Indonesian Journal of Computer Science
ISSN 2549-7286
Jln. Khatib Sulaiman Dalam, No. 1, Padang, Indonesia, Telp. (0751) 7056199, 7058325
Website: ijcs.stmikindonesia.ac.id | E-mail: ijcs@stmikindonesia.ac.id

Evaluation of Cloud-Based Ethereum Network Performance

Tri Apriyanto Sundara[1,2], Lathifah Arief[3]
tri.sundara@stmikindonesia.ac.id, lathifah.arief@it.unand.ac.id
[1]Universiti Kebangsaan Malaysia
[2]STMIK Indonesia Padang
[3]Andalas University

Keywords
Blockchain, Ethereum, Cloud, Ropsten, Rinkeby

Abstract
Ethereum, that enable development of decentralized applications, will likely to leverage cloud computing. In this research, we evaluate the performance of a cloud-based Ethereum network. We researched 3 Ethereum networks, namely: Ethereum mainnet, Ethereum testnet Ropsten, and Ethereum testnet Rinkeby. We analyze the computational resource utilization required to run an Ethereum node for a month as well as the costs involved. Research shows that the utilization of computing resources on the Main Net is generally higher than on the Test Net network. Computing resources used in the cloud cost thousands of dollars and this will increase as the number of nodes running to support the Ethereum network.

A. Introduction

Blockchain is a distributed ledger technology that is currently receiving widespread attention, both because of its use for cryptocurrencies and other fields. along with its development, blockchain has been used in various other sectors, such as: Internet of Things (IoT), supply chain, and others.

One of the widely used Blockchain networks is Ethereum, which is an example of Blockchain 2.0 which allows the development of decentralized applications. As the Ethereum network grows and becomes more valuable, more computing resources will be used to support it. With more massive cloud adoption, it is likely that many of the resources to support Ethereum will leverage cloud computing. This research aims to evaluate the performance of cloud-based Ethereum. [1], [2], [11]–[20], [3], [21]–[30], [4], [31]–[40], [5], [41]–[47], [6]–[10]

B. Research Methodology

To evaluate the performance of cloud-based Etherum, we conducted experiments in the cloud and carried out a comparative study of the performance of various Ethereum-based networks.

In this research, we use Amazon Web Services (AWS) as the cloud service platform. AWS provides Amazon Managed Blockchain just like Hyperledger and Ethereum. Below are some of the Ethereum-based networks and their availability on AWS. [48]

Table 1. Ethereum Networks

Network	Managed Blockchain
MainNet	Provided
TestNet Ropsten	Provided
TestNet Rinkeby	Provided
TestNet Kovan	Not Provided
TestNet Goerli	Not Provided

As shown in table 1, only 3 Ethereum networks are supported by AWS. We will use an instance of type bc.t3.large on Amazon Managed Blockchain and evaluate the utilization of computing resources, such as CPU and memory, on that instance.

C. Result and Discussion

The results of monitoring computing resources for Ethereum-based networks are shown in the figure below. Figures 1 and 2 show the performance on the Main Net network, while Figures 3 and 4 show the performance on one of the Test Net networks.

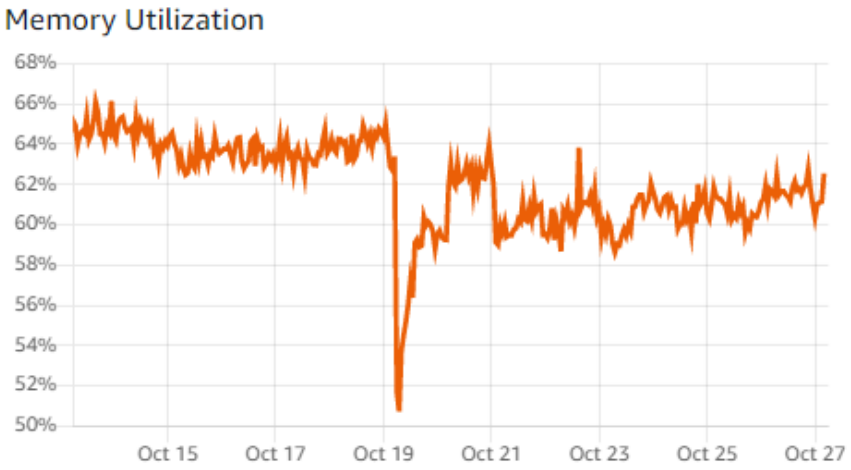

Figure 1. Memory Utilization of Single Ethereum Main Net Node

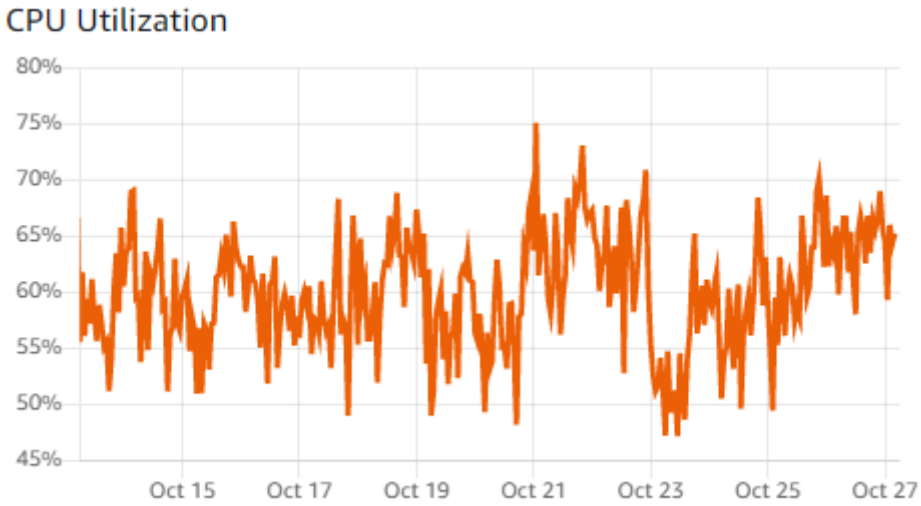

Figure 2. CPU Utilization of Single Ethereum Main Net Node

Figure 3. Memory Utilization of Single Ethereum TestNet Ropsten Node

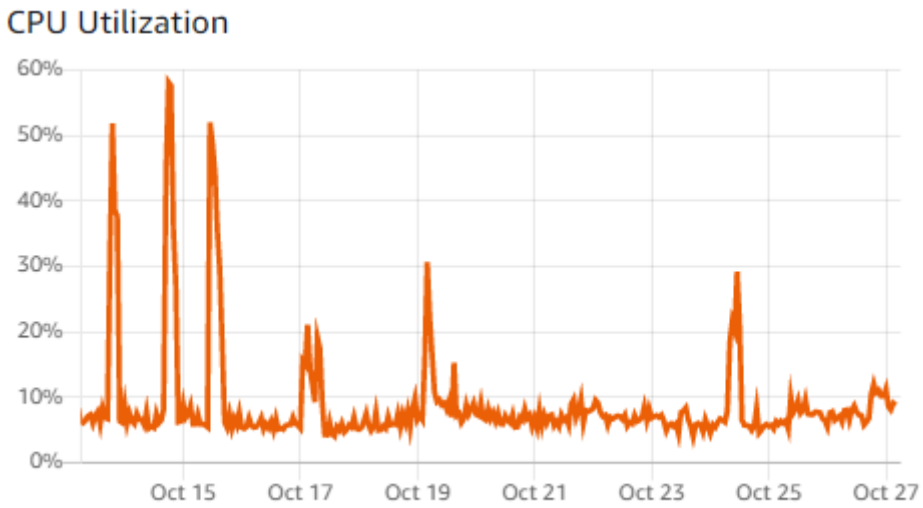

Figure 4. CPU Utilization of Single Ethereum TestNet Ropsten Node

Performance comparison between various Ethereum nodes on the Main Net and Test Net networks (Rinkeby and Ropsten) can be seen in Figures 5, 6, and 7.

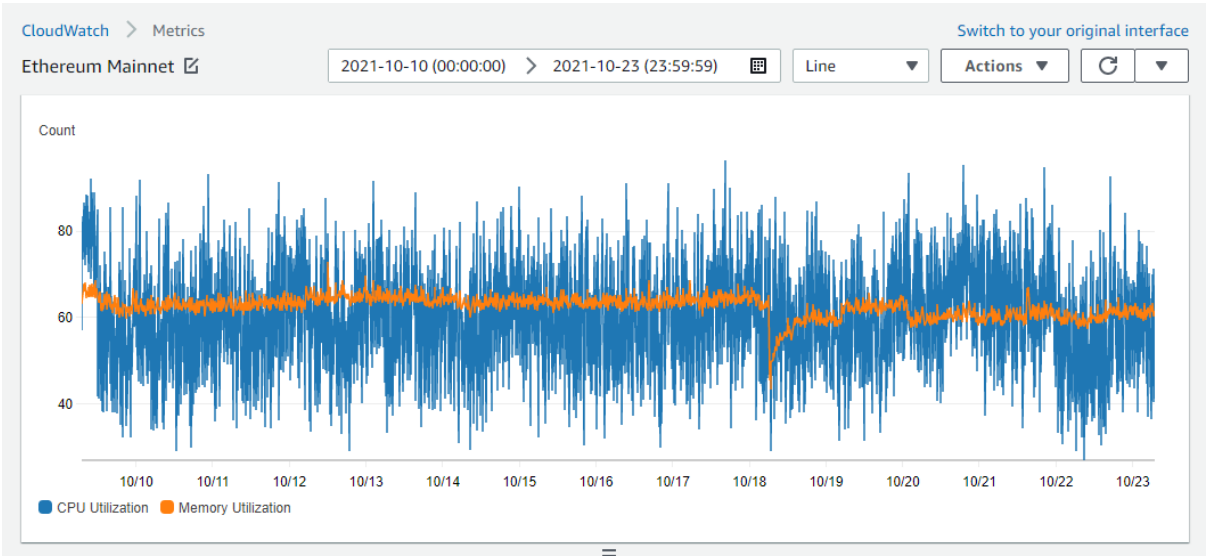

Figure 5. CPU and Memory Utilization of Single Ethereum Mainnet Node

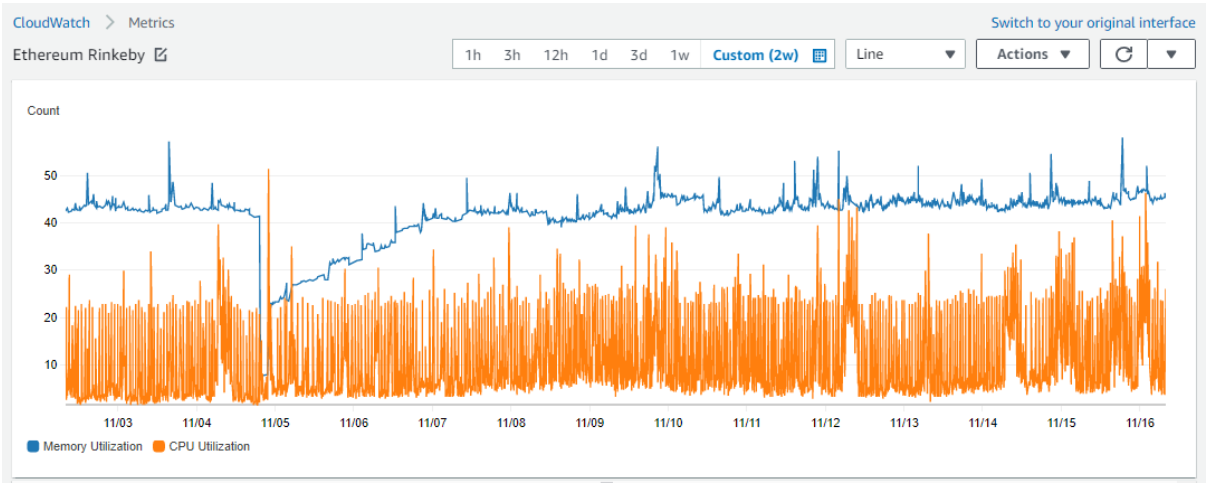

Figure 6. CPU and Memory Utilization of Single Ethereum TestNet Rinkeby Node

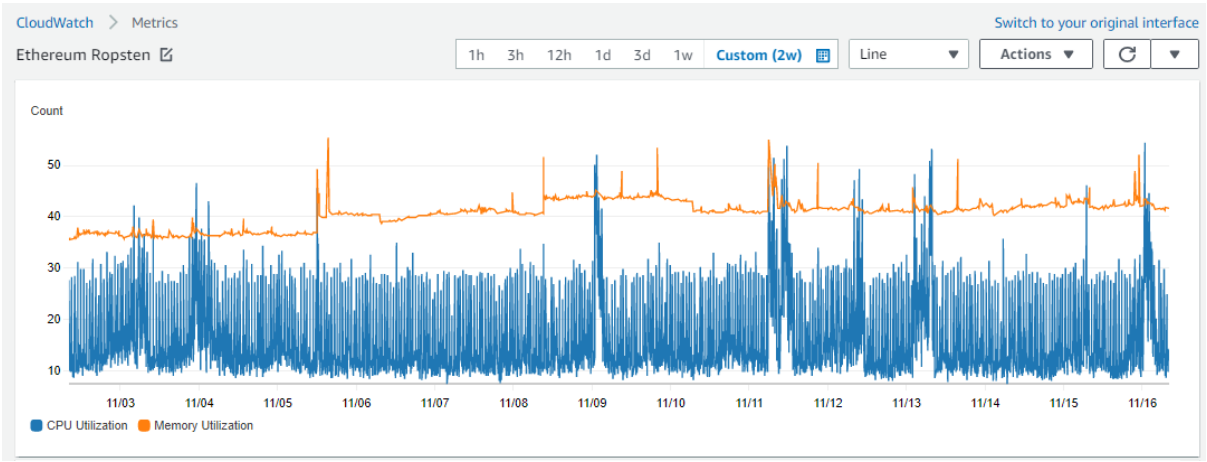

Figure 7. CPU and Memory Utilization of Single Ethereum TestNet Ropsten Node

D. Conclusion

Research shows that the utilization of computing resources on the Main Net is generally higher than on the Test Net network. Computing resources used in the cloud cost thousands of dollars and this will increase as the number of nodes running to support the Ethereum network.

E. Acknowledgement

This research is funded by Ministry of Education, Culture, Research and Technology (Indonesia) and TÜBİTAK: Scientific and Technological Research Council (Turkey) through South East Asia – Europe Union Joint Funding Scheme (SEA-EU JFS) for Research and Innovation. The authors would like to thank Ministry of Education, Culture, Research, and Technology (KemdikbudRistek) of Indonesia for supporting the research under contract number 343/E4.1/AK.04.PT/2021.

F. Referensi

[1] N. Khan, B. Kchouri, N. A. Yatoo, Z. Kräussl, A. Patel, and R. State, "Tokenization of sukuk: Ethereum case study," *Glob. Financ. J.*, no. May, 2020, doi: 10.1016/j.gfj.2020.100539.

[2] S. Asadi Bagloee, M. Tavana, G. Withers, M. Patriksson, and M. Asadi, "Tradable mobility permit with Bitcoin and Ethereum – A Blockchain application in transportation," *Internet of Things*, vol. 8, p. 100103, 2019, doi: 10.1016/j.iot.2019.100103.

[3] D. Guo, J. Dong, and K. Wang, "Graph structure and statistical properties of Ethereum transaction relationships," *Inf. Sci. (Ny).*, vol. 492, pp. 58–71, 2019, doi: 10.1016/j.ins.2019.04.013.

[4] P. M. Dhulavvagol, V. H. Bhajantri, and S. G. Totad, "Blockchain Ethereum Clients Performance Analysis Considering E-Voting Application," *Procedia Comput. Sci.*, vol. 167, no. Iccids 2019, pp. 2506–2515, 2020, doi: 10.1016/j.procs.2020.03.303.

[5] A. López Vivar, A. L. Sandoval Orozco, and L. J. García Villalba, "A security framework for Ethereum smart contracts," *Comput. Commun.*, vol. 172, no. March, pp. 119–129, 2021, doi: 10.1016/j.comcom.2021.03.008.

[6] A. Lisi, A. De Salve, P. Mori, L. Ricci, and S. Fabrizi, "Rewarding reviews with tokens: An Ethereum-based approach," *Futur. Gener. Comput. Syst.*, vol. 120, pp. 36–54, 2021, doi: 10.1016/j.future.2021.02.003.

[7] "Ethereum." https://ethereum.org/.

[8] M. Pustišek and A. Kos, "Approaches to Front-End IoT Application Development for the Ethereum Blockchain," *Procedia Comput. Sci.*, vol. 129, pp. 410–419, 2018, doi: 10.1016/j.procs.2018.03.017.

[9] X. Luo, Z. Wang, W. Cai, X. Li, and V. C. M. Leung, "Application and evaluation of payment channel in hybrid decentralized ethereum token exchange," *Blockchain Res. Appl.*, vol. 1, no. 1–2, p. 100001, 2020, doi: 10.1016/j.bcra.2020.100001.

[10] Y. A. Hsain, N. Laaz, and S. Mbarki, "Ethereum's smart contracts construction and development using model driven engineering technologies: A review,"

Procedia Comput. Sci., vol. 184, pp. 785–790, 2021, doi: 10.1016/j.procs.2021.03.097.

[11] M. Zulfiqar *et al.*, "EthReview: An Ethereum-based Product Review System for Mitigating Rating Frauds," *Comput. Secur.*, vol. 100, p. 102094, 2021, doi: 10.1016/j.cose.2020.102094.

[12] H. Patel and B. Shrimali, "AgriOnBlock: Secured data harvesting for agriculture sector using blockchain technology," *ICT Express*, no. xxxx, 2021, doi: 10.1016/j.icte.2021.07.003.

[13] M. Shaker, F. Shams Aliee, and R. Fotohi, "Online rating system development using blockchain-based distributed ledger technology," *Wirel. Networks*, vol. 27, no. 3, pp. 1715–1737, 2021, doi: 10.1007/s11276-020-02514-w.

[14] J. J. Kearney and C. A. Perez-Delgado, "Vulnerability of blockchain technologies to quantum attacks," *Array*, vol. 10, no. April, p. 100065, 2021, doi: 10.1016/j.array.2021.100065.

[15] R. A. Mishra, A. Kalla, A. Braeken, and M. Liyanage, "Privacy Protected Blockchain Based Architecture and Implementation for Sharing of Students' Credentials," *Inf. Process. Manag.*, vol. 58, no. 3, p. 102512, 2021, doi: 10.1016/j.ipm.2021.102512.

[16] B. Routledge and A. Zetlin-Jones, "Currency stability using blockchain technology," *J. Econ. Dyn. Control*, no. xxxx, p. 104155, 2021, doi: 10.1016/j.jedc.2021.104155.

[17] J. Polge, J. Robert, and Y. Le Traon, "Permissioned blockchain frameworks in the industry: A comparison," *ICT Express*, vol. 7, no. 2, pp. 229–233, 2021, doi: 10.1016/j.icte.2020.09.002.

[18] H. MS, S. R, and R. M, "Block Chain Based Agricultural Supply Chain-A Review," *Glob. Transitions Proc.*, pp. 0–9, 2021, doi: 10.1016/j.gltp.2021.08.041.

[19] A. S. Almasoud, F. K. Hussain, and O. K. Hussain, "Smart contracts for blockchain-based reputation systems: A systematic literature review," *J. Netw. Comput. Appl.*, vol. 170, no. May, p. 102814, 2020, doi: 10.1016/j.jnca.2020.102814.

[20] H. Ma, E. X. Huang, and K. Y. Lam, "Blockchain-based mechanism for fine-grained authorization in data crowdsourcing," *Futur. Gener. Comput. Syst.*, vol. 106, pp. 121–134, 2020, doi: 10.1016/j.future.2019.12.037.

[21] J. Moubarak, M. Chamoun, and E. Filiol, "On distributed ledgers security and illegal uses," *Futur. Gener. Comput. Syst.*, vol. 113, pp. 183–195, 2020, doi: 10.1016/j.future.2020.06.044.

[22] A. Ghosh, S. Gupta, A. Dua, and N. Kumar, "Security of Cryptocurrencies in blockchain technology: State-of-art, challenges and future prospects," *J. Netw. Comput. Appl.*, vol. 163, no. April, p. 102635, 2020, doi: 10.1016/j.jnca.2020.102635.

[23] M. Farnaghi and A. Mansourian, "Blockchain, an enabling technology for transparent and accountable decentralized public participatory GIS," *Cities*, vol. 105, no. March, p. 102850, 2020, doi: 10.1016/j.cities.2020.102850.

[24] Z. Zhou, M. Wang, C. N. Yang, Z. Fu, X. Sun, and Q. M. J. Wu, "Blockchain-based decentralized reputation system in E-commerce environment," *Futur. Gener. Comput. Syst.*, vol. 124, pp. 155–167, 2021, doi:

10.1016/j.future.2021.05.035.
[25] M. Westerkamp, F. Victor, and A. Küpper, "Tracing manufacturing processes using blockchain-based token compositions," *Digit. Commun. Networks*, vol. 6, no. 2, pp. 167–176, 2020, doi: 10.1016/j.dcan.2019.01.007.
[26] F. Leal, A. E. Chis, and H. González–Vélez, "Multi-service model for blockchain networks," *Inf. Process. Manag.*, vol. 58, no. 3, p. 102525, 2021, doi: 10.1016/j.ipm.2021.102525.
[27] V. Chukowry, G. Nanuck, and R. K. Sungkur, "The Future of Continuous Learning - Digital Badge and Microcredential System using Blockchain," *Glob. Transitions Proc.*, pp. 0–9, 2021, doi: 10.1016/j.gltp.2021.08.026.
[28] T. Hewa, M. Ylianttila, and M. Liyanage, "Survey on blockchain based smart contracts: Applications, opportunities and challenges," *J. Netw. Comput. Appl.*, vol. 177, p. 102857, 2021, doi: 10.1016/j.jnca.2020.102857.
[29] A. Schweizer, P. Knoll, N. Urbach, H. A. Von Der Gracht, and T. Hardjono, "To What Extent Will Blockchain Drive the Machine Economy? Perspectives from a Prospective Study," *IEEE Trans. Eng. Manag.*, vol. 67, no. 4, pp. 1169–1183, 2020, doi: 10.1109/TEM.2020.2979286.
[30] R. Kumar and R. Sharma, "Leveraging Blockchain for Ensuring Trust in IoT: A Survey," *J. King Saud Univ. - Comput. Inf. Sci.*, no. xxxx, 2021, doi: 10.1016/j.jksuci.2021.09.004.
[31] M. Krietemeyer, "Blockchain Technologies ' Influence on Hotel Bookings," 2019.
[32] S. Ali, G. Wang, B. White, and R. L. Cottrell, "A Blockchain-Based Decentralized Data Storage and Access Framework for PingER," *Proc. - 17th IEEE Int. Conf. Trust. Secur. Priv. Comput. Commun. 12th IEEE Int. Conf. Big Data Sci. Eng. Trust. 2018*, pp. 1303–1308, 2018, doi: 10.1109/TrustCom/BigDataSE.2018.00179.
[33] N. S. Clarke, B. Jürgens, and V. Herrero-Solana, "Blockchain patent landscaping: An expert based methodology and search query," *World Pat. Inf.*, vol. 61, no. March, 2020, doi: 10.1016/j.wpi.2020.101964.
[34] G. Leduc, S. Kubler, and J. P. Georges, "Innovative blockchain-based farming marketplace and smart contract performance evaluation," *J. Clean. Prod.*, vol. 306, p. 127055, 2021, doi: 10.1016/j.jclepro.2021.127055.
[35] S. K. Radha, I. Taylor, J. Nabrzyski, and I. Barclay, "Verifiable Badging System for Scientific Data Reproducibility," *Blockchain Res. Appl.*, p. 100015, 2021, doi: 10.1016/j.bcra.2021.100015.
[36] J. Ducrée, "Research – A blockchain of knowledge?," *Blockchain Res. Appl.*, vol. 1, no. 1–2, p. 100005, 2020, doi: 10.1016/j.bcra.2020.100005.
[37] F. Asuncion *et al.*, "Connecting Supplier and DoD Blockchains for Transparent Part Tracking," *Blockchain Res. Appl.*, p. 100017, 2021, doi: 10.1016/j.bcra.2021.100017.
[38] M. Antwi, A. Adnane, F. Ahmad, R. Hussain, M. Habib ur Rehman, and C. A. Kerrache, "The Case of HyperLedger Fabric as a Blockchain Solution for Healthcare Applications," *Blockchain Res. Appl.*, vol. 2, no. 1, p. 100012, 2021, doi: 10.1016/j.bcra.2021.100012.
[39] V. Babich and G. Hilary, "Distributed ledgers and operations: What operations management researchers should know about blockchain

technology," *Manuf. Serv. Oper. Manag.*, vol. 22, no. 2, pp. 223–240, 2020, doi: 10.1287/MSOM.2018.0752.

[40] H. Saputra, B. I. Aresta, T. A. Sundara, I. Stephane, and L. Maltaf, "Blockchain-based diploma information system development," *Invotek*, vol. 21, no. 1, pp. 37–44, 2021, [Online]. Available: http://invotek.ppj.unp.ac.id/index.php/invotek/article/view/833.

[41] L. Arief, T. A. Sundara, and H. Saputra, "Studi Perbandingan Jaringan Blockchain sebagai Platform Sistem Rating," *Rekayasa Sist. dan Teknol. Inf.*, vol. 5, no. 10, pp. 827–836, 2021.

[42] A. Zutshi, A. Grilo, and T. Nodehi, "The value proposition of blockchain technologies and its impact on Digital Platforms," *Comput. Ind. Eng.*, vol. 155, no. August 2020, p. 107187, 2021, doi: 10.1016/j.cie.2021.107187.

[43] A. Sadu, A. Jindal, G. Lipari, F. Ponci, and A. Monti, "Resilient Design of Distribution Grid Automation System against cyber-physical attacks using Blockchain and Smart Contract," *Blockchain Res. Appl.*, p. 100010, 2021, doi: 10.1016/j.bcra.2021.100010.

[44] N. Truong, G. M. Lee, K. Sun, F. Guitton, and Y. K. Guo, "A blockchain-based trust system for decentralised applications: When trustless needs trust," *Futur. Gener. Comput. Syst.*, vol. 124, pp. 68–79, 2021, doi: 10.1016/j.future.2021.05.025.

[45] W. Rashideh, "Blockchain technology framework: Current and future perspectives for the tourism industry," *Tour. Manag.*, vol. 80, no. April, p. 104125, 2020, doi: 10.1016/j.tourman.2020.104125.

[46] F. Casino, T. K. Dasaklis, and C. Patsakis, "A systematic literature review of blockchain-based applications: Current status, classification and open issues," *Telemat. Informatics*, vol. 36, no. November 2018, pp. 55–81, 2019, doi: 10.1016/j.tele.2018.11.006.

[47] Z. Xu, W. Liu, J. Huang, C. Yang, J. Lu, and H. Tan, "Artificial Intelligence for Securing IoT Services in Edge Computing: A Survey," *Secur. Commun. Networks*, vol. 2020, 2020, doi: 10.1155/2020/8872586.

[48] AWS, "Amazon Managed Blockchain Ethereum Developer Guide." 2021.