-RESEARCH ARTICLE-

THE ROLE OF BLOCKCHAIN TECHNOLOGY IN PRODUCT COST MANAGEMENT OF ELECTRONIC PAYMENT SERVICES: BIG DATA AS AN INTERVENING VARIABLE

Ghazi Maan Faisal*

Post-graduate Institute for Accounting and Financial Studies,
University of Baghdad, Iraq.
ORCID: https://orcid.org/0009.0002.9338.1713
Email: ghazi.maan@uobaghdad.edu.iq

Saba Kareem Abbood

Post-graduate Institute for Accounting and Financial Studies,
University of Baghdad, Iraq.
ORCID: https://orcid.org/0009.0007.9466.8157
Email: Saba.k@pgiafs.uobaghdad.edu.iq

─**Abstract**─

The study explores the role of Big Data (BD) in mediating the relationship between Blockchain Technology (BT) and Product Cost Management (PCM) within electronic payment services. Employing a descriptive approach, a questionnaire was distributed among employees of the International Smart Card (ISC) (Qi Card), academics, and auditors in Iraq, yielding 74 responses. ISC was selected as it represents the largest electronic payment company in the country. The findings indicate that BT significantly influences PCM, with BD serving as an intervening variable. Given Iraq's rapid advancements in electronic payment to foster financial inclusion, this study contributes by highlighting how electronic payment companies can minimise service costs through BT adoption. The results underscore the significance of electronic payment systems in developing economies by strengthening trust in digital financial infrastructures.

Keywords: Blockchain Technology, Big Data, Product Cost Management, Electronic Payment, Financial Inclusion.

INTRODUCTION

Companies must understand customer value for various reasons, including assessing the financial requirements of an economic unit for marketing expenditures and evaluating profitability (Herman et al., 2021). BT functions as an information network composed of interconnected nodes, with each device maintaining a database to record network transactions, subject to verification by other network participants (Srivastava et al., 2023). It also operates as a ledger system that facilitates global asset registration and accounting, enabling transactions across diverse asset types by international stakeholders (Barker et al., 2022). BT relies on a synchronised digital database maintained through algorithms and distributed across multiple nodes (Jannes et al., 2021). Its primary strength lies in transaction transparency and decentralisation, encompassing payments, bank transfers, property ownership registration, asset exchange, and document verification (Provost & Fawcett, 2013).

BD refers to large datasets beyond the capability of traditional database software in terms of acquisition, storage, management, and analysis. It is characterized by high volume, high velocity, diversity, and low intrinsic value in its raw state (Zhang & Lv, 2021). BD involves collection and analysis of organisational data to provide insights in terms of effective resource coordination, technologies, and expertise (Nudurupati et al., 2024; Su et al., 2022). BD analysis overcomes data provision, processing, storage, and analysis challenges by maintaining data privacy. The International Telecommunication Union describes BD as datasets with significant volume, high processing rate, and high heterogeneity compared to traditional data (Sandhu, 2021). PCM refers to tools supporting cost planning, control, and decision-making, hence increasing competitiveness through long-term strategic programs (Xu et al., 2025). It refers to efforts by companies to reduce production cost to make products available in markets with affordable prices. PCM allows cost rationalisation and decision-making (Mehling et al., 2022). Besides, cost reduction refers to allocation of resources to carry out necessary operational activities, thus satisfying corporate goals (Kurasova et al., 2021) and, as a result, contributing to PCM.

Electronic payment service providers in Iraq are faced with challenges minimizing wastage of resources, enhancing operational effectiveness and optimizing PCM. The challenges call for the adoption of practical frameworks facilitating effective measurement and management of service costs. The adoption of BT and BD is a vital tool with which innovation in service delivery can be promoted, substituting classical operational patterns used by the study sample company. BT, coupled with BD as an intervening variable, enables costs associated with electronic payment services to be managed accordingly. The study issue revolves around classical cost management systems utilized by the study sample company and challenges associated with these systems when utilized in electronic payment services. The study explores how service

cost management can be made more effective by BT-BD integration and evaluates its impact on PCM. The study contributes significantly to generating data and insights on BT's role coupled with BD towards PCM in electronic payment services, eventually facilitating service quality enhancement and cost reduction among the study sample.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The interaction between BT and BD in improving service delivery, including e-payment services, has been studied rigorously in recent research works. Hassani et al. (2018) presents one of the major studies, given its study of the research and development deficit in BD systems based on BT in banking services. The study was based on opportunities and challenges by banking professionals, with discussions on prospective effects of BD from BT on future data analysis in banking services. The study gave empirical evidence of BT adoption in banking services as well as challenges affecting its adoption globally. (Wang & Shen, 2019) analyzed BT's impact on innovation and transformation in PCM. The study suggested a decentralized cost management information system with a vision of better cost structures, cost forecasting and control, accounting reports, and performance measurement. The study highlighted BT's ability to add corporate value through optimised PCM. Deepa et al. (2022) performed a full review of BT and BD integration in their study, where BD's role in ensuring secure use, storage, as well as analysis, with data privacy was examined. The study concluded BT had attracted considerable attention to enhance high-security BD systems and network administration.

Wang and Shen (2019) also analyzed BT's decentralized trust management functionalities as a solution to data storage issues. The study proposed a shared data model based on BT to facilitate BD analysis for project cost management. The study offered a comprehensive investigation of cost management practices under BD usage, with a block-based infrastructure data storage approach. On another note, Gusc et al. (2022) evaluated cost management issues with regard to information technologies, utilizing a qualitative interpretive approach to establish insights into cost optimisation. Vitale (2023) investigated BD and BT integration into management accounting, with a specific interest in accounting and control. The study illustrated how BD-based insights can improve decision-making effectiveness, hence improving management accounting practices. Similarly, Kostopoulos and Antonopoulou (2024) examined BD and BT's syndetic function in decentralized decision-making processes. The research deduced inherent realities and features of both technologies, mapping out possibilities to enhance organisational autonomy and cooperation. The research identified BD and BT's transformative potential in decentralized decision-making, advancing strategy-oriented recommendations on how to incorporate them among businesses and policymakers. Xiu (2024) also examined BD's function in cryptography mechanisms, focusing especially on its role in disclosing inherent patterns among financial transactions in

web-based, as well as data storage structures. The research noted BD's crucial function in enabling the transition from paper currency to digital financial mechanisms, advancing towards cryptocurrencies and monetary policy organization and administration.

Hooda et al. (2024) mention BT's role in data security, integrity, and scalability. They propose a hybrid architecture by leveraging blockchain security with scalable BD frameworks to enable real-time data management in finance, healthcare, and IoT by implementing advanced encryption. Theodorakopoulos et al. (2024) highlight BD-BT integration to enable decentralised decision-making, transparency, security, and real-time processing. Krishna et al. (2024) address data accuracy, security, and scalability issues by employing decentralised storage, smart contracts, fragmentation, and encryption. Vermani et al. (2024) solve issues related to data security and privacy threats in web platforms by proposing a strategy based on real-time analysis of data and unique digital identifiers to prevent unauthorised entry and fraud.

Osilaja et al. (2024) analysed cyber threats and data breaches with emphasis on secure and adaptable software architectures. The research considered BT to be a revolutionary solution to improve security in software due to BT's tamper-resistance and decentralisation features. The research showed how BT can be used to produce transparent, decentralized, and secure applications through the implementation of BT in software frameworks. The research used BT's data im-mutability and encryption integrity features to prove BT's promise to eradicate threats due to unauthorized access, avoidance of centrally stored data vulnerabilities, and tampering of data. A description of modern security issues in software exposed problems with centrally stored data warehouses, poor security in cybersecurity, and poor access controls. The research concluded by laying out a vision of future-proof secure architectures by integrating BT with artificial intelligence and trust-based security architectures. It gave real-world insights to software developers and engineers in their endeavor to improve application security, ultimately resulting in more secure and trustworthy systems in an increasingly networked digital landscape.

Effectiveness of BT towards improving data integrity and security was evaluated by (Krishna et al., 2024). BT's role to achieve data stability, auditability, and transparency across various industries was examined by this study. It also focused on countermeasures to BT limitations and challenges and how it extends to data security mechanisms and sensitive information protection. Examination of BT's role in product and corporate finance cost savings through facilitating information sharing and information asymmetry reduction was carried out by (Khan et al., 2024). BT's role in lowering finance costs and carbon emissions associated with supply chains and its impact on decision-making optimization was revealed by this study. The study concluded a linear link between manufacturer profit and efficiency, with measurable

carbon emissions reduction irrespective of following pre-set norms of emissions.

Peng et al. (2024) suggested a distributed equity management information system with BD and BT integration. The research designed a dual-chain architecture with an Individual Shareholder Chain (ISB) and an Economic Association Chain (EAB) to cater to village shareholders. It utilized attribute-based encryption to apply rigorous access control and secure data sharing to rural equity systems with improved data security in BD and BT integration scenarios. Chilukoori and Gangarapu (2024) also performed a thorough analysis of BD pipeline optimization in the AWS environment. The research focused on cost-effective methods, utilizing instant instances, and applying intelligent data lifecycle management. The research demonstrated a 37% decrease in total operational costs in Amazon's BD processing infrastructure. The insights of study contribute to increasing knowledge on resource optimization in clouds and provide actionable suggestions to organizations operating large-scale data processing loads in clouds. Zhiping (2024) investigated BT application in cost management in corporate value chains. The research performed a literature review on blockchain-based supply chain management and cost optimization frameworks. Case study methodology was applied to analyze BT deployment in lowering transaction charges, improving transparency, and optimizing operations. The results demonstrated tangible improvements in cost efficiency, reporting accuracy, and collaborative efforts among supply chain partners. Based on the findings of these prior studies, the following hypotheses are proposed:

H1: *There is a statistically significant moral influence relationship for BT in BD.*
H2: *There is a statistically significant moral influence relationship for BT in PCM.*
H3: *There is a statistically significant moral influence relationship for BD in PCM.*
H4*: BD mediates the relationship between BT and PCM.*

METHODOLOGY

Sample

The study population comprised individuals from diverse professional backgrounds, including academics from multiple Iraqi universities, administrators, accountants, auditors, and engineers engaged in electronic payment services. The International Smart Card (ISC) company, known as Qi Card, was selected for this study. Established in 2007 as a joint venture between the private sector—represented by the Iraqi Electronic Payment Systems Company—and the government sector—represented by Rafidain Bank, the largest bank in Iraq—Qi Card has accumulated 14 years of experience in electronic payment services. It is recognised as the leading provider and collector of electronic payment cards in Iraq. A total of 100 questionnaires were distributed, yielding a response rate of 74%, which is considered adequate for representing the study population and achieving the research objectives. Table 1 presents the characteristics of

the sample.

Table 1: Sample Characteristics.

Sample	Details	No.	Ratio
Academic Certificate	Diploma	5	6.8%
	Bachelor's	18	24.3%
	Master's	23	31.1%
	PhD	28	37.8%
Experience	Less than 5 years	19	25.7%
	From 5 – 10 years	14	18.9%
	More than 10 years	41	55.4%
Specialization	Accountant	11	14.9%
	Auditor	8	10.8%
	Engineer	5	6.8%
	Programmer	9	12.2%
	Administrator in an electronic payment services Co.	4	5.4%
	Academic in Educational Institutions	37	50.0%

Design of the Measurement Tool

A structured questionnaire was developed to assess the study variables, comprising 21 questions. The BT variable was measured using seven questions, the BD variable was assessed through seven questions, and the Reducing Costs Associated with Electronic Payment Services variable was also evaluated using seven questions. Table 2 presents a detailed breakdown of these variables.

Table 2: Paragraph Size and Dimensions for Each Variable

Variables	Number of Vertebrae	Reference
BT	7	(Prux et al., 2021; Avdimiotis & Moschotoglou, 2022)
BD	7	(Xiao et al., 2021; Cui et al., 2022)
PCM	7	(Shree et al., 2021; Nikkeh et al., 2022)

Hypothetical Study Model

The study model, illustrated in Figure 1, aims to examine the impact of BT and BD variables on PCM in the context of electronic payment services.
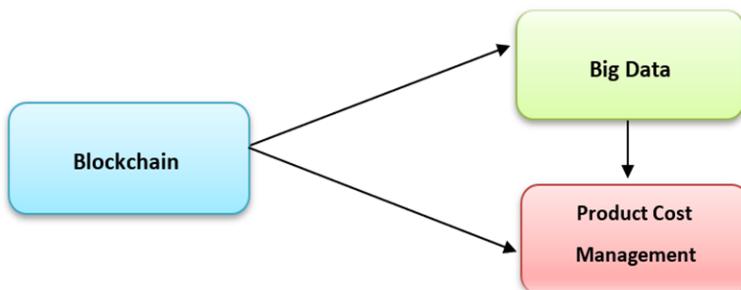

Figure 1: Study Model

RESULTS

Descriptive Statistics:

Table 3 presents the descriptive analysis of the study variables, including the arithmetic mean, standard deviation, coefficient of variation, and relative importance coefficient. Table 3 presents the results, indicating that the average values of BT, BD, and PCM are similar. The BD variable exhibits the lowest standard deviation (0.53), suggesting greater homogeneity and a closer proximity to the average compared to BT and PCM. Additionally, BD has the lowest coefficient of variation (0.13), reflecting greater stability in its data. In contrast, BT has the highest coefficient of variation (0.15), indicating higher variance. Consequently, BD is the most important variable (36%) due to its stability, followed by PCM at 33%, while BT is the least important (31%) due to its greater variance.

Table 3: Descriptive Statistics for the Study Variable

Variables	Mean	Standard Deviation	Coefficient of Variation	Relative Importance
BT	4.01	0.59	0.15	31%
BD	3.99	0.53	0.13	36%
PCM	4.04	0.57	0.14	33%

Inferential Statistics

To test the study hypotheses inferentially, two structural models will be conducted for each hypothesis. The first model examines the role of BT and BD in managing product costs (PCM) associated with electronic payment services. The main hypothesis tests how BT and BD influence PCM in the context of a global smart card company, as illustrated in Figure 2. Moreover, Figure 2 reveals that the R^2 value explaining the impact of BT on BD is 37%, with the remaining 63% attributed to other contributions and variables not addressed in the study. In contrast, the R^2 value for the model examining the relationship between BT, BD, and their impact on PCM is 76%, with the remaining 24% attributed to variables excluded from the model. Notably, the mediation effect has narrowed the R^2 gap in the relationship between the independent and dependent variables, highlighting BD's effective role as an interactive variable that enhances the impact of BT on PCM.
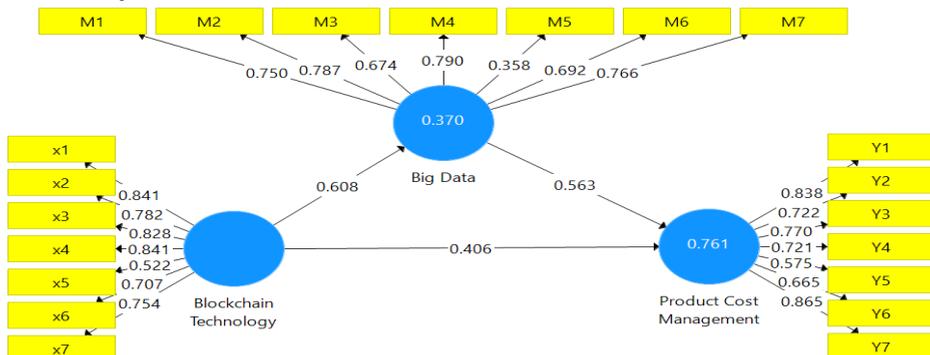

Figure 2: Quality of the Study Model

The results in Table 4 demonstrate the quality of the study model. Cronbach's alpha, Composite Reliability, and rho_A coefficients all exceed 0.7 for the three variables, indicating strong internal consistency. Additionally, the AVE coefficient is above 0.5 for the BT and PCM variables, though it failed to meet this threshold for the BD variable. Despite this, the overall model quality is considered acceptable, as it meets the required criteria for measurement validity. Therefore, the model is deemed valid based on the overall results.

Table 4: Testing the Quality of the Study Model

Variables	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
BT	0.875	0.890	0.904	0.579
BD	0.819	0.851	0.867	0.493
PCM	0.860	0.873	0.894	0.551

Testing the Relationship Between Variables

The study aimed to directly test the basic hypothesis regarding the relationship between blockchain, BD, and PCM, followed by testing BD's mediation between BT and PCM, as depicted in Figure 3.

The model results in Figure 3 represent the inferential test of the main study model. It is observed that the significance level for all dimensions was completely significant, with p-values of 0.000, and the p-value for the overall model is less than 0.05, indicating statistical significance. The findings confirm a direct influential relationship between BT, BD, and PCM, with BD mediating the relationship between BT and PCM. The results of Table 5 present the direct tests conducted to further examine these relationships.
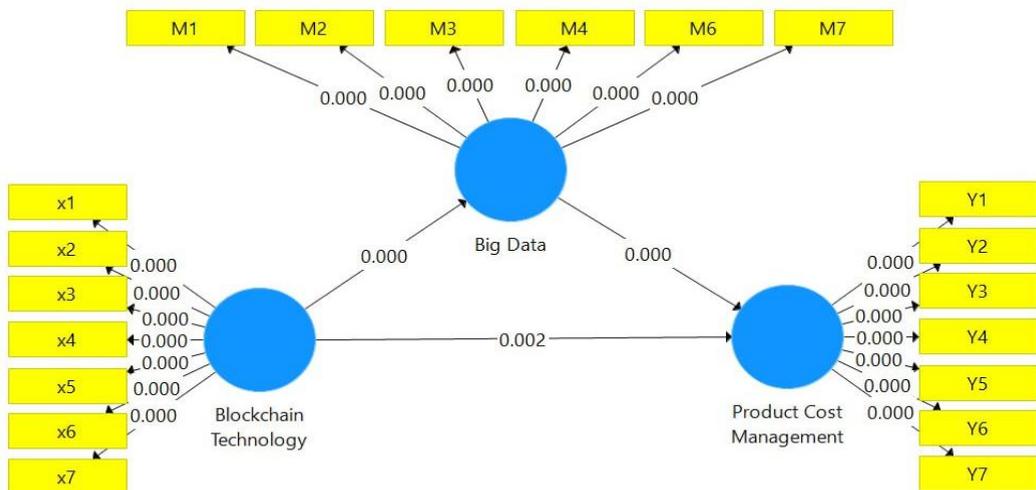

Figure 3: Study Model to Test the Relationship Between Variables

The results in Table 5 show the following path statistics. For the path (BT -> BD), the T-statistics value of 5.304 exceeds the tabular value of 1.96, confirming the significant impact of BT on BD, with a p-value of 0.000 (less than the 0.05 significance level). The impact level is 0.615, indicating that a one-unit change in BT results in a 61% impact on BD. For the path (BT -> PCM), the T-statistics value of 7.722 is the highest, again exceeding the tabular value of 1.96. This confirms the significant impact of BT on PCM, with a p-value of 0.000 (less than 0.05), and an impact level of 0.749, meaning a one-unit change in BT leads to a 74% impact on PCM. For the path (BD -> PCM), the T-statistics value of 3.957 exceeds the tabular value of 1.96, confirming a significant impact of BD on PCM, with a p-value of 0.000 (below 0.05). The impact level is 0.552, indicating that a one-unit change in BD results in a 55% impact on PCM. The model's indirect effects, under BD's mediation in the relationship between BT and PCM, will be discussed in Table 6.

Table 5: Results of the Main Structural Model

Path	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
BT -> BD	0.615	5.304	0.000
BT -> PCM	0.749	7.722	0.000
BD -> PCM	0.552	3.957	0.000

The results presented in Table 6, based on Baron and Kenny's test, suggest that BD acts as a mediating variable in the relationship between BT and PCM. The path (BT → BD → PCM) yielded a calculated T Statistics value of 4.590, which exceeds the tabulated value of 1.96, indicating statistical significance and confirming the mediating role of BD in the BT-PCM relationship. The findings indicate that the relationship is partial, considering the influence of BD on PCM. The mediation impact coefficient of 0.340 further implies that a one-unit change in BT leads to a 34% effect on PCM. The model parameter was statistically significant, as it fell below the 5% significance level. The results of Sobel's test are provided in Table 7. Moreover, the results presented in Table 7, with a value of 3.165667, further validate the findings from the Baron and Kenny three-step test. The test statistics were statistically significant, demonstrating the impact of blockchain and BD technology on PCM, as the significance value of 0.000 is lower than the 5% significance level.

Table 6: Path Test for BD Mediation in the Impact of BT on PCM

Path	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
BT -> BD -> PCM	0.340	4.590	0.000

Table 7: The Results of Sobel's Test

Details	Results
Sobel Test Statistic	3.165667
One-Tailed- Probability	0.000774
Two-Tailed -Probability	0.001547

DISCUSSION OF RESULT

Increased interest in BT and BD integration has been observed in various sectors, particularly financial and admin services. Previous research indicated the following advantages of these technologies: enhanced security, data analysis, decentralised solution-based decision-making, and cost management. Hassani et al. (2018) investigated challenges and opportunities of blockchain adoption in banking with emphasis on BD impacts on financial data analysis. Wang and Shen (2019) developed research into blockchain applicability in PCM with a model of a decentralised approach to aid business in accounting and costing. Deepa et al. (2022) investigated blockchain's usage in its inventory management and BD's role in decision-making in order to enhance operational effectiveness. There are various studies on these technologies' effects in different sectors like finance, e-commerce, energy, healthcare, and building construction. For instance, Krishna et al. (2024) investigated integration of both technologies to address security concerns, and Zhiping (2024) investigated cost management with blockchain.

Contrary to these studies, our study explores a new model explaining BD as a mediator between BT and PCM, with a prime emphasis on electronic payment services. The study results show that BD significantly mediates BT's impact on PCM, enhancing cost management, curtailing financial risks, and enhancing the efficacy of electronic payments. This is reinforced by a calculated value of T-statistics of 4.590, surpassing the tabled value of 1.96. Additionally, this study shows that a change of one unit in BT yields a 34% effect on PCM, with its model parameter statistically significant (less than the 5% level of significance). This highlights the originality of this study in outlining BD mediation's role in enhancing BT performance in PCM, especially in electronic payment services, as compared to prior research that was oriented towards the overall uses of blockchain with no mention of BD's specific role in enhancing the efficiency of BT in this context.

SOCIAL IMPACTS

BT also plays an important role in spreading financial inclusion and lowering transaction costs, hence extending access to electronic financial services to low-income groups and unbanked people. The above strengthens confidence in financial institutions by improving security, transparency, and trust, all of these reducing the risks of fraud as well as financial manipulation accordingly. BT also helps improve customer experience by improving convenience. The inclusion of BD as an intermediary variable adds to this experience by facilitating personalised and rapid services based on persons' individual financial behaviors. Not only does this make the digital economy more robust but also facilitates bridging the digital divide, advancing more inclusive access to financial services as well as resources.

CONCLUSION

This study provides an overview of the expanding literature on artificial intelligence technologies, with a particular emphasis on BT and BD, as these are the centrepiece of this investigation. The study, based on descriptive and inferential statistical analysis of data from Qi Card, revealed a statistically significant association between BT and BD, whereby BT exerts a strong moral impact on PCM. More importantly, BD was identified as a mediator between BT and PCM. Despite these encouraging results, the study recognises that building Internet infrastructure and electronic payment services in Iraq continues to lag, with challenges facing broad BT adoption. The overall predominance of cash transactions, as well as sparse usage of e-wallets and payment cards such as Qi Card and MasterCard, underscores needed progress. Furthermore, a lack of legislation, poor infrastructure, and increases in cyberattacks and electronic fraud related to digital currencies and BT in Iraq are among its critical impediments. To address these issues, the study recommends investment in digital infrastructure, especially Internet networks and security, as these are necessary to enable digital payments transition. It also proposes pilot projects with the cooperation of the Central Bank of Iraq and private banks to evaluate the effectiveness of BT in reducing costs associated with electronic payments. Moreover, the study proposes the launch of an official digital currency based on BT, such as the Iraqi digital dinar, to facilitate the digital financial system. The attempt should be supplemented with transparent legislation to manage BT usage in Iraq as well as a thorough study of the effects of digital currencies on Iraq's economy with particular emphasis on inflation, money transfer, and e-trade.

REFERENCES

Avdimiotis, S., & Moschotoglou, P. (2022). Knowledge spillover through blockchain network in tourism: development and validation of block questionnaire. Knowledge, 2(2), pp. 337-346. https://doi.org/10.3390/knowledge2020019

Barker, R., Lennard, A., Penman, S., & Teixeira, A. (2022). Accounting for intangible assets: suggested solutions. *Accounting and Business Research*, *52*(6), 601-630. https://doi.org/10.1080/00014788.2021.1938963

Chilukoori, V. V. R., & Gangarapu, S. (2024 .(Strategic Cost Management in Cloud-Based Big Data Processing: An AWS Case Study from Amazon. *International Journal for Research in Applied Science and Engineering Technology*, *12*(9). https://doi.org/10.22214/ijraset.2024.64155

Cui, Y., Firdousi, S. F., Afzal, A., Awais, M., & Akram, Z. (2022). The influence of big data analytic capabilities building and education on business model innovation. *Frontiers in Psychology*, *13*, 999944. https://doi.org/10.3389/fpsyg.2022.999944

Deepa, N., Pham, Q.-V., Nguyen, D. C., Bhattacharya, S., Prabadevi, B., Gadekallu, T.

R., Maddikunta, P. K. R., Fang, F., & Pathirana, P. N. (2022). A survey on blockchain for big data: Approaches, opportunities, and future directions. *Future Generation Computer Systems*, *131*, 209 .226- https://doi.org/10.1016/j.future.2022.01.017

Gusc, J., Bosma, P., Jarka, S., & Biernat-Jarka, A. (2022). The big data, artificial intelligence, and blockchain in true cost accounting for energy transition in Europe. *Energies*, *15*(3), 1089. https://doi.org/10.3390/en15031089

Hassani, H., Huang, X., & Silva, E. (2018). Banking with blockchain-ed big data. *Journal of Management Analytics*, *5*(4), 256-275. https://doi.org/10.1080/23270012.2018.1528900

Herman, L. E., Sulhaini, S., & Farida ,N. (2021). Electronic customer relationship management and company performance: Exploring the product innovativeness development. *Journal of Relationship Marketing*, *20*(1), 1-19. https://doi.org/10.1080/15332667.2019.1688600

Hooda, A., Hooda, A., & Yadav ,D. (2024). Integrating Blockchain with Big Data for Secure Data Sharing: A Comprehensive Methodology. https://doi.org/10.21203/rs.3.rs-5005857/v1

Jannes, K., Lagaisse, B., & Joosen, W. (2021). OWebSync: Seamless synchronization of distributed web clients. *IEEE Transactions on Parallel and Distributed Systems*, *32*(9), 2338-2351. https://doi.org/10.1109/TPDS.2021.3066276

Khan, N., Hossain, S., Khadka, U., & Sarkar, S. (2024). Blockchain in Supply Chain Management: Enhancing Transparency, Efficiency, and Trust. *AIJMR-Advanced International Journal of Multidisciplinary Research*, *2*(5). http://dx.doi.org/10.62127/aijmr.2024.v02i05.1105

Kostopoulos, N., & Antonopoulou, H. (2024). The Role of Big Data and Blockchain in Decentralized Decision-Making: A Comprehensive Review *Technium Business and Management*. http://dx.doi.org/10.47577/business.v10i.11998

Krishna, M. H., Raju, H., Jain, A., Al-Rubaye, T. M. K., Thandra, N., & Tewari, P. (2024). Synergizing Blockchain with Big Data for Improved Data Integrity and Transparency. 2024 7th International Conference on Contemporary Computing and Informatics (IC3I) ,https://doi.org/10.1109/IC3I61595.2024.10828642

Kurasova, O., Marcinkevičius, V., Medvedev, V., & Mikulskienė, B. (2021). Early cost estimation in customized furniture manufacturing using machine learning. *International journal of machine learning and computing.*, *11*(1), 28-33. http://dx.doi.org/10.18178/ijmlc.2021.11.1.1010

Mehling, H., Brütting, M., & Haussmann, T. (2022). PCM products and their fields of application-An overview of the state in 2020/20 .21*Journal of Energy Storage*, *51*, 104354. https://doi.org/10.1016/j.est.2022.104354

Nikkeh, N. S., Hasan, S. I., Saeed, H. S., & Flayyih, H. H. (2022). The role of costing techniques in reduction of cost and achieving competitive advantage in iraqi financial institutions. *International Journal of Economics and Finance Studies*, *14*(4), 62-79. https://doi.org/10.34109/ijefs. 20220104

Nudurupati, S. S., Tebboune, S., Garengo, P., Daley, R., & Hardman, J. (2024). Performance measurement in data intensive organisations: resources and capabilities for decision-making process. *Production Planning & Control*, *35*(4), 373-393. https://doi.org/10.1080/09537287.2022.2084468

Osilaja, A. M., Raheem, A., & Edmund, E. (2024). Enhancing software security with blockchain integration for decentralized and tamper-proof application architectures. *World Journal of Advanced Research and Reviews*, *24*(3). http://dx.doi.org/10.30574/wjarr.2024.24.3.3977

Peng, K., Qiao, Y., & Shi, J. (2024). Design of Management Information System Architecture Based on Big Data and Blockchain Technology. 2024 Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC) , https://doi.org/10.1109/IPEC61310.2024.00100

Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. *Big data*, *1*(1), 51-59. https://doi.org/10/1089.big.2013.1508

Prux, P. R., Momo, F. D. S., & Melati, C. (2021). Opportunities and challenges of using blockchain technology in government accounting in brazil. *BAR-Brazilian Administration Review*, *18*, e200109. https://doi.org/10.1590/1807-7692bar2021200109

Sandhu, A. K. (2021). Big data with cloud computing: Discussions and challenges. *Big Data Mining and Analytics*, *5*(1), 32-40. https://doi.org/10.26599/BDMA.2021.9020016

Shree, S., Pratap, B., Saroy, R., & Dhal, S. (2021). Digital payments and consumer experience in India: a survey based empirical study. *Journal of Banking and Financial Technology*, *5*, 1-20. https://doi.org/10.1007/s42786-020-00024-z

Srivastava, S., Chaurasia, B. K., & Singh, D. (2023). Blockchain-based IoT security solutions. In *Distributed Computing to Blockchain* (pp. 327-339). Elsevier. https://doi.org/10.1016/B978-0-323-96146-2.00020-6

Su, X., Zeng, W., Zheng, M., Jiang, X., Lin, W., & Xu, A. (2022). Big data analytics capabilities and organizational performance: the mediating effect of dual innovations. *European Journal of Innovation Management*, *25*(4), 1142-1160. https://doi.org/10.1108/EJIM-10-2020-0431

Theodorakopoulos, L., Theodoropoulou, A., & Halkiopoulos, C. (2024). Enhancing decentralized decision-making with big data and blockchain technology: A comprehensive review. *Applied Sciences*, *14*(16), 7007. https://doi.org/10.3390/app14167007

Vermani, L. S., Anooja, A., Thankachan, B., Kumar, A., Verma, A., & Thakore, A. (2024). Real-time Big Data Analytics for Privacy-preserving of human data through Blockchain technology. 2024 IEEE International Conference on Blockchain and Distributed Systems Security (ICBDS) , https://doi.org/10.1109/ICBDS61829.2024.10837256

Vitale, G. (2023). Information Technologies for Business Management: From Big Data

to Blockchain, a Literature Overview. *Understanding Supply Chain Digitalization Through Actor-Network Theory: The Interplay Between Blockchain, Accounting and Management Control*, 1-22. https://doi.org/10.1007/978-3-031-30988-5_1

Wang, F.-Z., & Shen ,X.-R. (2019). The Influence of Block Chain Technology on Cost Management. *DEStech Transactions on Social Science Education and Human Science*. http://dx.doi.org/10.12783/dtssehs/icssm2018/27086

Xiao, F., Song, B., Liu, K., & Qu, C. (2021). Analysis and Research Based on Method of Questionnaire Survey and the Algorithm of Big Data Analysis. In Journal of Physics: Conference Series, Vol.1813, No.1, p.012040 . https://doi.org/10.1088/1742-6596/1813/1/012040

Xiu, Z. (2024). Application of Big Data in Digital Currency and Blockchain Finance. *Scientific and Social Research* https://doi.org/10.26689/ssr.v6i10.8615

Xu, Y., Cheah, J. H., Hair Jr, J. F., & Liu, Y. (2025). Does EMA implementation promote green innovation? The mediation effects of both cross-functional coopetition and supplier co-creation. *Business Strategy and the Environment*, *34*(1), 380-401. https://doi.org/10.1002/bse.3987

Zhang, A., & Lv, N. (2021). Research on the impact of big data capabilities on government's smart service performance: empirical evidence from China. *Ieee Access*, *9*, 50523-50537. https://doi.org/10.1109/ACCESS.2021.3056486

Zhiping, Z. (2024). The Application of Blockchain Technology in Enterprise Value Chain Cost Management [J]. *Pacific International Journal*, *7*(1). https://doi.org/10.55/014pij.v7i1.541