access, vol. 6, pp. 12336–12341, 2018.

28. D. Shrier, W. Wu, and A. Pentland, ‘‘Blockchain & infrastructure (iden- tity, data security),’’ Massachusetts Inst. Technol., Cambridge, MA, USA, 2016, vol. 1, no. 3.
29. F. Tschorsch and B. Scheuermann, ‘‘Bitcoin and beyond: A technical sur- vey on decentralized digital currencies,’’ IEEE Commun. Surveys Tuts., vol. 18, no. 3, pp. 2084–2123, 3rd Quart., 2016.
30. M. del Castillo. (2017). Chain is Now Working on Six ‘Citi-Sized’ Blockchain Networks. [Online]. Available: https://www.coindesk.com/ chainnow-working-six-citi-sized-blockchain-networks.
31. F. Glaser, ‘‘Pervasive decentralisation of digital infrastructures: A frame- work for blockchain enabled system and use case analysis,’’ in Proc. 50th Hawaii Int. Conf. Syst. Sci., 2017, pp. 1–10.
32. T. I. Kiviat, ‘‘Beyond bitcoin: Issues in regulating blockchain tranac- tions,’’ Duke Law J., vol. 65, p. 569, 2015.
33. S. King and S. Nadal, ‘‘PPCoin: Peer-to-peer crypto-currency with proof-of-stake,’’ vol. 19, Aug. 2012. [Online]. Available: http:// www.peercoin.net/
34. W. Wang, D. T. Hoang, P. Hu, Z. Xiong, D. Niyato, P. Wang, Y. Wen, and D. I. Kim, ‘‘A survey on consensus mechanisms and mining strategy man- agement in blockchain networks,’’ IEEE Access, vol. 7, pp. 22328–22370, 2019.
35. Biryukov, D. Khovratovich, and I. Pustogarov, ‘‘Deanonymisation of clients in bitcoin P2P network,’’ in Proc. ACM SIGSAC Conf. Comput. Commun. Secur., Nov. 2014, pp. 15–29.
36. Blundell-Wignall, The Bitcoin Question, no. 37. OECD iLibrary, 2014. doi: 10.1787/5jz2pwjd9t20-en.
37. Gervais, G. O. Karame, and K. Wüst, V. Glykantzis, H. Ritzdorf, and S. Capkun, ‘‘On the security and performance of proof of work blockchains,’’ in Proc. ACM SIGSAC Conf. Comput. Commun. Secur., Oct. 2016, pp. 3–16.
38. S. Bano, M. Al-Bassam, and G. Danezis, ‘‘The road to scalable blockchain designs,’’ USENIX, Login, Mag., Dec. 2017, pp. 1–6.
39. Z. Zheng, S. Xie, H.-N. Dai, X. Chen, and H. Wang, ‘‘Blockchain chal- lenges and opportunities: A survey,’’ Int. J. Web Grid Services, vol. 14, no. 4, pp. 352–375, 2016.
40. F. Casino, T. K. Dasaklis, and C. Patsakis, ‘‘A systematic literature review of blockchain-based applications: Current status, classification and open issues,’’ Telematics Inform., vol. 36, pp. 55–81, Mar. 2019.
41. J. Al-Jaroodi and N. Mohamed, ‘‘Blockchain in industries: A survey,’’ IEEE Access, vol. 7, pp. 36500–36515, 2019.
42. M. Kouhizadeh and J. Sarkis, ‘‘Blockchain practices, potentials, and perspectives in greening supply chains,’’ Sustainability, vol. 10, no. 10, p. 3652, Oct. 2018.
43. K. Salah, M. H. U. Rehman, N. Nizamuddin, and A. Al-Fuqaha, ‘‘Blockchain for AI: Review and open research challenges,’’ IEEE Access, vol. 7, pp. 10127–10149, 2019.
44. T. Aste, P. Tasca, and T. D. Matteo, ‘‘Blockchain technologies: The foreseeable impact on society and industry,’’ Computer, vol. 50, no. 9, pp. 18–28, Jan. 2017.