



ICIS2022Penang

<https://fim.uitm.edu.my/index.php/research/conference/342-icis-2022>
5th International Conference on Information Science
Royale Chulan, Penang, Malaysia, 19-21 Sep 2022
Organised by Faculty of Information Management, UiTM, Malaysia



An overview of Blockchain Technology towards E-voting in Malaysia

Fadhilnor Rahmad, Mad Khir Johari Abdullah Sani, Irni Eliana Khairuddin

Senior Lecturer, Faculty of Information Management,
UiTM, Shah Alam, Malaysia

fadhilnor@uitm.edu.my, madkhirjohari@uitm.edu.my, irnieliana@uitm.edu.my
Tel: +60123263246

Abstract

This paper gives a general overview of blockchain-based electronic voting systems. The aim of this paper is to examine the status of blockchain-based voting research, as well as any potential difficulties, with the aim of predicting future developments in the Malaysia scenario. This paper was conducted based on literature review. A conceptual description of the planned blockchain-based e-voting application is provided after an introduction to the fundamental structure and characteristics of the blockchain in relation to e-voting. In addition, this paper also highlights several issues related to blockchain technologies and e-voting.

Keywords: e-voting, Blockchain, Blockchain technology

eISSN: 2398-4287© 2021. The Authors. Published for AMER ABRA cE-Bs by e-International Publishing House, Ltd., UK. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). Peer-review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers), ABRA (Association of Behavioural Researchers on Asians/Africans/Arabians) and cE-Bs (Centre for Environment-Behaviour Studies), Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.
DOI: <https://doi.org/10.21834/ebpj.v7i1S110.4126>

1.0 Introduction

Rapid technological change has resulted in the emergence of fresh concepts that will allow people to make success in their business and service practices. The underlying principle of blockchain technology is that all operations are integrated and organised into relational computing, eliminating the need for a third party or intermediary. It is also to identify inconsistency in voting and lack of privacy in blockchain characteristics or applications that could negatively impact organisations' decision to adopt Blockchain technology. In addition to the lack of cryptography expertise needed to develop blockchain technology, there is a lack of understanding of the blockchain technology. Although public awareness of the technology would undoubtedly help, businesses and organization need to be more knowledgeable about it than the general population. Bringing in foreign companies to establish regional centres locally is another method the nation may advance in the blockchain sector. The palm oil and agricultural sectors, Islamic banking, and the renewable energy and utilities sectors are three of the first industries in Malaysia to investigate this area (Sharon, 2018). Recent blockchain implementations in Malaysia include the Covid-19 vaccine recipients' digital vaccination certificates (Bernama, 2021) and the Malaysian Palm Oil Council's traceability in the palm oil industry (Neo, 2020). Both projects are substantial in size and need for significant capital investments. Blockchain technology has the potential to increase industry trust and openness while preventing scandals like those that have occurred in the past years.

Yeoh (2017) argued that Blockchain technology adoption has been increasing significantly in the past decade; it is essential to examine the factors influencing the decision to adopt Blockchain technology in e-voting. Furthermore, examining the factors that influence the Blockchain chain's adoption is significant because it could help stakeholders identify factors that influence the adoption of new technologies in the future (Park & Park, 2017).

eISSN: 2398-4287© 2021. The Authors. Published for AMER ABRA cE-Bs by e-International Publishing House, Ltd., UK. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). Peer-review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers), ABRA (Association of Behavioural Researchers on Asians/Africans/Arabians) and cE-Bs (Centre for Environment-Behaviour Studies), Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.
DOI: <https://doi.org/10.21834/ebpj.v7i1S110.4126>

In a democratic society such as Malaysia, voting has always been an essential aspect of expressing one's opinions. From counting raised hands and filling out paper ballots to voting online, humanity is constantly looking for ways to enhance a procedure that was formerly time-consuming, unreliable, and prone to errors. Using an electronic voting system for various voting events, such as elections and general meetings, is possibly the most straightforward approach to eliminating or reducing the stress of manually counting votes and making mistakes. Estonia was the first country to conduct national elections using an electronic voting system. Switzerland and Norway quickly followed suit, putting computerised systems in place. For democratic countries as well as for state voters' confidence and responsibility, electoral integrity is crucial. Methods of political voting are essential in this regard. From a political standpoint, electronic voting technology can increase voter turnout, trust, and enthusiasm for the electoral process. Elections have long been a social issue since they are a reliable method of making democratic decisions. Therefore, this study aims to overview the concept of blockchain technology in evoting system in Malaysia. It is crucial to prevent a decline in voting confidence. The traditional election system was not completely hygienic, raising various concerns about fairness, equality, and how well the desire of the people was understood and represented by the form of government.

2.0 E-voting concept

The use of electronic voting is frequently viewed as a method to improve the effectiveness of elections and boost public confidence in election administration. E-voting technologies, when properly implemented, can improve ballot security, accelerate the processing of results, and simplify voting. The difficulties are significant, though. E-voting has the potential to erode voter confidence if not thoroughly thought out and implemented. The majority of these functions must be carried out by an effective e-voting system while adhering to a set of regulations, and it must be able to meet stringent requirements for privacy, auditability, accessibility, cost-effectiveness, scalability, and ecological sustainability. There are primarily two categories of electronic voting:

- electronic voting systems present at polling places that are physically monitored by officials from the government or an independent electoral body;
- Remote e-voting over the Internet, often known as i-voting, allows voters to cast their ballots electronically from anywhere and send them to the election officials..

Electronic voting system have a variety of internal features, such as security, communication, randomization, and encryption. It is outside the immediate purview of this paper to analyse these functionalities in detail. However, it is helpful to consider the following list of some of the end-user functionalities that such systems can offer to both voters and election officials in order to get a basic knowledge of what e-voting systems can perform.:

- Electronic voter lists and voter authentication- An electronic voter list that covers either a single polling location or the entire nation can be a component of an electronic voting system. This list can be used to verify that people are eligible to vote and to keep track of their votes.
- Poll worker interfaces- Unique features that are solely accessible to poll workers, such as resetting the vote count at polling place opening and closure and printing and transmitting results.
- Interfaces for casting votes. These include push buttons, touch-sensitive tablets, optical mark recognition (OMR) ballots that are fed into a scanner, web pages, and specialised client software for Internet voting.
- Special interfaces for handicapped voters- These include greater access for voters with physical limitations, Braille or audio input devices, and user interfaces that are more straightforward for voters who are illiterate.

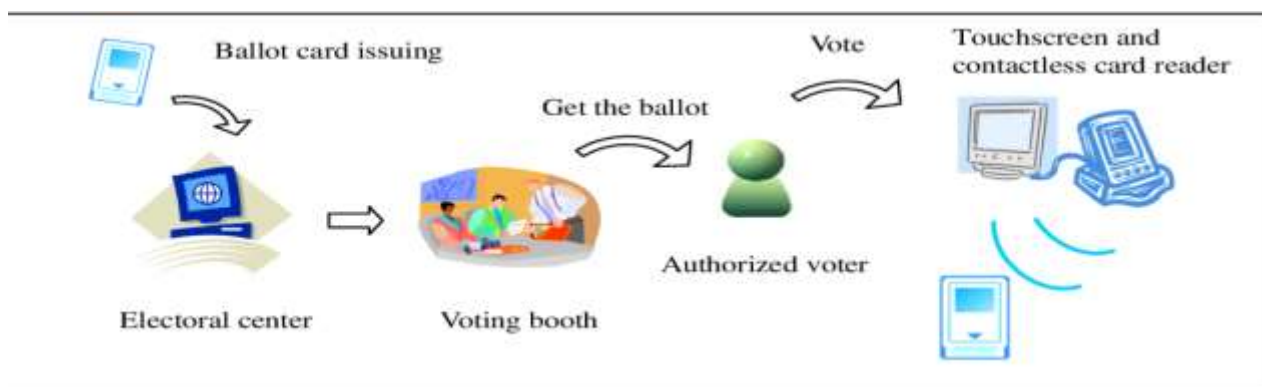


Figure 1. How the evoting works

The evoting has been in Estonia's pilot programme for municipal elections made it the first country to undertake legally binding national elections online in 2005. The electronic voting method was deemed successful by Estonian election officials and confirmed to be reliable in actual use. The Estonia's e-voting success story lies in the country's explicit and effective risk management and in addressing all expected risks by enhancing the capacities of the procurer, carrying out in-depth risk analyses, and endeavoring to

generate trust through consistent dialogue and openness. In the case of radically new solutions, it is highly important to address societal risks by increasing absorptive capacities and generating public acceptance.

Table 1: Internet voting in the Estonian Elections (2005-2011)

Type of elections	Date	Internet votes (% of all votes)	Turnout (% of electorate)	Internet voting turnout (% of electorate)	First time users of ID card online (%)
Municipal elections	Oct 2005	1.9	47.4	0.9	61
Parliamentary elections	April 2007	5.5	61.9	3.4	39
European Parliament	June 2009	14.7	43.9	6.5	19
Municipal elections	Oct 2009	15.8	60.6	9.5	18.5
Parliamentary elections	March 2011	24.3	63.5	15.4	N/A

Source: Estonia National Electoral Committee 2005-2011

3.0 Blockchain concept

Blockchain is a distributed ledger or database. Each node of the network has an exact copy of the whole database, and data are stored in data structures called blocks. Security is ensured since the majority of the copies of the ledger will not reflect this modification and will reject it if someone tries to edit or delete an entry in one of them. There are three main types of Blockchain in the current system: public, private, and consortium. Public or open Blockchain has no access restrictions. This means that anyone can read it, write to it by performing transactions, and even become a validator as one of the nodes. This type of Blockchain is also called a permissionless blockchain (Clohessy & Clohessy, 2020). Private Blockchain has restrictions on who can read and write to the chain and validate it. It is generally controlled by an organisation aiming to limit Blockchain access internally. This type of Blockchain can also be called a permission blockchain. A consortium blockchain is another type of permission Blockchain. However, instead of being restricted to use by a single organisation, the ownership can be divided among several (Kamble, S., Gunasekaran, A., & Arha, H., 2019). Thus:

- **Public or open blockchain** has no access restrictions. This means that anyone can read it, write to it by performing transactions, and even become a validator as one of the nodes. This type of blockchain is also called a *permissionless blockchain*.
- **Private blockchain** has restrictions as to who can read and write to the chain, as well as validate it. It is generally controlled by an organization that aims to limit the access to the blockchain internally. This type of blockchain can also be called a *permissioned blockchain*.
- **Consortium blockchain** is another type of permissioned blockchain. However, instead of being restricted to use by a single organization, the ownership can be divided among several of them.

The electronic voting system involved the following procedures: Voter registration is the first step (registration). The authorities then verify voter identification on election day (verification and authentication). People who are qualified to vote may do so in the following phase (casting collation). The vote ought to be verified and encrypted. The votes' accuracy, secrecy, and anonymity must all be ensured and cannot be modified or removed in any way. The final step in the counting of votes in electronic voting systems is the addition of all votes based on the design (results presentation through counting). The majority of e-voting applications use central authority control. Such systems have a number of shortcomings and perceived hazards. For instance, there are no standards for electronic voting systems, security and reliability risks, fraud and hacker vulnerabilities, expensive machine costs, and insecure transaction storage.

- Immutability
- decentralized
- enhanced security
- distributed ledger
- consensus
- faster settlement

The benefits of the use of blockchain:

- improved transparency as a result of transparent and distributed ledgers,
- inherent confidentiality,
- safety and reliability Anti Denial of Service Attacks
- immutability

Barrier of blockchain:

- Lack of adoption
- Skill gap
- Trust among users

- Financial or budget resources
- Blockchain interoperability

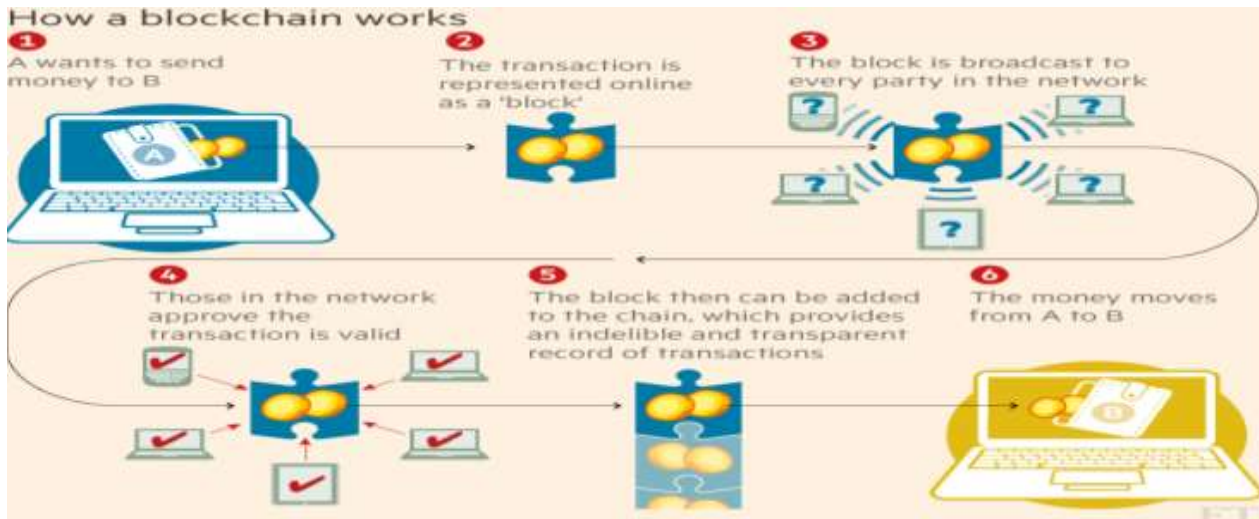


Figure 2. How the blockchain works by World Economic Forum (2016)

4.0 Blockchain concept and evoting

An overview of e-voting systems and blockchain is provided in this section. Electronic voting is a type of voting that records or counts votes using electronic devices. In the past, the term "electronic voting" has been used to describe voting that relies on electronic hardware and/or software to facilitate the voting process. Such systems may be able to support/implement a wide range of tasks, from the voting process' startup to the storage of votes. There are many different types of systems, including computers, mobile devices, and kiosks seen at voting offices. There should be registration, authentication, voting, and tallying steps in the electronic voting system. Figure 3 explains how e voting can incorporate within blockchain technology.

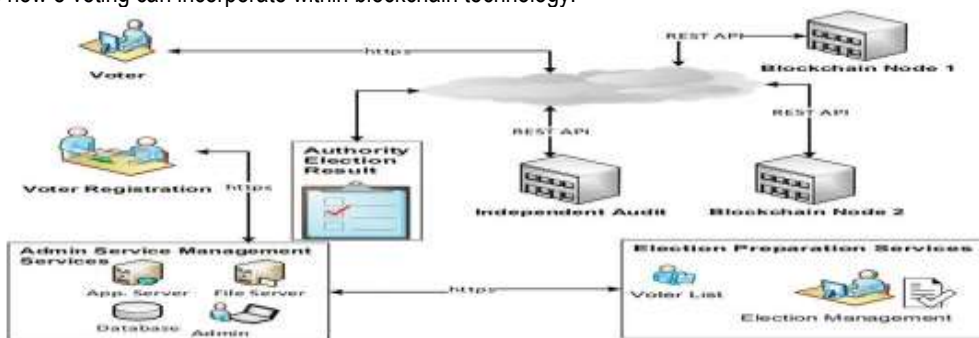


Figure 3: A Blockchain voting systems overview

Using blockchain technology to vote is not only possible for elections, but also for a variety of other applications, such as polls or boardroom meetings. have also created a voting mechanism for smaller-scale polls and elections within the institution, such as department chair elections, student council elections, and rector elections. To recap, blockchain technology may be used to provide voting solutions for a variety of elections and polls. These are further divided into small-scale and large-scale use cases based on the voting system's scale.

Voting Type	Blockchain Type	Method	Advantages	Limitations
Small-scale polls and elections	Public	Smart Contract	Once written, smart contracts cannot be (illegally) removed or modified. The Ethereum network is capable of self-tallying. Asynchronous execution is possible for all transactions.	Difficult to make updates once the smart contracts are deployed. Code executes slower in smart contracts than in servers. Accessing external data requires external code.

Small to large-scale polls and elections	Private		On a private test network the initial block difficulty can be adjusted so that blocks can be produced in less time.	More difficult to set up as it includes building a private Ethereum test network.
Small-scale elections	Public	Zcash	ZCash allows for anonymization of the identities of the voters. The underlying ZCash protocol inherently ensures that every vote is valid and no same vote can be cast twice.	Zcash might be more vulnerable to attacks than Bitcoin or Ethereum. Since the target platform of the protocol would be user's end devices, there's a possibility of the voting machine being compromised.
Small-scale polls and elections			This method employs quadratic voting, which allows for voters to pay in order to cast additional votes for a desired candidate or idea. Thus, the resulting outcome is aligned with the intensity of voter preferences.	
Small to large-scale elections	Private	Custom Blockchain	New blocks can be created in a custom blockchain almost momentarily. More realistic for large-scale elections as it can be set up specifically to accommodate them.	With fewer nodes than in public networks, it might be easier to attack the entire blockchain.
Small-scale polls and elections	Public	Cryptographic Signature	In case of using digital signatures, it is difficult for the voter to prove how they voted. As such, a potential coercer cannot cooperate with the voter.	If voting authority is corrupt, it might be possible to falsify votes by generating extra signatures.
Small to large-scale polls and elections	Private			

5.0 Reflection

This article will give an overview of potential in adoption of blockchain technology that may lead to better approaches in strategizing and developing an e-voting system. On the other hand, it will lead to new trends & patterns in Malaysian knowledge of e-voting. Blockchain technology may lead to better approaches for the future voting environment and contribute to developing the digital humanities for a brighter future. Blockchain technology can be used to address several voting-related difficulties, making electronic voting more secure, convenient, and cost-effective than using any other network. The necessity for more research into blockchain-based electronic voting and the technological difficulties to investigate. Blockchain technology offers many solutions for electronic voting's problems, making it more affordable, enjoyable, and secure than any other network. Research has throughout time drawn attention to certain issues, such as the necessity for additional study into blockchain-based electronic voting and the technological difficulties that exist with such systems.

6.0 Conclusion

In this article, various paper on blockchain-based evoting systems is reviewed and evaluated. The article reviewed on blockchain technology and e-voting research. The blockchain concept and its applications are introduced before information on current e-voting methods. The blockchain can serve as an appropriate mechanism for a decentralised e-voting system, according to many researchers. The several blockchain applications have offered distinct routes for blockchain adoption. These complement and enhance current organisational processes while lowering operational expenses, thus a major overhaul of business procedures is necessary. In Malaysia, blockchain technology is still relatively new. Blockchain technology appears to be a viable sector to enter because Malaysia has the possibility and capacity to collaboratively reinvent the nation's overall business environment. Remittance, data storage, and transparency are only a few of the implementation areas this article has introduced. The blockchain technology used in recent electronic voting research is discussed in the article. Existing electronic voting systems are introduced after the blockchain concept and its uses. Then, a number of issues with the current electronic voting methods are found and fixed. The blockchain has the potential to significantly

improve electronic voting, as well as existing blockchain-based voting solutions and prospective future research directions. A decentralised electronic voting system may be a suitable fit for blockchain, according to many experts.

7.0 Acknowledgement

The authors would like to acknowledge the Faculty of Information Management, Selangor branch and Research Nexus UiTM (ReNeU), Office of Deputy Vice-Chancellor (Research & Innovation) Universiti Teknologi MARA for funding and support.

References

- Acharya, S. and Dunn, J. (2016) 'Overstock.com ventures into digital currencies', *Journal of Business Cases and Application*, pp. 1–16.
- Anspers A., Buldas A., Willemson J. Krüptograafiliste algoritmid elutsükli uuring 2017.
- Buchanan, B., Naqvi, N. and Academy, T. C. (2018) 'Building the Future of EU: Moving Forward with International Collaboration on Blockchain', *The Journal of The British Blockchain Association*, 1(1), pp. 1–4.
- Bernama (2021). Malaysia, Singapore use blockchain technology for vaccination certificates. *The Edge Markets*. <https://www.theedgemarkets.com/article/malaysia-singapore-use-blockchain-technology-vaccination-certificates>
- Bucovetchi, O., Badea, D. and Stanciu, R. D. (2018) 'Blockchain technology – a new approach in business environment', 184, p. 4016. doi: 10.1051/matecon/201818404016.
- Browne, J. (2018). Five things that must happen for blockchain to see widespread adoption, according to Deloitte. Retrieved from <https://www.cnbc.com/2018/10/01/five-crucial-challenges-for-blockchain-to-overcome-deloitte.html> [accessed 4 May, 2019].
- Chen, G., Xu, B., Lu, M., & Chen, N. S. (2018). Exploring blockchain technology and its potential applications for education. *Smart Learning Environments*, 5(1), 1–10.
- Christensen, C. M., Raynor, M. E., & McDonald, R. (2015). What is disruptive innovation. *Harvard Business Review*, 93(12), 44–53.
- Clohesy, T., & Acton, T. (2019). Investigating the influence of organizational factors on blockchain adoption: An innovation theory perspective. *Industrial Management & Data Systems*, 119(7), 1457–1491.
- Clohesy, T., Acton, T., & Rogers, N. (2019). Blockchain adoption: Technological, organizational and environmental considerations. In H. Treiblmaier & R. Beck (Eds.), *Business transformation through Blockchain volume I*.
- Clohesy, T., & Clohesy, S. (2020). What's in the box? Combating counterfeit medications in pharmaceutical supply chains with blockchain vigilant information systems. In H. Treiblmaier & T. Clohesy (Eds.), *Blockchain and distributed ledger technology use cases* (pp. 51–68).]
- Clohesy, T. (2019). *Blockchain the business perspective*, Galway, Ireland: NovoRay Publishers.
- Duan, J., Zhang, C., Gong, Y., Brown, S., & Li, Z. (2020). A content-analysis based literature review in blockchain adoption within food supply chain. *International Journal of Environmental Research and Public Health*, 17(5), 1784.
- Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., & Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration, and resilience within a humanitarian supply chain setting. *International Journal of Production Research*, 58(11), 3381–3398.
- Gramoli, V., & Staples, M. (2018). Blockchain standard: Can we reach consensus? *IEEE Communications Standards Magazine*, 2, 16–21.
- Hsu, H. Y., Liu, F. H., Tsou, H. T., & Chen, L. J. (2019). Openness of technology adoption, top management support and service innovation: A social innovation perspective. *Journal of Business & Industrial Marketing*, 34(3), 575–590.
- Kamble, S., Gunasekaran, A., & Arha, H. (2019). Understanding the Blockchain technology adoption in supply chains-Indian context. *International Journal of Production Research*, 57(7), 2009–2033. Kher, R., Terjesen, S., & Liu, C. (2020). Blockchain, Bitcoin, and ICOs: A review and research agenda. *Small Business Economics*, 1–22. <https://link.springer.com/article/10.1007%2Fs11187-019-00286-y>.
- Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, 231, 107831
- Mohtar, J. and Loh, J. (2020). Adoption of blockchain route for the halal meat industry. *Focus Malaysia*. <https://focusmalaysia.my/top/adoption-of-blockchain-route-for-the-halal-meat-industry/>.
- O'Connor, N., Lowry, P. B., & Treiblmaier, H. (2020). Interorganizational cooperation and supplier performance in high-technology supply chains. *Heliyon*, 6(3) e03434, 1–16.