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Introduction to Blockchain in Accounting and Auditing

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Blockchain is one of the popular emerging technologies that interests academic researchers and practitioners in the recent decade in various business domains, such as supply chain (e.g., Saberi, Kouhizadeh, Sarkis, and Shen 2019), finance (e.g., Tapscott and Tapscott 2017a), marketing (e.g., Tapscott and Tapscott 2017b), accounting (e.g., Liu, Wu, and Xu 2019) and auditing (e.g., Dai and Vasarhelyi 2017). Its *decentralized*, *persistent*, *transparent*, *traceable (auditable)*, and *immutable* characteristics, supported by the underlying mechanisms of cryptographic hash functions, asymmetric-key cryptography, and different consensus mechanisms (Yaga, Mell, Roby, and Scarfone 2019; Zheng, Xie, Dai, Chen, and Wang 2017), make it excellently applicable to information-sharing and transaction-recording activities. Bitcoin, designed by Nakamoto (2008), might be the most well-known application of blockchains, indirectly thriving other digital asset ecosystems[1] , decentralized applications (DApps)[2] , non-fungible tokens (NFTs), central bank digital currencies (CBDCs), and other blockchain applications.

The development of blockchains could be depicted as three main phases: Blockchain 1.0, 2.0, and 3.0 (Swan 2015; Xu, Chen, and Kou 2019). Blockchain 1.0 is applications related to digital currencies (such as bitcoin) intended to create decentralized payment systems. Blockchain 2.0 has a broader scope containing applications built by smart contracts in the finance area, including DApps, decentralized autonomous organizations (DAOs), etc. Blockchain 3.0 includes applications beyond finance such as natural science and healthcare and token-based ones (Swan 2015). Blockchains are continuously growing and evolving.

Consensus mechanisms of blockchains plays an important role in blockchains' performance, operation efficiency, and security. Popular consensus algorithms include Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Practical Byzantine Fault Tolerance (PBFT), and Raft (Du, Ma, Zhang, Wang, and Chen 2017). Furthermore, Blockchains can be classified into *permissionless (public)* and *permissioned (consortium* and *private*) ones based on the

[1] For example, Ethereum is another well-known blockchain platform that support tremendous decentralized applications. More information is available at its official website: https://ethereum.org/en/

[2] Decentralized finance (DeFi), decentralized exchange (DEX), and decentralized gaming are examples.

level of participant restriction (Zheng et al. 2017). Bitcoin and Ethereum (MultiChain[3]) are examples of permissionless (permissioned) blockchains.

Blockchain Applications in Accounting and Auditing

Blockchains, with their auditability, have many applications in the accounting and auditing. For instance, Liu, Wu, and Xu (2019) discussed the impacts of blockchains on the audit practice and the challenges and opportunities from permissioned and permissionless blockchains on auditors. Moreover, Dai and Vasarhelyi (2017) envisioned that blockchains *"could enable a real-time, verifiable, and transparent accounting ecosystem"* and have *"the potential to transform current auditing practices, resulting in a more precise and timely automatic assurance system."* Different from those concept-oriented academic papers, the "financial blockchain confirmation platform" was designed and practically implemented in Taiwan to facilitate the efficiency and effectiveness of bank confirmation process starting from 2018 (Wang and Chen 2021)[4] . The empirical evidence indicated that the days of bank confirmation (from 14 days to 0.5 to 3 days) and the re-confirmation rates (from 25% to 0.37%) are significantly decreased after the implementation (Wang and Chen 2021).

Some scholars envisioned that smart contracts could be implemented and integrated into the future financial statement audits. For example, Rozario and Vasarhelyi (2018) proposed that the smart audit procedures (a new type of audit data analytics), enabled by smart contracts and performed in blockchain environments, could be *autonomously* implemented to address different audit risks and have the potential to realize the close-to-real-time audit reporting. Also, Rozario and Thomas (2019) proposed the concept of *interlinked* blockchain ecosystems composed of the *external audit* and the *business* private/permissioned blockchain ecosystems in which smart audit procedures could be performed. Specifically, auditors would participate as a node on the business blockchain with read-only access to ensure they have the *population* of audit relevant information stored on the blockchain and load it to the external audit blockchain. After that, the pre-determined smart audit procedures (including smart internal control tests, smart test of details, and smart analytics) could be performed *autonomously*, designed to detect material misstatements. Auditors can also share relevant information to stakeholders, such as the PCAOB, the SEC, and the audit committee on the external audit blockchain.

There are some literature review papers summarizing the concept and ideas of blockchains in the accounting and auditing domain (e.g., Secinaro, Dal Mas, Brescia, and Calandra. 2021; Schmitz and Leoni. 2019; Yu, Lin, and Tang 2018). Those reviews provide readers with the proposed frameworks and approaches, the current findings and envisions, and the potential research topics from different perspectives. In my personal opinion, more empirical evidence after implementing blockchain in the accounting and audit practices would be valuable the community to demonstrate the benefits of blockchains.

[3] The official website of MultiChain. https://www.multichain.com/

[4] There are 48 financial institutes, 494 accounting firms in different scales, and more than 40,000 companies (audit clients) are participating in the platform until July 2021 (Wang and Chen 2021).

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