

Integrating Artificial Intelligence and Maqāṣid al-Syarī'ah: Revolutionizing Indonesia's Sharia Online Trading System

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Abstract

This study explores the integration of maqāṣid al-syarī'ah principles with Artificial Intelligence (AI) in developing a Sharia Online Trading System (SOTS) for Indonesia's Islamic capital market. By focusing on key principles such as justice (al-'adalah) and public benefit (al-maṣlahah), this research employs a phenomenological approach to analyze the subjective experiences of market participants. Findings reveal that an AI-based system using prompt engineering can enhance transparency, efficiency, and compliance in sharia transactions. The system provides real-time notifications to investors, helping them understand the ethical and legal aspects of their transactions. This research contributes to bridging the gap between Islamic ethical frameworks and modern technological advancements, paving the way for a more inclusive and sustainable Islamic financial ecosystem. Future research could expand on implementation evaluation, global comparisons, and further algorithmic development to deepen the impact of AI in Islamic financial markets.

Keywords: Artificial Intelligence; Maqāṣid; SOTS; Trading System; Capital Market

Introduction

The development of technology in the financial world has profoundly impacted various aspects of economic life, including investment systems in capital markets (Nti et al., 2020a). The Islamic capital market, as part of the Islamic financial ecosystem, continues to grow in response to increasing societal demand for investments aligned with Shariah principles (Al Hashfi et al., 2021; Almaida et al., 2024). In Indonesia, the Islamic capital market has become one of the sectors with significant growth, supported by increasingly clear regulations and diverse Shariah-compliant investment instruments.

However, in the context of the Islamic capital market, compliance with Shariah principles remains a primary concern (Antonio et al., 2019; Anwar & Ardiansyah, 2023). Principles such as justice (al-'adalah), transparency, and public welfare (al-maṣlahah) must always be upheld to ensure market integrity (Allam & Dhunny, 2019; Asutay et al., 2023). The development of the Islamic capital market in Indonesia also reflects the need for new approaches that not only accommodate Shariah values but also remain relevant to the demands of the digital era.

Research on the experiences of participants in the Islamic capital market has emerged as a significant area in the development of Islamic economics (Bossman et al., 2022; Hamayel & Owda, 2021). Various studies indicate that regulations and practices in the Islamic capital market often face methodological challenges in ensuring compliance with Shariah principles (Cipto et al., 2024; Hassija et al., 2021). These challenges arise from the complexity of transactions involving modern financial instruments that are not fully addressed in traditional Shariah rules.

One of the main challenges is the limitation of quantitative approaches in understanding the subjective dimensions and experiences of market participants (Nti et al., 2020b). Such approaches often fail to capture the essence of Shariah values, which focus not only on outcomes but also on processes that uphold justice, public welfare, and transparency (Fatur Rahman & Nugraha, 2022; Singh et al., 2022). For example, moral and ethical aspects of transactions are frequently overlooked in quantitative analyses that prioritize statistical results.

These limitations highlight the need for deeper exploration of the subjective experiences of Islamic capital market participants (Febriandika et al., 2023; Kellner et al., 2019). Consequently, a phenomenological approach becomes relevant for uncovering the profound meanings behind actions, decisions, and interactions in the Islamic capital market (Fianto et al., 2023; Théate & Ernst, 2021). This understanding not only fills gaps in the literature but also provides practical contributions to developing regulations and practices that are more inclusive and relevant to modern needs.

Despite the significant growth of the Islamic capital market in Indonesia, gaps remain in the comprehensive application of *maqāṣid al-sharī'ah* principles, particularly in the context of modern technological developments such as the Sharia Online Trading System (SOTS) (Gati et al., 2024; Hua et al., 2022). Current regulations tend to focus on general guidelines without offering specific directions on integrating Shariah-based technology, such as using AI to ensure real-time Shariah compliance.

Traditional approaches in the Islamic capital market, such as manual screening to detect Shariah compliance, face limitations in terms of efficiency and accuracy (Ferreira et al., 2021; Gondo et al., 2023). Additionally, the lack of focus on the subjective experiences of Islamic capital market participants results in missed opportunities to deeply understand their challenges and needs (Barja-Martinez et al., 2021; Hakim et al., 2021). This is crucial because subjective experiences can provide valuable insights for designing systems that are more aligned with *maqāṣid al-sharī'ah* principles.

This research seeks to answer a central question: how can *maqāṣid al-sharī'ah* principles be integrated with AI technology to create a stock trading system that is not only Shariah-compliant but also transparent and inclusive? By addressing this question, the study aims to bridge the gap between the theory of *maqāṣid al-sharī'ah* and the implementation of technology in the Islamic capital market.

This study demonstrates how integrating *maqāṣid al-sharī'ah* principles with AI technology, particularly through prompt engineering, can create a Shariah-compliant stock trading system that is more transparent, efficient, and aligned with Islamic values (Hasan et al., 2021; Huang et al., 2019). By exploring relevant literature, such as Ibn Ashur's thoughts on *maqāṣid al-sharī'ah* and contemporary challenges in the Islamic capital market, the research offers technology-based solutions that address practical and ethical needs in Indonesia's Islamic capital market.

A phenomenological approach is employed to understand the experiences and perceptions of Islamic capital market participants (Atsalakis et al., 2019; Zouaoui, 2019). Through in-depth interviews and thematic analysis, this study explores how technology can help address challenges such as lack of transparency, excessive speculation, and uncertainty that contradict Shariah principles (Yusfiarto et al., 2023; Zhou et al., 2019). This approach not only provides theoretical insights but also yields practical recommendations for developing AI-based Sharia Online Trading Systems (SOTS).

The article is organized into several sections. The introduction outlines the research background and objectives. The methodology section details the phenomenological approach used, including data collection and analysis techniques. The results section presents key findings on the experiences of Islamic capital market participants and the relevance of *maqāṣid al-sharī'ah* in AI-based trading systems. The discussion connects the findings with previous literature, while the conclusion offers practical implications and opportunities for further research.

Method

Study Design

This research adopts an interpretative phenomenological approach to understand the experiences and perceptions of Islamic capital market participants regarding the integration of *maqāṣid al-sharī'ah* and AI technology in the Sharia Online Trading System (SOTS) (Niu et al., 2022; Yusfiarto et al., 2023). The phenomenological approach was chosen for its focus on exploring the deep meaning of subjective experiences, which is relevant for examining the implementation of *maqāṣid al-sharī'ah* principles in a modern context (Kang et al., 2022; Yudaruddin, 2023). This design enables the study to explore how Shariah values are applied within technology and investment practices.

Participants

The study involves ten participants from the Islamic capital market, selected through purposive sampling (Paiva et al., 2019; Yaqin et al., 2021). Inclusion criteria include: (1) At least three years of experience in Shariah-compliant stock investments, (2) A basic understanding of Shariah principles in investment, and (3) Engagement in the development or use of AI technology in the Islamic capital market. Participants come from diverse backgrounds, including investors, investment managers, and system developers.

Data Collection

Data was collected through in-depth interviews using semi-structured guidelines (Nam & Seong, 2019). Each interview lasted between 45–60 minutes and was conducted either in person or via secure online platforms (Razavi, 2021). The interview instrument covered questions on participants' understanding of maqāṣid al-sharī'ah, their experiences using AI technology in stock transactions, as well as the challenges and benefits they perceived (Hendershott et al., 2021). To ensure participants' comfort, interviews were conducted in a conducive environment, with prior written consent obtained.

Data Analysis

The data analysis technique employed was thematic analysis based on interpretative phenomenology. The analytical process consisted of several stages (Barykin et al., 2021):

1. Data Transcription: All interviews were transcribed verbatim to ensure data accuracy.
2. Initial Coding: Meaning units were identified based on themes of maqāṣid al-sharī'ah, such as justice and public welfare.
3. Thematic Grouping: Similar meaning units were grouped into major themes.
4. Thematic Validation: The resulting themes were validated through data triangulation from literature and additional interviews.
5. In-Depth Interpretation: Each theme was analyzed within the context of participants' experiences to understand the relevance of maqāṣid al-sharī'ah principles to AI technology.

Results

The Implementation of Maqāṣid al-Syarī'ah in AI-Based Shariah Transactions

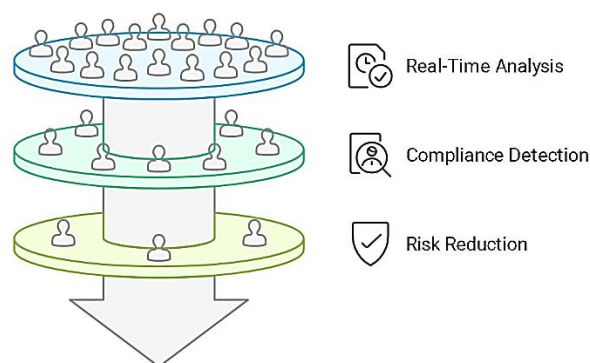


Figure 1: AI-Enhanced Sharia Compliance

The findings presented in Figure 1 indicate that maqāṣid al-sharī'ah, particularly the principles of justice (al-'adalah) and public welfare (al-maṣlahah), can be integrated with AI technology to support compliance in Shariah transactions. Interviews with practitioners revealed that the use of prompt engineering enables real-time detection of non-compliant transactions. One respondent stated, "With AI, transactions can be immediately checked for compliance, thereby reducing the risk of Shariah violations in the capital market." This underscores the relevance of maqāṣid al-sharī'ah in developing systems that are adaptive and responsive to the needs of the modern market.

Efficiency and Transparency in the Sharia Online Trading System

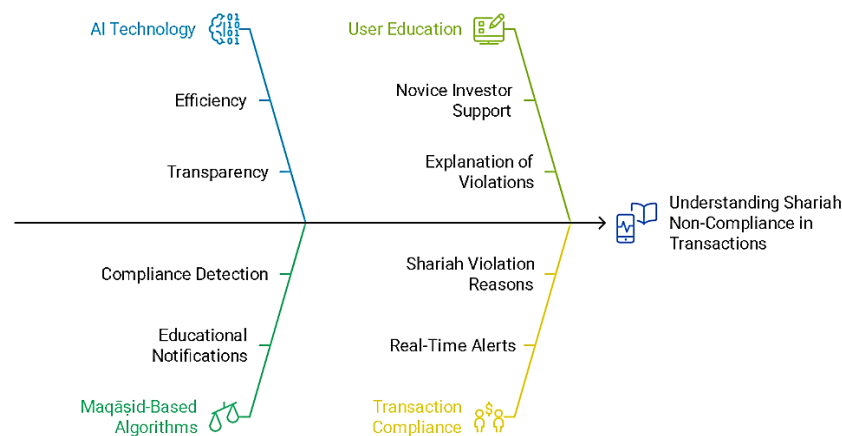


Figure 2: Enhancing Sharia Online Trading System

The findings in Figure 2 demonstrate that the use of AI technology not only enhances efficiency but also improves transparency. Systems designed with maqāṣid-based algorithms provide real-time education to users. For example, if a non-compliant transaction occurs, the system automatically issues a notification explaining the reason for the violation. One research participant stated, "This system is very helpful for novice investors in understanding why certain transactions do not comply with Shariah principles." Thus, AI serves not only as a technical tool but also as an educational instrument in the Islamic capital market.

Challenges and Solutions in System Development

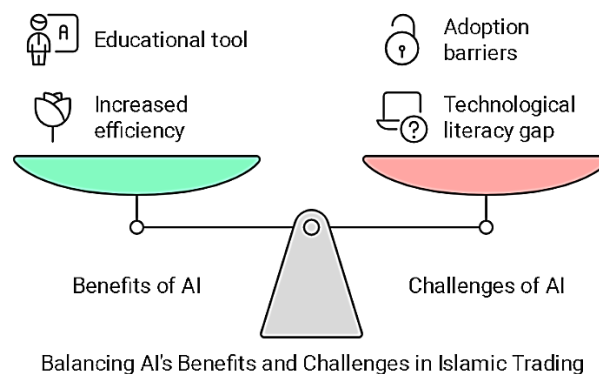


Figure 3: Balancing AI's Benefits and Challenges in Islamic Trading

The findings in Figure 3 also reveal that while the benefits of AI in Shariah-compliant stock trading systems are evident, significant challenges remain, such as a lack of technological literacy among Shariah market participants. However, the analysis indicates that a maqāṣid-based approach can offer innovative solutions. For instance, the development of simple and interactive interfaces has made it easier for users to understand the system. One respondent noted, "We observed that integrated education within the system is key to increasing the adoption of this technology."

The findings of this study highlight that integrating maqāṣid al-sharī'ah with AI technology in the Sharia Online Trading System enhances efficiency, transparency, and Shariah compliance. This system not only provides technical solutions but also serves as an educational tool that empowers Shariah investors. Consequently, AI technology based on maqāṣid is not only relevant but also essential in addressing the dynamics of the modern Islamic capital market.

Discussion

This study reveals that integrating the principles of *maqāṣid al-syarī'ah* with AI technology, particularly through a prompt engineering approach, provides innovative solutions for enhancing transparency and Sharia compliance in capital markets. The findings show that AI-based systems can detect Sharia violations in real time and provide educational notifications to users, helping them better understand Sharia principles.

The findings detail how *maqāṣid al-syarī'ah* can be implemented in Sharia-compliant stock trading systems based on AI technology. Interviews with Sharia capital market practitioners revealed that justice (*al-'adalah*) and public interest (*al-maṣlahah*) are the most relevant *maqāṣid* principles in designing the Sharia Online Trading System (SOTS). Leveraging prompt engineering, the system enables real-time detection of transactions that violate Sharia principles, such as those involving *gharar* (uncertainty) or *maisir* (speculation).

A key contribution of this research is the development of a system that not only detects violations but also educates users by providing notifications explaining why certain transactions are deemed non-compliant with Sharia principles. For instance, one participant stated that this feature helps them understand often complex and inaccessible Sharia aspects through traditional sources. Additionally, the research highlights that integrating Sharia principles with technology can enhance investor confidence, which is critical for the growth of the Sharia capital market in Indonesia.

These findings provide clear answers to the research question: How can *maqāṣid al-syarī'ah* be integrated into modern technology to create a more inclusive and efficient trading system? By offering a technology-based solution accessible to all investor segments, this study presents a novel approach that responds to contemporary needs without compromising Sharia principles.

This study significantly contributes to expanding discussions on developing technology-based Sharia capital markets, particularly through the integration of *maqāṣid al-syarī'ah* with Artificial Intelligence (AI). Within the context of existing literature, this research fills an important gap by aligning technological innovation with fundamental Sharia values, which have rarely been explored in-depth in previous studies.

Literature, such as works by Ibn Ashur (1952) and contemporary studies by Faizin (2020), emphasizes the importance of *maqāṣid al-syarī'ah*, particularly the principles of justice (*al-'adalah*), public interest (*al-maṣlahah*), and wealth protection (*ḥifẓ al-māl*), in designing Islamic economic systems relevant to modern needs. However, prior studies tend to be conceptual and rarely address how technology can be concretely integrated to achieve these *maqāṣid* objectives. This study goes further by linking these principles with AI technology, particularly in creating adaptive, transparent, and inclusive Sharia Online Trading Systems (SOTS).

For example, the principle of justice is realized through AI systems designed to eliminate potential discrimination in access to financial information. All users, whether novice or experienced investors, receive equally accurate transaction information. The principle of public interest is evident in how the system helps prevent *gharar* (uncertainty) and *maisir* (speculation), common challenges in Sharia capital markets.

This study also positions *maqāṣid al-syarī'ah* within the discourse of financial technology (fintech), aligning with global trends documented in literature such as Rizaldy et al. (2019) on Sharia screening standards and Robiyanto et al. (2021) on Sharia-based investment strategies. However, no previous research specifically addresses the integration of *maqāṣid al-syarī'ah* with AI technology in Indonesia's Sharia capital market. In this context, this study offers a new perspective relevant to the fields of Artificial Intelligence, Communication, and Computer Science.

For instance, the use of AI-based prompt engineering enables not only real-time detection of Sharia violations but also educates investors on Sharia principles. This creates a more effective communication space between investors, systems, and regulators, relevant to the communication discipline. In computer science, the algorithm design for big data analysis in Sharia capital markets reflects significant innovation rooted in Sharia principles.

As an additional contribution, this research affirms the relevance of *maqāṣid al-syarī'ah* in guiding the design and implementation of technological systems that not only comply with regulations but also meet users' social and spiritual needs. This aligns with studies such as Asutay et al. (2020) on the influence of religiosity on

investor behavior. The research demonstrates that applying *maqāṣid al-syarī'ah* through AI adds value, as the system not only automates processes but also instills ethical meaning into every transaction.

Thus, this research transcends existing theoretical frameworks by offering an integrative approach grounded in logical and empirical data. Its contributions not only enrich the literature but also pave the way for further exploration of the synergy between technology and *maqāṣid al-syarī'ah* in the development of Sharia capital markets in the digital era.

This study offers several practical implications for developing technology-based Sharia capital markets in Indonesia. The integration of *maqāṣid al-syarī'ah* with AI technology, such as prompt engineering, presents solutions that improve transaction efficiency and enhance investor confidence in Sharia compliance within stock trading systems. One of the most notable practical implications is the system's ability to provide real-time educational notifications, enabling users to understand Sharia principles relevant to their transactions.

Another emerging implication is the increased accessibility of Sharia capital markets to various groups, including novice investors. With an interface intuitively designed based on *maqāṣid*, this system creates a more inclusive user experience, expanding public participation in Sharia-based investments. This supports the *maqāṣid* objective of extending benefits to all parties.

Although this research provides valuable insights, several limitations must be noted. First, the scope of this study is limited to the Sharia capital market in Indonesia, so the findings may not fully apply to Sharia capital markets in other countries. Second, the implementation of AI systems based on *maqāṣid al-syarī'ah* is still in its early stages, meaning this research primarily explores potential rather than evaluating actual results.

Additionally, the phenomenological approach used emphasizes subjective experiences, meaning the findings may not fully represent broader perspectives, especially from regulators or technology providers. These limitations serve as a foundation for more in-depth and extensive future research.

Based on the findings and limitations of this study, future research is suggested to evaluate the implementation of AI systems based on *maqāṣid al-syarī'ah* in Sharia capital markets, including their impact on efficiency and Sharia compliance. Comparative cross-country studies could provide insights into applying *maqāṣid al-syarī'ah* in various technological contexts. Further research could also focus on developing ethical Sharia-based algorithms and using these systems as educational tools to enhance Sharia financial literacy and support the sustainable growth of the Sharia financial

Conclusion

This study demonstrates that integrating *maqāṣid al-sharī'ah* with Artificial Intelligence (AI) technology, through a prompt engineering approach, offers innovative solutions to enhance efficiency, transparency, and compliance with Islamic law in the Islamic capital market. By focusing on the principles of justice (*al-'adalah*) and public welfare (*al-maṣlahah*), this AI-based trading system provides practical benefits such as real-time detection of Sharia violations, educational notifications for users, and an inclusive design for diverse groups of investors, including beginners.

However, the study notes several limitations, such as its scope being confined to the Indonesian Islamic capital market and the system's implementation being in its early stages. These limitations open opportunities for further research, such as evaluating implementation outcomes, developing Sharia-compliant algorithms, and conducting cross-country comparative studies. Overall, this study makes a significant contribution by linking *maqāṣid al-sharī'ah* with modern technology, offering a novel approach that aligns with the digital era and has the potential to strengthen a sustainable and inclusive Islamic financial ecosystem.

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References

- [1] Al Hashfi, R. U., Naufa, A. M., & Munawaroh, U. (2021). ARE ISLAMIC STOCKS LESS EXPOSED TO SENTIMENT-BASED MISPRICING THAN NON-ISLAMIC ONES? EVIDENCE FROM THE INDONESIAN STOCK EXCHANGE. *Journal of Islamic Monetary Economics and Finance*, 7(1), 1–26. Scopus. <https://doi.org/10.21098/jimf.v7i1.1319>
- [2] Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, 89, 80–91. Scopus. <https://doi.org/10.1016/j.cities.2019.01.032>
- [3] Almaida, A., Abbas, U., Watto, W. A., Asdullah, M. A., Fahlevi, M., & Ichdan, D. A. (2024). The Islamic effect: Exploring the dynamics of Islamic events on sustainable performance of Islamic and conventional stock markets. *Uncertain Supply Chain Management*, 12(1), 235–248. Scopus. <https://doi.org/10.5267/j.uscm.2023.10.002>
- [4] Antonio, M. S., Laela, S. F., & Darmawan, R. R. (2019). Corporate Governance, earnings quality and market response: Comparison of Islamic And Non-Islamic Stock in the Indonesian Capital Market. *Academy of Accounting and Financial Studies Journal*, 23(Special Issue 1). Scopus. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85074155218&partnerID=40&md5=d1679939c4269913745a0673a5163ac3>
- [5] Anwar, S., & Ardiansyah, M. (2023). Determinants of Hybrid Investor Behavior: Selecting Stock in The Islamic Capital Market with Maqasid of Sharia as Moderation. *Millah: Journal of Religious Studies*, 22(2), 701–732. Scopus. <https://doi.org/10.20885/millah.vol22.iss2.art15>
- [6] Asutay, M., Aziz, P. F., Indrastomo, B. S., & Karbhari, Y. (2023). Religiosity and Charitable Giving on Investors' Trading Behaviour in the Indonesian Islamic Stock Market: Islamic vs Market Logic. *Journal of Business Ethics*, 188(2), 327–348. Scopus. <https://doi.org/10.1007/s10551-023-05324-0>
- [7] Atsalakis, G. S., Atsalaki, I. G., Pasiouras, F., & Zopounidis, C. (2019). Bitcoin price forecasting with neuro-fuzzy techniques. *European Journal of Operational Research*, 276(2), 770–780. Scopus. <https://doi.org/10.1016/j.ejor.2019.01.040>
- [8] Barja-Martinez, S., Aragüés-Peñalba, M., Munné-Collado, Í., Lloret-Gallego, P., Bullich-Massagué, E., & Villafañila-Robles, R. (2021). Artificial intelligence techniques for enabling Big Data services in distribution networks: A review. *Renewable and Sustainable Energy Reviews*, 150. Scopus. <https://doi.org/10.1016/j.rser.2021.111459>
- [9] Barykin, S. Y., Kapustina, I. V., Sergeev, S. M., Kalinina, O. V., Vilken, V. V., de la Poza, E., Putikhin, Y. Y., & Volkova, L. V. (2021). Developing the physical distribution digital twin model within the trade network. *Academy of Strategic Management Journal*, 20(SpecialIssue2), 1–18. Scopus.
- [10] Bossman, A., Owusu Junior, P., & Tiwari, A. K. (2022). Dynamic connectedness and spillovers between Islamic and conventional stock markets: Time- and frequency-domain approach in COVID-19 era. *Heliyon*, 8(4). Scopus. <https://doi.org/10.1016/j.heliyon.2022.e09215>
- [11] Cipto, S. H., Endri, E., Haryono, Y., & Hartanto, D. (2024). Islamic Stock Indices and COVID-19: Evidence from Indonesia. *International Journal of Economics and Financial Issues*, 14(3), 83–88. Scopus. <https://doi.org/10.32479/ijefi.15942>
- [12] Fatur Rahman, T., & Nugraha, T. (2022). ISLAMIC STOCK PORTFOLIO OPTIMIZATION USING DEEP REINFORCEMENT LEARNING. *Journal of Islamic Monetary Economics and Finance*, 8(2), 181–200. Scopus. <https://doi.org/10.21098/jimf.v8i2.1430>
- [13] Febriandika, N. R., Wati, R. M., & Hasanah, M. (2023). Russia's invasion of Ukraine: The reaction of Islamic stocks in the energy sector of Indonesia. *Investment Management and Financial Innovations*, 20(1), 218–227. Scopus. [https://doi.org/10.21511/imfi.20\(1\).2023.19](https://doi.org/10.21511/imfi.20(1).2023.19)
- [14] Ferreira, F. G. D. C., Gandomi, A. H., & Cardoso, R. T. N. (2021). Artificial Intelligence Applied to Stock Market Trading: A Review. *IEEE Access*, 9, 30898–30917. Scopus. <https://doi.org/10.1109/ACCESS.2021.3058133>
- [15] Fianto, B. A., Shah, S. A. A., & Sukmana, R. (2023). Time varying intra/inter quantile developing relationship of Islamic stock returns: Empirical evidence from Indonesia using QBARDL. *Journal of Modelling in Management*, 18(6), 1696–1716. Scopus. <https://doi.org/10.1108/JM2-12-2021-0310>

- [16] Gati, V., Harymawan, I., & Nasih, M. (2024). Indonesia Shariah Stock Index (ISSI) firms and environmental, social, and governance (ESG) disclosure in Indonesia. *Journal of Islamic Accounting and Business Research*. Scopus. <https://doi.org/10.1108/JIABR-12-2022-0354>
- [17] Gondo, T. W., Balqis Megat Mazlan, P. N., Masron, T. A., & Nor, E. (2023). Does MCO Truly Assist the Islamic Stock Market to Rebound Amid Covid-19? *Jurnal Ekonomi Malaysia*, 57. Scopus. <https://doi.org/10.17576/JEM-2023-5702-14>
- [18] Hakim, A., Dewanta, A. S., Sidiq, S., & Astuti, R. D. (2021). Modeling the interaction across international conventional and Islamic stock indices. *Cogent Economics and Finance*, 9(1). Scopus. <https://doi.org/10.1080/23322039.2020.1862394>
- [19] Hamayel, M. J., & Owda, A. Y. (2021). A Novel Cryptocurrency Price Prediction Model Using GRU, LSTM and bi-LSTM Machine Learning Algorithms. *AI (Switzerland)*, 2(4), 477–496. Scopus. <https://doi.org/10.3390/ai2040030>
- [20] Hasan, M. B., Mahi, M., Hassan, M. K., & Bhuiyan, A. B. (2021). Impact of COVID-19 pandemic on stock markets: Conventional vs. Islamic indices using wavelet-based multi-timescales analysis. *North American Journal of Economics and Finance*, 58. Scopus. <https://doi.org/10.1016/j.najef.2021.101504>
- [21] Hassija, V., Chamola, V., Gupta, V., Jain, S., & Guizani, N. (2021). A Survey on Supply Chain Security: Application Areas, Security Threats, and Solution Architectures. *IEEE Internet of Things Journal*, 8(8), 6222–6246. Scopus. <https://doi.org/10.1109/JIOT.2020.3025775>
- [22] Hendershott, T., Zhang, X., Leon Zhao, J., & Zheng, Z. (2021). Fintech as a game changer: Overview of research frontiers. *Information Systems Research*, 32(1), 1–17. Scopus. <https://doi.org/10.1287/isre.2021.0997>
- [23] Hua, W., Chen, Y., Qadrdan, M., Jiang, J., Sun, H., & Wu, J. (2022). Applications of blockchain and artificial intelligence technologies for enabling prosumers in smart grids: A review. *Renewable and Sustainable Energy Reviews*, 161. Scopus. <https://doi.org/10.1016/j.rser.2022.112308>
- [24] Huang, B., Huan, Y., Xu, L. D., Zheng, L., & Zou, Z. (2019). Automated trading systems statistical and machine learning methods and hardware implementation: A survey. *Enterprise Information Systems*, 13(1), 132–144. Scopus. <https://doi.org/10.1080/17517575.2018.1493145>
- [25] Kang, J., Li, X., Nie, J., Liu, Y., Xu, M., Xiong, Z., Niyato, D., & Yan, Q. (2022). Communication-Efficient and Cross-Chain Empowered Federated Learning for Artificial Intelligence of Things. *IEEE Transactions on Network Science and Engineering*, 9(5), 2966–2977. Scopus. <https://doi.org/10.1109/TNSE.2022.3178970>
- [26] Kellner, F., Lienland, B., & Utz, S. (2019). An a posteriori decision support methodology for solving the multi-criteria supplier selection problem. *European Journal of Operational Research*, 272(2), 505–522. Scopus. <https://doi.org/10.1016/j.ejor.2018.06.044>
- [27] Nam, K., & Seong, N. (2019). Financial news-based stock movement prediction using causality analysis of influence in the Korean stock market. *Decision Support Systems*, 117, 100–112. Scopus. <https://doi.org/10.1016/j.dss.2018.11.004>
- [28] Niu, X., Wang, J., & Zhang, L. (2022). Carbon price forecasting system based on error correction and divide-conquer strategies. *Applied Soft Computing*, 118. Scopus. <https://doi.org/10.1016/j.asoc.2021.107935>
- [29] Nti, I. K., Adekoya, A. F., & Weyori, B. A. (2020a). A comprehensive evaluation of ensemble learning for stock-market prediction. *Journal of Big Data*, 7(1). Scopus. <https://doi.org/10.1186/s40537-020-00299-5>
- [30] Nti, I. K., Adekoya, A. F., & Weyori, B. A. (2020b). A systematic review of fundamental and technical analysis of stock market predictions. *Artificial Intelligence Review*, 53(4), 3007–3057. Scopus. <https://doi.org/10.1007/s10462-019-09754-z>
- [31] Paiva, F. D., Cardoso, R. T. N., Hanaoka, G. P., & Duarte, W. M. (2019). Decision-making for financial trading: A fusion approach of machine learning and portfolio selection. *Expert Systems with Applications*, 115, 635–655. Scopus. <https://doi.org/10.1016/j.eswa.2018.08.003>
- [32] Razavi, S. (2021). Deep learning, explained: Fundamentals, explainability, and bridgeability to process-based modelling. *Environmental Modelling and Software*, 144. Scopus. <https://doi.org/10.1016/j.envsoft.2021.105159>

- [33] Singh, R., Akram, S. V., Gehlot, A., Buddhi, D., Priyadarshi, N., & Twala, B. (2022). Energy System 4.0: Digitalization of the Energy Sector with Inclination towards Sustainability. *Sensors*, 22(17). Scopus. <https://doi.org/10.3390/s22176619>
- [34] Théate, T., & Ernst, D. (2021). An application of deep reinforcement learning to algorithmic trading. *Expert Systems with Applications*, 173. Scopus. <https://doi.org/10.1016/j.eswa.2021.114632>
- [35] Yaqin, H., Hartati, Z., Salabi, A., Bahri, S., & Mizani, H. (2021). Influence of Image-building, Financial Stability and Curriculum development on Education Management with Moderating effect of Educational Leadership: An Islamic Perspective. *Eurasian Journal of Educational Research*, 2021(94), 422–443. Scopus. <https://doi.org/10.14689/ejer.2021.94.19>
- [36] Yudaruddin, R. (2023). Financial technology and performance in Islamic and conventional banks. *Journal of Islamic Accounting and Business Research*, 14(1), 100–116. Scopus. <https://doi.org/10.1108/JIABR-03-2022-0070>
- [37] Yusfiarto, R., Nugraha, S. S., Mutmainah, L., Berakon, I., Sunarsih, S., & Nurdany, A. (2023). Examining Islamic capital market adoption from a socio-psychological perspective and Islamic financial literacy. *Journal of Islamic Accounting and Business Research*, 14(4), 574–594. Scopus. <https://doi.org/10.1108/JIABR-02-2022-0037>
- [38] Zhou, Z., Wang, B., Guo, Y., & Zhang, Y. (2019). Blockchain and Computational Intelligence Inspired Incentive-Compatible Demand Response in Internet of Electric Vehicles. *IEEE Transactions on Emerging Topics in Computational Intelligence*, 3(3), 205–216. Scopus. <https://doi.org/10.1109/TETCI.2018.2880693>
- [39] Zouaoui, M. (2019). Selectivity and market timing ability of fund managers: Comparative analysis of islamic and conventional HSBC Saudi mutual funds. *International Journal of Financial Studies*, 7(3). Scopus. <https://doi.org/10.3390/ijfs7030048>