A systematic literature review: benefits and challenges of blockchain-based digital transformation

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Abstract

Digital transformation has emerged as an important research area in strategic IS research. Digital transformation has made profound impacts on many industries with digital technologies. Blockchain could play a vital role in the digital transformation strategy for enterprises by providing security-rich data sharing, dynamic applications, and decentralized identity. Currently, the research on blockchain-based digital transformation is still in its infancy. The current literature provides limited knowledge and empirical evidence to explain how blockchain technologies empower organizational digital transformation. This study conducts a systematic literature review to study the current state-of-the-art on the digital transformation of blockchain and identifies the benefits and challenges of blockchain-based digital transformation.

Keywords: Blockchain, Digital Transformation, Digitalization, Systematic Literature Review

Introduction

Digital transformation is an important research topic for strategic information systems (IS) researchers (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Hanelt, Piccinini, Gregory, Hildebrandt, & Kolbe, 2015) as well as for practitioners (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014). Digital transformation enables profound changes to society and industries through the use of digital technologies (Majchrzak, Markus, & Wareham, 2016). Due to its unique characteristics, blockchain is considered as a promising and revolutionary technology that has a huge potential for helping enterprises obtain competitive advantages.

Blockchain plays a significant role in the digital transformation of enterprises. Blockchain platforms help enterprises unlock digital transformation by providing security-rich data sharing, dynamic applications, and decentralized identity. The blockchain technology market is predicted to be 39.7 billion USD by 2025 (Liu, 2020). Another report estimates that the business value of blockchain will exceed 3.1 trillion USD by 2030 (Davies & Likens, 2020).

However, the digital transformation is still in its infancy (Vial, 2019). Due to limited understanding of digital transformation in organizations, about 70% of all digital transformation initiatives did not fully reach their goals with billions of dollars wasted (Tabrizi, Lam, Girard, & Irvin, 2019). So far, the process of digital transformation within IS context is not well understood (Nadkarni & Prügl, 2021; Rowe, 2018).

The research motivation of this paper is to survey the literature on blockchain-based digital transformation to understand the current state-of-the-art in this specific area. We hope to identify the benefits and challenges facing blockchain-based digital transformation and advance digital transformation in the context of addressing blockchain-based systems in organizations.

Methodology

This study conducts a systematic literature review to study the current state-of-the-art on blockchain-based digital transformation. A systematic literature review is a rigorous method to conduct a literature review (Švábenský, Vykopal, & Čeleda, 2020). A systematic literature review could be defined as *"a systematic, explicit and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners"* (Okoli & Schabram, 2010). We followed the following three steps in our systematic literature review (Kitchenham, 2004; Pereira & Serrano, 2020; Webster & Watson, 2002): (1) Outlining a systematic literature review of blockchain-based digital transformation: identifying objective and setting criteria of the literature search. (2) Conducting a systematic literature review of blockchain-based digital transformation: applying filtering criteria of search and conducting filtration process. (3) Reporting a systematic literature review of blockchain-based digital transformation: reporting the findings and drawing conclusions.

Outlining a systematic literature review

This research focuses on the topic of blockchain-based digital transformation in organizations. Multiple databases are explored by using two distinct keywords: blockchain and digital transformation. Two research questions are examined:

(1) What are the benefits of achieving blockchain-based digital transformation?

(2) What are the challenges of achieving blockchain-based digital transformation?

Conducting a systematic literature review

The main objective of this research is to collect research articles about blockchain, so in an initial brief search, only blockchain is used as the keyword. In our literature search, four electronic repositories are used:

- ACM Digital Library: https://dl.acm.org/
- IEEE Xplore: https://ieeexplore.ieee.org/Xplore/home.jsp
- AIS eLibrary: https://aisel.aisnet.org/
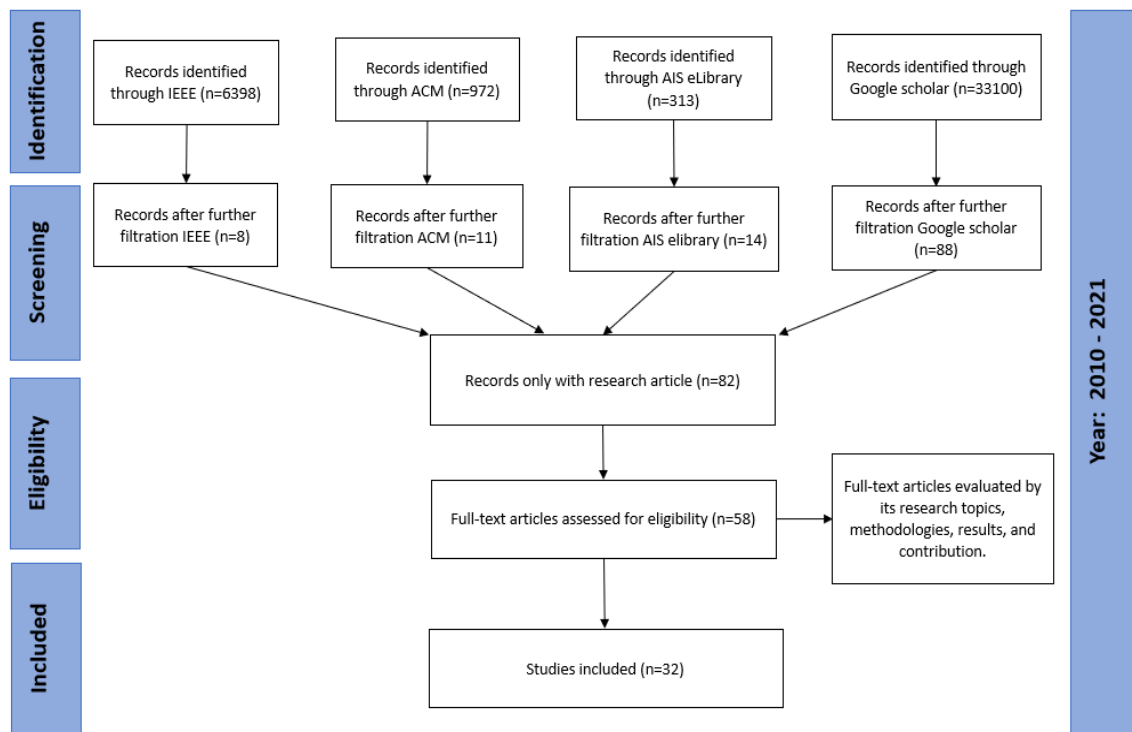- Google Scholar: https:// scholar.google.com/

Figure 1. Flowchart of Systematic Literature Review of Blockchain-based Digital Transformation

After the initial search filtered by the keyword "blockchain" in the research title, the further filtration process uses keyword "digital transformation" or "digitalization" to conduct systematic search. The filtration processes are shown in Figure 1.

Keywords: "blockchain" AND ("digital transformation" OR "digitalization")

Year Range: 2010 – 2021

As aforementioned, research articles need to be processed through four filtration processes in each database. The first filter (identification) applies the keyword "blockchain" to the research title. On the second filter (screening), the keywords "digital transformation" and "digitalization" are used to separate the articles that are exclusively related with the research domain. In the second filtration process, 82 articles are left after duplicated articles are removed. On the third filter (eligibility), each article's abstract and introduction is examined to assess the eligibility. 58 articles are selected for the full evaluation. On the fourth filter (inclusion), full-text article evaluation is conducted by its research topic, methodology, results and contribution. In the end, 32 research articles are selected for in-depth article analysis and information extraction.

Reporting a systematic literature review

After reviewing the articles in the final data set, we briefly summarized the findings in the following result section.

A Summary of Results

Blockchain is a distributed and decentralized database. Due to the chronological recording and public confirmation by all participants of the transaction network, the blockchain system can prevent a user from falsifying data (Babkin et al., 2018). Table 1 includes the main benefits of blockchain.

(1) Decentralization of system. The system does not require central trust belonging to any organization or individual.

(2) Immutability of data. During the transaction, the formats and signatures of data need to be checked and confirmed by all the other participants of the blockchain system.

(3) No intermediaries between participants. The uses of smart contracts and chronological records enable blockchain systems reliable.

(4) Transparency of system. The entire history of a transaction is easy to check. Everyone can verify the correctness of the records.

(5) Efficient provisioning of identities. Blockchain systems can create and manage identities at a lower cost. The transaction can be secured by using public key and private key.

Table 1. Benefits of Blockchain-based System

Benefits	Description	Reference
Decentralization of system	• Blockchain can improve the interoperability and speed of service. • Blockchain can increase the predictive capability.	Babkin et al., (2018); Hou, (2017); Zarrin, Hao, Laks, & Zarrin, (2021)
Immutability of data	• Blockchain can ensure the integrity of data. • User's anonymity can be accomplished by private keys.	Alexopoulos, Charalabidis, Androutsopoulou, Loutsaris, & Lachana, (2019); Foroglou & Tsilidou, (2015); Zheng, Xie, Dai, Chen, & Wang, (2018)
No intermediaries between participants	• Stored data can be easily shared. • Transaction cost can be reduced because the third party is removed	Atzori, (2015); Fauziah, Latifah, Omar, Khoirunisa, & Millah, (2020); Gervais et al., (2016); Nielsen & Krimmer, (2015)
Transparency of system	• Transactions and historical data are publicly visible. • Information stored in the system is open and accessible by anyone.	Atzori, (2015); Babkin et al., (2018); Bai & Sarkis, (2020); Hou, (2017)
Efficient provisioning of identities	• Blockchain can increase efficiency. • Blockchain can improve public services.	Hou, (2017); Koulizakis & Loukis, (2020)

As an emerging technology, blockchain is under constant development and faces some challenges and obstacles: (1) The capacity of blocks is small; the transactions might be delayed. Efforts are being made to address the scalability problem. (2) Although blockchain is considered as a safe transaction method, the value of all transactions and balances are publicly visible (Kosba, Miller, Shi, Wen, & Papamanthou, 2016). (3) Blockchain is susceptible to attacks of selfish miners. Table 2 includes the challenges of blockchain.

Table 2. Challenges of Blockchain-based System

Challenges	Description	Reference
Scalability of system	• With the increasing number of transactions, the blockchain system becomes heavier. • A large block size would slow down the propagation speed.	Ahl et al., (2020); Bruce, (2014); Mazlan et al., (2020); van den Hooff, Kaashoek, & Zeldovich, (2014)
Privacy leakage	• Transactions are linked to which may cause the leakage of users' information. • A set of identified nodes can be learned and used to find the origin of a transaction.	Biryukov, Khovratovich, & Pustogarov, (2014); Bonneau et al., (2014); Kosba et al., (2016); Meiklejohn et al., (2013); Miers, Garman, Green, & Rubin, (2013); Moser, (2013); Ruffing, Moreno-Sanchez, & Kate, (2014); Sasson et al., (2014)
Selfish mining	• Selfish miners keep their mined blocks without broadcasting and the private branch could be disclosed to the public.	Eyal & Sirer, (2014); Heilman, (2014); Nguyen et al., (2020); Nielsen & Krimmer, (2015); Sapirshtein, Sompolinsky, & Zohar, (2016); Solat & Potop-Butucaru, (2016)

Blockchain-based digital transformation is occurring in many industries globally. More and more organizations have realized the importance of deploy emerging information technology like blockchain technology to offer better services. The OECD published a paper in which discusses eight blockchain case studies from seven different countries (i.e., United States, Singapore, Sweden, Denmark, Mexico, Ghana, and United Arab Emirates) (Berryhill, Bourgery, & Hanson, 2018). Table 3 lists some examples.

Table 3. Blockchain-based Projects and Industries (Berryhill et al., 2018)

Case	Short Description	Industries	Country
BenBen	Provide an Ethereum-run digital register system of all land registries.	Land Registry	Ghana
Global Blockchain Council	Provide trainings of blockchain to non-tech-savvy managers and decision-makers.	Consulting	United Arab Emirates
Intergovernmental Emerging Citizen Technology Office	Introduce blockchain technology to public servants and citizens	Government Services	United States
Project Ubin	Develop and apply a blockchain-based transaction process with digital Singaporean dollar.	Financial	Singapore
Swedish Land Registry on Blockchain	Investigate the use of blockchain-based system to record land transactions and ownership.	Real Estate	Sweden
Blockchain Trust Accelerator	Develop a blockchain lab to promote accountable technologies.	Public Sector	United States
Vehicle Wallet	Develop a blockchain-based vehicle registration system.	Transportation	Denmark
Blockchain Talent Hackathon	Build a decentralized blockchain platform.	Networking	Mexico

Conclusion

Nowadays, digital transformation has changed the traditional business model by reforming the traditional industrial structure. The connected world creates digital imperatives for different companies and different industries. Digital transformation can benefit organizations because it allows organizations to effectively use digital technologies to achieve better customer experiences, streamlined operations and business models.

Our systematic literature review shows that there are some benefits and challenges with blockchain-based digital transformation in organizations. The business imperative of adopting blockchain and digital assets is growing noticeably. Future research will use qualitative analysis and quantitative analysis to shed light on the performance of blockchain-based digital transformation in different industries. We also plan to collect more case studies related to blockchain-based digital transformation in organizations.

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