



Demistifying of Triple-Entry Accounting (TEA): Integrating the Block

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Abstract. Current accounting system has been used for more than six decades, yet emerging technology like blockchain is arising to improve a new accounting method: triple-entry accounting. This study aims to construct a potential framework of triple-entry accounting embedded with smart contract. The research method of this study is qualitative with a study case. The result of this study is a triple-entry accounting with a smart contract framework. The blockchain (smart contract) ecosystem, the business parties will only need to record an internal entry, and the opponent entry will be stored in a desentralized ledger. Auditor will give permission access to the blockchain ledger to perform an audit. Triple-entry accounting with the smart contract will improve transparency and trust as well as decrease audit cost significantly.

Keywords: Triple-entry accounting · blockchain · smart contract

1 Introduction

Understanding how earlier technology advancements and institutions have extended and enhanced trade can assist us in determining whether blockchain represents a comparable transformational leap for business today. With such innovation, now is the best time to seize great opportunities for larger purposes like economics or even further another sphere like utilization in education. Furthermore, there was a prediction that blockchain technology will change accounting paradigm and ecosystem that is Triple-Entry Accounting with Blockchain Technology [1]. Access granted to blockchain contains accounting transactions, then anyone on the block can combine these transactions in real-time into the financial statements without requiring an auditor to ensure the accuracy and validity of the desentralized ledger [2]. Blockchain technology is being utilized to change the world of accounting through the preparation and audit of financial statements. [3] have conducted an early exploration of technology blockchain in accounting.

Earlier, single-entry accounting was by far the most convenient accounting method [4]. It stores all accounting information created by a firm. In addition, it utilizes a

cash-based recording system that keeps all incoming and outgoing cash [5]. Single-entry accounting failed to provide a comprehensive view of the company's financial status. Single-entry accounting, although the simplest record-keeping technique of all accounting procedures, is not especially suited for bigger enterprises with significant assets and liabilities [4].

Since Pacioli's time, double-entry accounting has been used [6]. Since then, double-entry accounting has been the standard accounting record method for modern corporate practices. For each transaction, the double-entry accounting method has established two accounts, debit, and credit. The double-entry system is a different kind of accrual-based accounting than the prior method. Accrual-based accounting provides more detailed information about revenue and costs over time than cash-based accounting. Consequently, double-entry accounting provides more accuracy than single-entry accounting [5]. Because two separate corporate interests may control a single transaction, it is error-prone. Such inaccuracies may be rectified using the auditing procedure. In addition, the auditing process is time-consuming, costly, and tiresome. Even though the business employs advanced accounting software, it cannot provide real-time visibility into organization activities [7]. The inadequacies of this double-entry accounting system must be remedied because stakeholders expect more transparency and real-time data.

In 1986, Yuji Ijiri created "triple-entry accounting" [8]. Ijiri added a third layer of entries known as trebits to the new set account to account for variations in revenue. A 'triple-entry' accounting system offers the organization timelier financial data, enhancing strategic decision-making. Then, in 2005, Ian Grigg developed "triple-entry accounting" [1]. Grigg's definition of triple-entry accounting in 2005 differs significantly from [8] definition of momentum accounting. [1] introduces a new concept known "the receipts are transactions," in which digitally signed receipts between parties involved are backed by financial cryptography and can be seen by third parties' shared entries to avoid fraudulent activity and reduce redundant data in company records.

To avoid ambiguity, this study clearly differentiates between Ijiri's and Grigg's works. This research is mainly focused on [1] concept of triple-entry accounting. In addition, this paper examines how blockchain facilitates the implementation of this alternative accounting technique. A study of triple-entry accounting as a possible approach of restructuring accounting systems is both topical and essential in an age of disruptive technology development.

Important developments in the era of digitalization can be seen in all accounting spheres, and, blockchain is a new way to store accounting information with triple-entry accounting. Many companies are starting to change their goal towards achieving an innovative organizational ecosystem where transparency and levels of trust among stakeholders are higher than ever before [9]. Therefore, it is very important to see how the development of triple-entry accounting with blockchain to increase the positive effect for accounting sphere. The aim of this study is to construct basic framework of a triple-entry accounting system with blockchain (smart contract).

2 Literature Review

2.1 Diffusion of Innovative (DOI) Theory

Humans are social creatures who continue to develop over time by producing various innovations from creatively generated ideas. It aims to help the problem-solving process properly as a solution to improve performance. According to [10] innovation is a breakthrough that can create significant changes to the industrial world or human life, where the existence of innovation in addition to solving the problems faced, also provides new value as an opportunity to improve the standard of human life.

One theory that helps explain this phenomenon is the Diffusion of Innovative (DOI) Theory, where this theory is one of the oldest social theories. [11] explains that diffusion innovation theory is a description of how creations built by humans form new cultural elements, actions, and instruments to be implemented in the environment, where diffusion itself refers to innovations that are communicated regularly in various ways aimed at certain parties. The purpose of the creation of new inventions by diffusion to the community or business industry, the result to be achieved is how the instrument or technology can be adopted properly.

According to [12], there are five categories of adoption, where when promoting a new thought, there are different strategies that can be used to communicate to several categories of adopters, namely:

- (1). Innovators are inventors who spark new ideas, technologies, and applications, where they are the first users who aim to identify the risks involved to be analyzed and prevented so that they can be used in society and industry.
- (2). Early adopters are a group of people who enjoy change by following the times and seeing opportunities in any changes that occur. At this stage, they adopt a technology that they believe will generate large profits as an opportunity for their business to progress, so they don't need the information to convince them to adapt.
- (3). An early majority is a group of people who are quick to adopt new technology as a medium to help them complete their work. The difference with early adopters is that in the early majority category, real evidence is needed from those resulting from adopting the new findings.
- (4). The Late Majority is a category that describes people who are skeptical of change. They need encouragement from most of the people who have adopted them and it takes quite a while for them to want to use them in their work.
- (5). The laggard is a category of people who strictly adhere to their traditional beliefs and are very skeptical of approaching impossible changes because they are based on fear and pressure to change in new ways.

As has been further explained regarding the DOI Theory, the description of the existence of the theory explains that a party needs information that is communicated effectively and regularly so that technological growth can be conveyed properly. The emergence of megatrends with the creation of various modern technologies has encouraged companies to be able to transform using technology to create advantages in being globally competitive and create new corporate value, so companies must be able to adapt and create a new business model that is adapted to changing times.

2.2 The Development of Accounting Entry System

Accounting records on financial transactions to provide comprehensive information to organizational stakeholders regarding the company's financial activities and situation. Single-entry accounting became famous in its era because its convenience that it does not require professional skills to record financial transactions. Given the single record and inability to crosscheck, this approach has major limitations because errors cannot be recognized and tracked, allowing for plenty of potential for fraud within organization. Due to the numerous limitations of single-entry accounting, Italian traders invented the double-entry accounting system in the late Middle Ages [6]. Every financial transaction in a double-entry accounting system necessitates the recording of two sides, namely the debit and credit. Then, one of the most essential aspects of this system is that it keeps a traceable and readily verifiable audit trail [5].

Nevertheless, this mechanism may act as a firewall. It is not a deterrent to fraud. Even if the debits match the credits, it is possible to do it dishonestly or deceptively [13]. Therefore, the balance check of double-entry cannot prevent fraud. Further, because an organization's accounting records completed transactions separately and confidentially, the possibility of falsified transactions exists. Shareholders and governments demand audits regularly to ensure the integrity of a company's accounts. The audit process is an expensive and time-consuming operation that necessitates information verification and reconciliation among several stakeholders [14]. Additionally, the system lacks transparency, is controlled by each other, and is incapable of providing real-time insight into corporate processes.

To address the issues of double-entry accounting, the concept of triple-entry accounting was created [1, 8]. The core notion of triple-entry accounting is that one entity records a transaction, the opposing entity agrees, and the operator of the joint transaction repository verifies it. Thus, every transaction results in three persons accepting a receipt. In the form of a single decentralized entry, all entities possess the same transactional information [15]. The triple-entry accounting system is thus preferable to the ordinary double-entry accounting system. All accounting entries involving third parties are cryptographically sealed by a third accounting entry (i.e., Blockchain). The major objective of triple-entry accounting is precision, which is inextricably related to using immutable real-time data [16] to enable the organization's strategic decision-making process to be more effective.

2.3 Triple-Entry Accounting Blockchain-Based

[1] major conceptual enhancements were made to the business recording system. At the moment, it was uncertain who would be the reliable and impartial third party controlling the third shared ledger. Three years later, Cryptocurrency was introduced (Bitcoin) [17] and it is proven that blockchain technology makes bitcoin transactions secured because they are stored in a ledger that can be traced by the parties involved.

A blockchain database is a distributed ledger that is decentralized, duplicated, and shared [18]. Because each participant in this blockchain database gets the same copy of the 'whole' ledger, it is no longer necessary for a central authority (e.g., a bank) to keep track of parties' information.

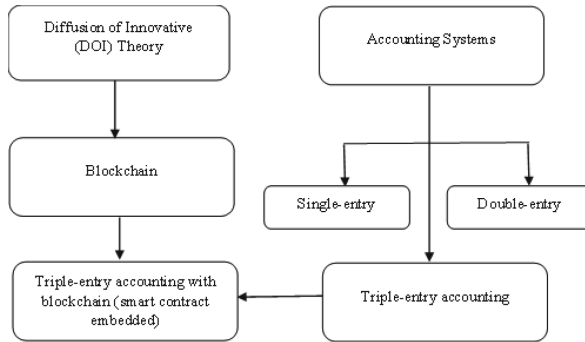


Fig. 1. Theoretical Framework

When there is a change record in ownership of an asset in such a shared ledger, the ledger is updated and shared with every party in the network. Consequently, this distributed ledger adheres to [1] triple-entry accounting method since a commercial transaction between two entities may be recorded in this third-party shared ledger, and all entities can see this ledger's most recent update. Auditing and reconciling with others should not be necessary if all transactions are recorded in such a ledger (i.e., Blockchain). In order to get a rapid understanding of the relationship of Diffusion of Innovative (DOI) Theory, blockchain to triple-entry accounting embeddedd with smart contract, Fig. 1 presents the theoretical framework of this research.

3 Research Methods

For visualizing future triple-entry accounting framework practices, the current study used a single case study technique. The majority of the research is a qualitative descriptive in nature. First, this research identifies the flaws of the existing double-entry accounting system. This has been done by doing a thorough assessment of the literature.

Secondly, the research constructs a potential of triple-entry accounting with blockchain artifact. The construction conducted with a scenario:

Case: Triple-entry accounting embedded with smart contract.

The company would implement a mix of triple-entry accounting rules and smart contracts. In such instances, Sect. 4 discusses the possibility of accounting methods.

4 Triple-Entry Accounting Embedded with Smart Contract

The smart contract is a fundamental concept that enhances triple-entry accounting over the previous double-entry method. According to [19], a smart contract is a consensual agreement between parties that is implemented by hardware or software that embeds the property's contractual terms. Moreover, according to [20], a smart contract is a digital contract whose terms are agreed upon by two parties and recorded on a blockchain. Due to the immutability of blockchain, neither party can alter these terms after they have been recorded.

Consequently, with incorporated smart contracts, the blockchain-based third share ledger is substantially more than a regular ledger with recorded data [3]. The agreements signed by two parties can be self-executed and/or self-enforced by this ledger. It can also reply to and transmit data. Furthermore, this ledger can function similarly to a typical bank.

This ledger may store client assets and transmit value: instead of trading in fiat, the system’s unit of account is money (in a tokenized form). This third ledger that has been linked to smart contracts is thus a “live” ledger. It delivers data, records data, and completes transactions autonomously based on pre-programmed “program codes.” As a consequence, the old financial system is eliminated.

Figure 2 illustrates a triple-entry accounting scenario using blockchain [5]. In the first triple-entry accounting system, Companies A and B establish payment requirements for a self-executing digital contract: Firm A will pay company B \$100 after the task has been finished. On this third ledger, the contract is signed by both parties. Company A and Company B sign the contract again when the service is complete, the third ledger is updated, and the computer program delivers \$100 to Company B. The following qualities are included in all payment records stored on a blockchain [5]: (1). The use of tokens (cryptocurrency) for payment removes the necessity for conventional banks. (2) This financial transaction is documented in chronological sequence and is irreversible and permanent. If there is an alteration, a new block will be needed. (3). Security threats are reduced since a centralized administrator does not control this data. (4). This document provides a link between the internal records of firms A and B, making them less prone to error and fraud. (5). This document is readily verifiable, creating an audit trail.

The procedure described above demonstrates the advantages of a triple-entry accounting system. Embedding triple-entry accounting with smart contracts offers the ability to overcome the fundamental trust and transparency issues that plague traditional accounting. This revolutionary technique may consequently cut auditing time and expenses. As a result, rather than just checking facts, more effort may be devoted to preventing fraud. This prospective framework may not eradicate all types of fraud, but

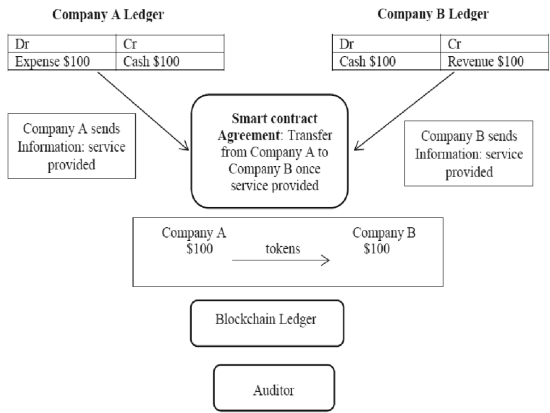


Fig. 2. A payment transaction between Company A and B using triple-entry accounting with blockchain

it may greatly minimize internal fraud and increase the operational efficiency of an organization.

However, this study proposed framework in order to improve the previous one. Figure 3 depicts one possible design for improved triple-entry accounting embedded with a smart contract. This model would keep track of both business-to-business transactions and data flows inside a company. In the system, each transaction would generate a record that would be recorded in the blockchain ledger, in addition to the requirement of double-entry system entries. To represent data flows inside an enterprise, blockchain ledger entries would be recorded in token transfers across accounts, forming an interlocking system of permanent accounting records.

Blockchain ledgers' accounts would be arranged hierarchically to aggregate data at several levels, allowing for both quick accounting equation balancing and diverse views of information for different users. Tokens in the blockchain ledger might potentially be used as certificates to prove obligations or assets ownership between entities. Blockchain technology enables rapid analysis of any mistakes or fraud within accounting entries (for example, duplicate payments), as well as transaction verification automation utilizing data from entities. Furthermore, smart contracts encoded with accounting and business regulations might allow for effective recording process control.

Above framework aims to construct a share and desentralized ledger through a triple-entry accounting embedded with smart contract. To get a comprehensive understanding of the framework, for example, company A has to pay \$1000 for services rendered by company B. Then company A creates an invoice. This invoice is encrypted using business B's public key and sent to the smart contract along with the transaction's hash, information, and terms and conditions. Then, business B will be notified of the request and may check the transaction, request a hash, and approve it. Once business B approves this transaction, the blockchains will be updated, and a shared ledger will be created between the two parties.

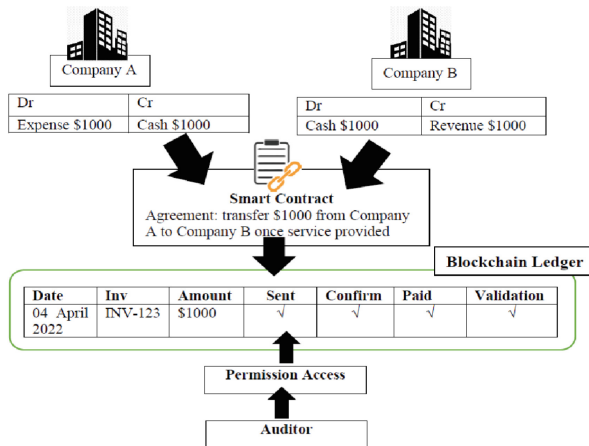


Fig. 3. A proposed triple-entry accounting with smart contract framework

After payments have been made, this public ledger is balanced. Auditors may use the distributed ledger by requesting access to this ledger. An auditor may verify the legality of a transaction using the hash stored in the blockchains at the moment each original transaction was generated after the request had been approved.

5 Conclusion

Accounting, which encompasses measuring, processing, auditing, and sharing financial data about economic entities, exists largely to promote trust and openness. Although the current accounting system (double-entry accounting) and auditing procedure are time-consuming, expensive, and ineffectual, they are time-consuming and expensive. Triple-entry accounting with integrated smart contracts is a unique and potentially more effective technique for attaining trust and transparency and is thus positioned to transform the accounting industry. The audit process will be more efficient, and audit costs will decrease. Only a small number of triple-entry accounting blockchain products and services are fully operational in the accounting industry, but the projects described in this article have already shown extraordinary potential. Future research should concentrate on the obstacles to the wider use of triple-entry accounting. In addition, the research methodologies might include surveying, experimentation, and design science study.

References

1. Grigg, "Triple Entry Accounting Work-in-Progress Triple Entry Accounting," *Syst. Inc*, no. December 2005, 2005, doi: <https://doi.org/10.13140/RG.2.2.12032.43524>.
2. D. Yermack, "Corporate governance and blockchains," *Rev. Financ.*, vol. 21, no. 1, pp. 7–31, 2017, doi: <https://doi.org/10.1093/rof/rfw074>.
3. J. Dai and M. A. Vasarhelyi, "Toward blockchain-based accounting and assurance," *J. Inf. Syst.*, vol. 31, no. 3, pp. 5–21, 2017, doi: <https://doi.org/10.2308/isy-51804>.
4. H. T. M. Gamage, H. D. Weerasinghe, and N. G. J. Dias, "A Survey on Blockchain Technology Concepts, Applications, and Issues," *SN Comput. Sci.*, vol. 1, no. 2, pp. 1–15, 2020, doi: <https://doi.org/10.1007/s42979-020-00123-0>.
5. C. W. Cai, "Triple-entry accounting with blockchain: How far have we come?," *Account. Financ.*, 2019, doi: <https://doi.org/10.1111/acfi.12556>.
6. T. Edwards, Richard and Boyns, *A History of Management Accounting. The British Experience*, 1st Editio. New York, NY, USA: Routledge, 2012.
7. D. Appelbaum and S. Stein Smith, "Blockchain Basics and Hands-on Guidance: Taking the Next Step toward Implementation and Adoption," *CPA J.*, vol. 88, no. 6, pp. 28–37, 2018, [Online]. Available: <http://web-1ebscost-1com-10000f4h3028c.han.ub.fau.de/ehost/pdfviewer/pdfviewer?vid=16&sid=fc526975-895b-430e-8f7b-c92229f39f1b%40sessionmgr4007>.
8. Y. Ijiri, "A Framework for Triple-Entry Bookkeeping," vol. LXI, no. 4, 1986.
9. P. Secinaro, Silvana, Calandra, Davide, And Biancone, "Blockchain, trust, and trust accounting: can blockchain technology substitute trust created by intermediaries in trust accounting? A theoretical examination," *Int. J. Manag. Pract.*, vol. 14, no. No 2, pp. 129–145, 2021.
10. M. G. Alles, "Drivers of the use and facilitators and obstacles of the evolution of big data by the audit profession," *Account. Horizons*, vol. 29, no. 2, pp. 439–449, 2015, doi: <https://doi.org/10.2308/acch-51067>.

11. E. M. Rogers, *Diffusion of innovations*, Third Edit. New York, NY, USA: The Free Press, 1983.
12. D. W. Stacks, M. B. Salwen, and K. C. Eichhorn, *An integrated approach to communication theory and research, third edition*. 2019.
13. P. Skole-sørensen, "An Argument for the Implementation of Triple- Entry Bookkeeping," *Aalborg Univ. Cand.Merc.Aud*, 2016.
14. J. Schmitz and G. Leoni, "Accounting and Auditing at the Time of Blockchain Technology: A Research Agenda," *Aust. Account. Rev.*, vol. 29, no. 2, pp. 331–342, 2019, doi: <https://doi.org/10.1111/auar.12286>.
15. Faccia and N. Mosteanu, "Accounting and blockchain technology: from double-entry to triple-entry," vol. 10, no. 2, pp. 108–116, 2019.
16. M. Hambiralovic and R. Karlsson, "Blockchain Accounting in a Triple-Entry System," pp. 1–53, 2018, [Online]. Available: <http://lup.lub.lu.se/student-papers/record/8953732>.
17. S. Nakamoto, "Bitcoin: A peer-to-peer Electronic Cash System," *J. Gen. Philos. Sci.*, vol. 39, no. 1, pp. 53–67, 2008, doi: <https://doi.org/10.1007/s10838-008-9062-0>.
18. Tilooby, "The Impact of Blockchain Technology on Financial Transactions," no. May, 2018.
19. N. Szabo, "Smart Contracts," 1997. <http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html>.
20. R. G. Brown, "A Simple Model for Smart Contracts," 2015. <https://gandal.me/2015/02/10/a-simple-model-for-smart-contracts/>.

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