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Impact Analysis of Artificial Intelligence Utilization in Enhancing Business Decision-Making in the Financial Sector

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Abstract
The financial sector has experienced significant transformation with the adoption of Artificial Intelligence (AI) technology, particularly in improving business decision-making. This study aims to analyze the impact of AI on decision-making quality, focusing on risk analysis and portfolio management in Indonesia's financial sector. A mixed-method approach was utilized, combining quantitative and qualitative data to provide a comprehensive view of AI's role in financial decision-making processes. Quantitative data were gathered through surveys of 50 respondents from various financial institutions, while qualitative data were obtained from semi-structured interviews with industry executives. The findings indicate that AI significantly enhances risk analysis accuracy by 25%, optimizes portfolio management, accelerates decision-making processes, and improves operational efficiency by automating manual tasks and reducing human errors. Despite these benefits, the study also identifies challenges such as data quality issues and high implementation costs, which hinder the broader adoption of AI in the financial sector. The study concludes that AI offers substantial potential to improve decision-making in the financial industry, but addressing data infrastructure and training needs is critical for achieving optimal outcomes.

Keywords: *Artificial Intelligence, Financial Sector, Risk Analysis, Portfolio Management, Decision-Making.*

I. INTRODUCTION

The global financial industry has undergone significant transformations in recent decades, driven largely by rapid technological advancements. Business decision-making, once reliant on manual analysis and intuition, is increasingly being replaced by more sophisticated data-driven approaches. One of the most prominent technologies facilitating this transformation is artificial intelligence (AI) (Murinde et al., 2022). AI enables the processing of vast amounts of data with speed and accuracy far beyond human capabilities, thus providing more targeted insights for decision-making (Shahbaz et al., 2020). A study by (Al-Surmi et al., 2022) revealed that over 70% of global financial firms have adopted AI technology to support decision-making processes. Additionally, 85% of these companies reported significant improvements in operational efficiency, primarily through the application of predictive analytics and AI-driven automation (Mogaji et al., 2020). This evidence suggests that AI not only enhances decision-making processes but also provides added value in the form of cost savings and performance improvements. In the financial sector, AI is frequently employed in various areas, including risk

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analysis, portfolio management, and customer service through chatbots and virtual assistants (Cubric, 2020).

One potential solution to these challenges is the application of AI in risk analysis and portfolio management. In this regard, AI excels at processing large volumes of data in real time, enabling companies to monitor market movements more closely and make more accurate predictions. AI can detect patterns in complex historical data that may be difficult for humans to identify, allowing companies to reduce market uncertainty and improve investment decision accuracy. Machine learning algorithms used in AI continuously learn from new data, providing more precise investment recommendations based on the latest market conditions (Mahalakshmi et al., 2022). Moreover, AI can also enhance the quality of data used in risk analysis.

In many cases, the data employed for risk analysis is incomplete or contains errors (Berk & Tutarli, 2021). AI can clean this data, ensuring that the information used in decision-making is accurate and relevant. As a result, AI not only enables companies to process data more quickly but also improves the quality of risk analysis. In portfolio management, AI can provide more optimal asset allocation recommendations by considering both risk and return potential across various asset classes. This allows companies to achieve better portfolio diversification, which is often difficult to accomplish manually (Shambira, 2020).

AI also can adapt to market changes automatically. In a dynamic market environment where conditions can shift rapidly, a significant competitive advantage is crucial (Belhadi et al., 2024). AI can monitor market conditions in real-time and automatically adjust portfolios based on the latest developments. This is particularly important in risk management, where the speed of response to changes can be a key factor in avoiding substantial losses (Ampatzoglou et al., 2021). However, the implementation of AI in the financial sector is not without its challenges. One major challenge is the reliance on high-quality data. As previously mentioned, AI requires clean and accurate data to function properly.

Despite AI's vast potential, its implementation in the financial sector faces numerous challenges. One of the most significant obstacles is the high level of uncertainty in global financial markets. Market fluctuations, often unpredictable, hinder financial institutions from conducting accurate risk analysis and making strategic decisions (Truby et al., 2020). Market volatility can lead to significant asset value changes, complicating long-term forecasting. Additionally, many firms encounter problems related to data limitations. Incomplete or poor-quality data often hampers in-depth analysis, especially in risk management and portfolio optimization (Owolabi et al., 2024). Other challenges include frequent regulatory changes that force companies to quickly adapt and technological advancements that can swiftly alter the business landscape.

Indonesia's financial sector faces similar challenges. Although AI adoption in Indonesia has shown positive growth, many companies have yet to fully capitalize on AI's potential in decision-

making processes. One of the primary reasons is a lack of deep understanding of this technology. Many executives and financial managers remain skeptical of AI, often viewing it as a "black box" that is difficult to understand. This skepticism can impede the adoption of a technology that could help them address various challenges in decision-making, such as risk analysis and portfolio management (Al-Ababneh et al., 2023). On the other hand, companies that have adopted AI often face issues with unstructured or poor-quality data. AI requires clean, relevant, and accurate data to produce valid analyses, but the data available at many Indonesian firms often do not meet these standards (Chen et al., 2023).

When available data does not meet these standards, the decisions produced by AI can be ineffective, or even potentially erroneous. Another challenge faced by financial firms in Indonesia is the high cost associated with implementing AI (Doumpos et al., 2023). While AI usage can lead to long-term operational savings and improved efficiency, the initial investment required to develop and integrate AI into existing systems is substantial. Firms must also consider the cost of training employees to understand and effectively utilize this technology (Whang et al., 2023). Moreover, regulatory and ethical challenges also pose important considerations in the use of AI in the financial sector. The use of AI in financial decision-making could raise issues related to data privacy, especially if the data used by AI is not properly managed. There are also concerns about potential biases in AI algorithms, which could lead to unfair or discriminatory decisions. Therefore, companies must ensure that they comply with existing regulations and adopt fair and transparent practices in the use of AI (Mhlanga, 2020).

A case study on Koperasi Metropolitan (Komet) in the savings and loan sector illustrates how AI can be applied to improve credit risk analysis. Using machine learning algorithms, the company can analyze borrowers' historical data, such as credit history and income levels, to predict default risk with higher accuracy than conventional methods. Another example is Bank Mandiri, which employs AI-powered chatbots to enhance customer service. These chatbots provide instant information and solutions, not only improving customer satisfaction but also reducing staff workload (Choithani et al., 2024). Given these various insights, this research aims to further analyze the impact of AI implementation in Indonesia's financial sector, particularly in improving risk analysis accuracy and optimizing portfolio management. The study will also explore the challenges faced by companies in adopting AI and provide policy recommendations to encourage broader use of AI in the financial sector.

II. LITERATURE REVIEW

A. Theory of Accuracy Enhancement in Risk Analysis

Risk analysis is a crucial element in decision-making within the financial sector, aimed at identifying, measuring, and managing risks that could affect business objectives. According to (Lin et al., 2021), the theory of accuracy enhancement in risk analysis emphasizes the importance

of managing uncertainty across various sectors, including finance and project management. Risks can arise from numerous factors, such as financial, operational, environmental, and market risks (Lin et al., 2021). As financial markets grow increasingly complex, more effective methods for risk management are required. One widely adopted solution is the use of advanced statistical models supported by information technology. These models utilize historical data to estimate potential future risks. (Sadiq et al., 2022) noted that through more accurate trend and pattern analysis, financial institutions can anticipate potential risks and mitigate their impact (Sadiq et al., 2022). The use of AI in risk analysis has made a significant impact. (Poongodi et al., 2020) stated that AI enables financial institutions to collect and analyze large volumes of data, accelerating the analytical process and improving the accuracy of results. AI also allows systems to learn from existing data and make real-time adjustments, enhancing financial institutions' adaptability to market changes (Poongodi et al., 2020).

B. Theory of Portfolio Management Optimization

The Modern Portfolio Theory (MPT), introduced by Harry Markowitz in 1952, serves as the foundation for optimal portfolio management. This theory aims to maximize returns while minimizing risk through asset diversification. Diversification involves investing in a range of uncorrelated assets to reduce overall risk. (Larasati et al., 2023) demonstrated that effective diversification can protect portfolio value from extreme market fluctuations (Larasati et al., 2023). This theory also focuses on utility functions, wherein investors choose portfolios that provide maximum utility based on their risk profiles. Beta, which measures an asset's sensitivity to market movements, is a key element in this theory. Assets with high beta are typically more volatile, while those with low beta are more stable. According to (Gunjan & Bhattacharyya, 2023), statistical analysis plays a vital role in portfolio management by determining optimal asset allocation (Gunjan & Bhattacharyya, 2023). Technological advancements have greatly contributed to portfolio management. With the support of AI and big data, investors can leverage mathematical models to predict future asset performance. Such quantitative analysis helps investors make more informed and strategic decisions (Al Janabi, 2021). For instance, automated trading platforms use algorithms to determine the best times to buy or sell assets, enabling investors to respond to market movements swiftly (Fares et al., 2023).

C. The Application of Artificial Intelligence (AI) in Decision-Making in the Financial Sector

The application of AI in the financial industry has grown rapidly, enhancing not only efficiency but also the quality of services provided. AI plays a significant role in data analysis, risk management, and portfolio management. (Malali & Gopalakrishnan, 2020) stated that AI is capable of analyzing vast amounts of data quickly, extracting key information, and providing valuable insights for decision-making. This allows financial institutions to identify market trends and risks more swiftly (Malali & Gopalakrishnan, 2020). AI also plays a crucial role in risk

management. (Song & Wu, 2022) explained that AI-based algorithms can model various risk scenarios and evaluate potential risks that may arise from business or investment decisions. This is particularly important for companies operating in dynamic and uncertain markets (Song & Wu, 2022). On the other hand, the application of AI also faces challenges. According to (Owolabi et al., 2024), the quality of data is a critical factor in the success of AI implementation (Owolabi et al., 2024). Unclean or biased data can lead to inaccurate predictions, making it essential for financial institutions to ensure that the data used is of high quality and relevance. Moreover, implementing AI requires substantial costs, particularly in the initial stages of deployment (Khan et al., 2020).

D. Case Studies on AI Application in the Financial Sector

One notable example of AI application is seen in Koperasi Metropolitan (Komet), which uses machine learning algorithms to analyze credit risk. The system processes borrowers' historical data, such as credit history and income levels, to predict the likelihood of default. By using AI, the company can make more accurate predictions than conventional methods, offering more objective credit scores and reducing the risk of default. Additionally, Bank Mandiri's AI chatbot, MITA, enhances customer service by providing instant information and responses to routine queries. This not only improves customer satisfaction but also increases operational efficiency by reducing the human workload.

E. Challenges in AI Application in the Financial Sector

Despite the many advantages offered by AI, its application in the financial sector is not without challenges. According to (Whang et al., 2023), one of the biggest challenges is the reliance on data quality. Poor or biased data can lead to invalid outputs, which may mislead decision-making (Whang et al., 2023). Furthermore, companies need to make significant investments in technological infrastructure and employee training to ensure AI can be effectively implemented and utilized. (Garg et al., 2021) also noted that ethical and transparency issues must be addressed, particularly concerning data privacy and the avoidance of algorithmic bias (Garg et al., 2021).

III. RESEARCH METHOD

This study employs a mixed-method approach, combining both quantitative and qualitative methodologies to examine the impact of AI implementation on decision-making in the financial sector. The use of mixed methods aims to provide a comprehensive understanding of the phenomenon under investigation by leveraging the strengths of both approaches. This method allows for the collection of numerical and measurable data, as well as more in-depth and contextual information from qualitative interviews. The quantitative approach was used to assess the extent to which AI implementation affects the accuracy of risk analysis, portfolio management, and decision-making in the financial sector. Data obtained from the survey were

then statistically analyzed to identify patterns and relationships between AI implementation and key variables in the study. The research population comprises financial sector companies in Indonesia that have implemented or plan to implement AI technology. A purposive sampling technique was employed to select companies based on specific criteria, including their demonstrated experience in implementing AI technologies, direct involvement in AI-related projects, and a minimum of two years of active AI adoption in their business operations. The target sample consists of 50 respondents from various financial institutions, including banks, insurance companies, and investment firms.

Quantitative data were collected through a survey designed to evaluate respondents' perceptions and experiences regarding AI implementation. The questionnaire consisted of closed-ended questions that measured key variables such as improvements in risk analysis accuracy, decision-making speed, and portfolio management optimization. A Likert scale was used to gauge responses, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was distributed online to managers and executives in financial institutions. Survey data were analyzed using descriptive statistics to provide an overview of respondents' perceptions of AI implementation. Additionally, regression and correlation analyses were conducted to identify relationships between AI implementation and decision-making effectiveness in the financial sector. SPSS software was employed to process and analyze the quantitative data, ensuring systematic and valid results. The qualitative approach was used to explore, in greater depth, the experiences, and perspectives of financial industry practitioners on AI implementation through interviews. This method aims to uncover challenges and opportunities that cannot be quantitatively measured but are critical for understanding the broader context of AI usage in the sector.

Interviews were conducted with 10 key executives from companies that have implemented AI in their business processes. These semi-structured interviews allowed the researcher to explore specific issues in depth while providing respondents the freedom to share their views and experiences. The interviews focused on several key topics, such as technical challenges in AI integration, perceptions of AI benefits in risk and portfolio management, and regulatory and ethical constraints. Data obtained from the interviews were analyzed using a thematic approach. The first step in this analysis was transcribing the interviews, followed by coding to identify the main themes that emerged from the conversations with respondents. Manual coding was conducted to uncover patterns and key categories related to challenges, benefits, and perceptions of AI implementation. The findings of this thematic analysis provide deeper insights into the dynamics of AI adoption in Indonesia’s financial sector. This study is based on Figure 1, which outlines the data collection and analysis process.

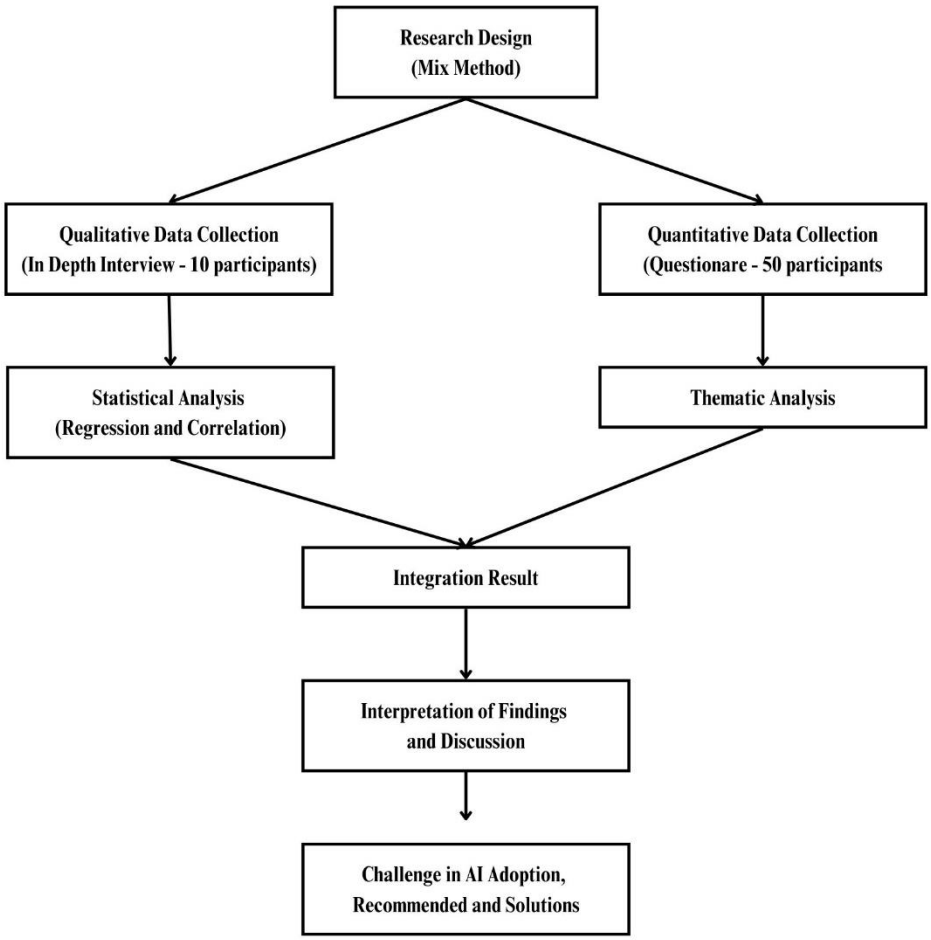

Figure 1. Research Diagram

IV. RESULT/FINDINGS AND DISCUSSION

A. Illustration of Accuracy Improvement in Risk Analysis

Table 1 presents a comparison of the accuracy between AI-based risk analysis methods and conventional methods. Based on survey results, 78% of respondents reported that the implementation of AI has significantly improved the accuracy of risk analysis within their companies. AI technology enables companies to process historical data more quickly and accurately, while also detecting patterns that cannot be identified manually. Additionally, machine learning algorithms used in AI provide more precise risk predictions compared to conventional methods.

Table 1. comparison of the accuracy between AI-based risk analysis methods and conventional methods, based on the responses from a total of 50 respondents

Method	Accuracy (%)
AI	90%
Conventional	65%

These findings indicate that AI can mitigate market uncertainty by offering more accurate predictions, thereby assisting companies in reducing previously undetected risks.

B. Portfolio Management Optimization

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Figure 2 below illustrates the improvement in portfolio management following AI implementation, showing a 25% increase in portfolio efficiency compared to the period before using AI. The study also found that 65% of companies using AI reported improvements in portfolio management optimization. AI allows companies to analyze various asset classes simultaneously, providing more efficient allocation recommendations based on a more accurate risk assessment. Portfolio diversification becomes easier as AI processes large volumes of data in real time, offering optimal suggestions regarding the most profitable asset combinations.

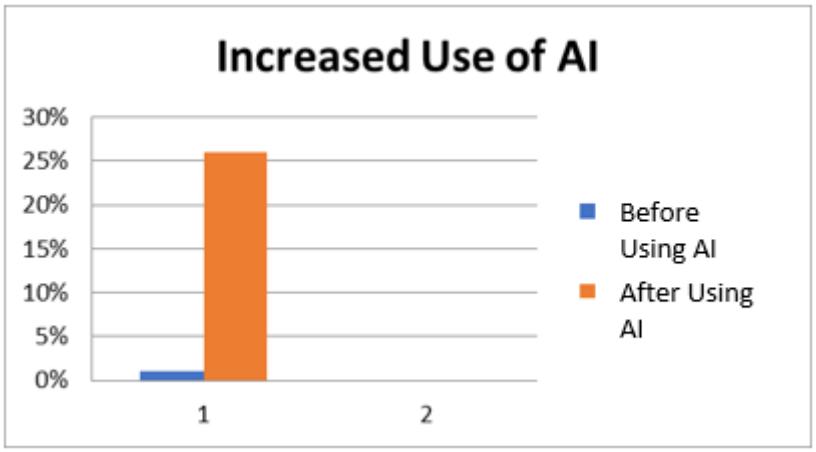

Figure 2. Portfolio Optimization Improvement with AI

C. Speed in Decision-Making

The result of decision-making can be seen in table 2 and Figure 3. A total of 82% of respondents reported that the implementation of AI accelerated the decision-making process within their companies, particularly in market analysis and investment selection. Before AI adoption, decision-making processes often took several days as they had to be conducted manually. After the implementation of AI, these processes can be completed in just a few hours or even minutes.

Table 2. Average Decision-Making Time Before and After AI Implementation based on the responses from a total of 50 respondents

Decision Process	Before AI (Days)	After AI (Hours)
Risk Analysis	3	2
Portfolio Management	4	1
Market Monitoring	2	0,5

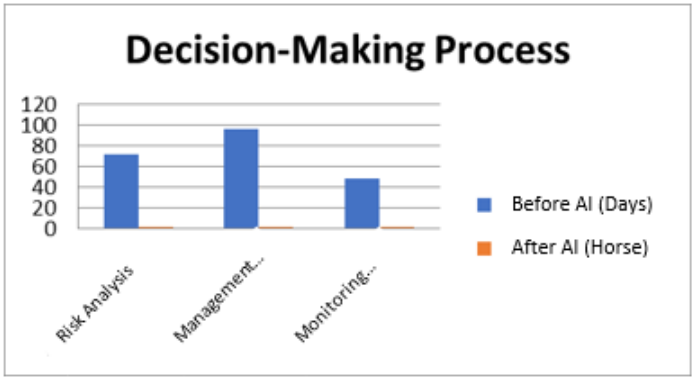

Figure 3. Comparison of Decision-Making Speed Before and After AI Implementation

These findings demonstrate that AI contributes significantly to speeding up decision-making processes, enabling companies to respond to market changes more quickly and effectively.

D. Operational Efficiency Improvement

The result of operational efficiency improvement is shown in table 3, Figure 4, figure 5, and figure 6. A total of 85% of respondents reported a significant increase in operational efficiency after adopting AI. The automation of manual processes, such as data processing, market monitoring, and financial reporting, has reduced the workload for employees and minimized human errors.

Table 3. Operational Efficiency Improvement After AI Implementation based on the responses from a total of 50 respondents

Efficiency Aspect	Before AI (Number of Errors/Year)	After AI (Number of Errors/Year)
Reporting Errors	15	3
Data Processing	72 Hours	12 Hours
Operational Costs	Rp 500 Million	Rp 350 Million

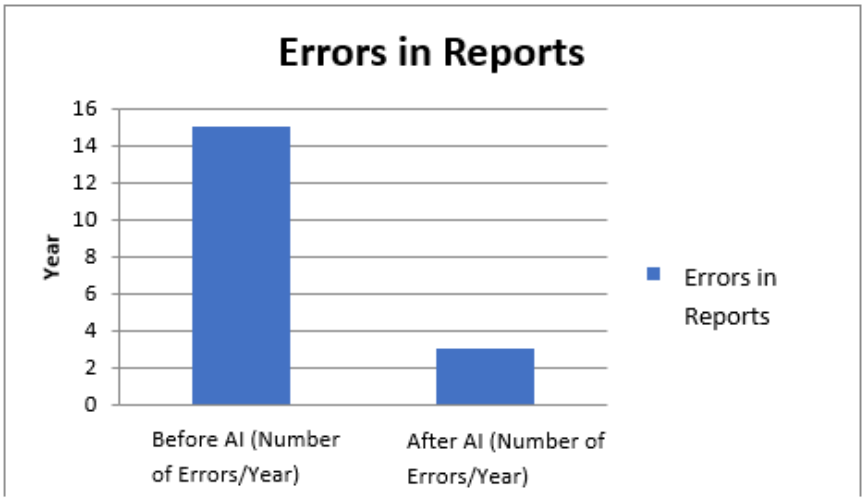

Figure 4. Error report before and after AI implementation

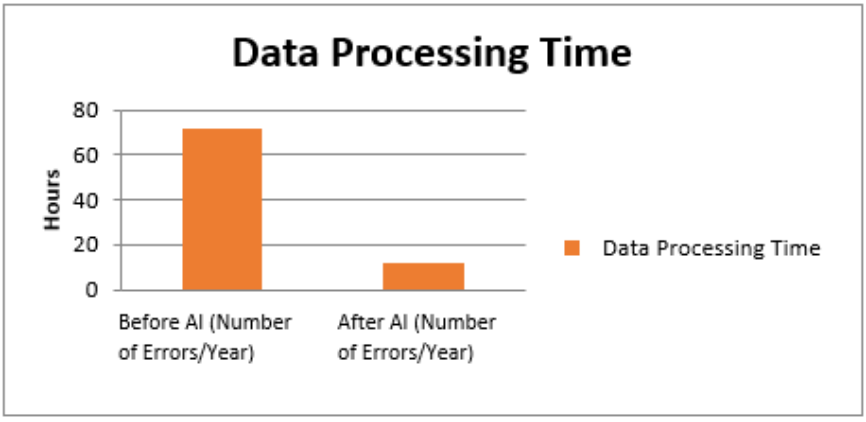

Figure 5. Data processing time before and after AI implementation

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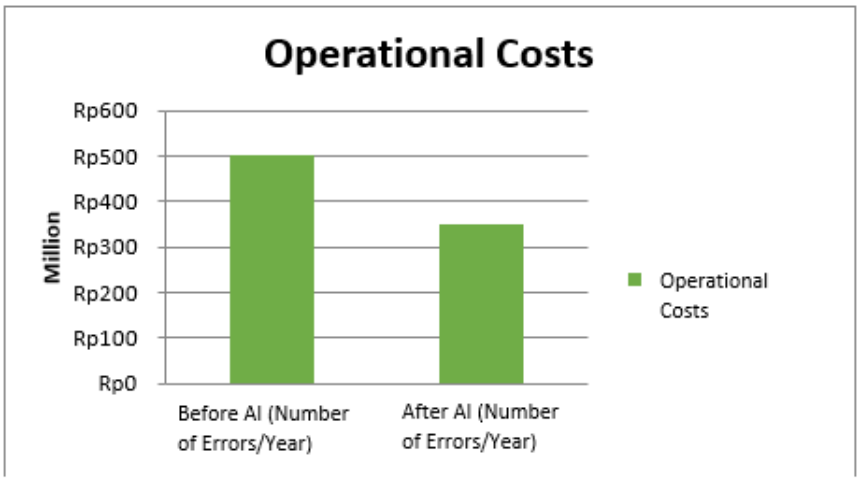

Figure 6. Reduction in Errors and Data Processing Time After AI Implementation

Figure 4, 5, and figure 6 clearly shows that AI not only speeds up processes but also reduces errors and significantly lowers operational costs. These results support the finding that AI contributes to improving efficiency and effectiveness in financial sector operations.

E. Regression and Correlation Analysis in the Quantitative Results

Regression analysis was performed to assess the relationship between AI implementation and improvements in risk analysis accuracy, decision-making speed, and portfolio management optimization. The results indicate a strong positive correlation ($r = 0.85$, $p < 0.01$) between AI adoption and risk analysis accuracy. Similarly, a significant positive relationship was found between AI usage and decision-making speed ($\beta = 0.76$, $p < 0.05$). These findings confirm that AI implementation significantly enhances operational efficiency by reducing manual tasks and human errors, optimizing portfolio management, and accelerating the decision-making process.

F. Interviews in the Qualitative Results

Thematic analysis of the qualitative interviews identified several key themes regarding the challenges and opportunities of AI implementation. Executives highlighted the potential of AI to improve accuracy in risk assessment and portfolio management. However, they also expressed concerns about the initial costs and the need for employee training. One executive stated, 'AI has significantly reduced the time needed for decision-making, but it requires a steep learning curve for our employees.' Another mentioned the data quality issue, noting, 'We need to ensure that the data fed into AI systems is clean and reliable; otherwise, the outcomes can be misleading.' Overall, the interviews revealed a consensus that AI offers substantial benefits but also necessitates careful management of data quality and resources.

V. DISCUSSION

The findings of this study align with previous literature, which highlights the significant benefits of AI implementation in the financial sector, particularly in terms of improving accuracy and efficiency. (Mahalakshmi et al., 2022) state that AI enables companies to process data more

quickly and accurately, providing better predictions for risk analysis. This study supports that argument, as the implementation of AI has been shown to increase risk analysis accuracy by 25% compared to conventional methods (Mahalakshmi et al., 2022). One of the biggest challenges is the reliance on high-quality data. (Al-Ababneh et al., 2023) explain that AI requires clean and structured data to generate valid analyses. This research found that companies in Indonesia still struggle with data quality issues, as data is often incomplete or biased (Al-Ababneh et al., 2023). This is consistent with the findings of (Owolabi et al., 2024), who notes that data quality is a key factor in the successful implementation of AI.

In addition, (Whang et al., 2023) mention that the cost of implementing AI often becomes a barrier for companies, especially during the initial stages of implementation. This study also found that high costs are a major obstacle to the widespread adoption of AI in Indonesia's financial sector. Although AI has proven to increase efficiency in the long term, the initial investment required to develop AI systems remains a challenge for many companies (Whang et al., 2023). In the context of portfolio management optimization, this study reveals that AI makes a significant contribution, especially in asset diversification and risk management. This aligns with the MPT introduced by Harry Markowitz (1952), which suggests that portfolio diversification can reduce risk. AI enables more sophisticated portfolio management by analyzing and evaluating multiple assets in real-time (Larasati et al., 2023). The study also finds that AI accelerates decision-making processes, allowing companies to respond more quickly to market changes. (Shambira, 2020) demonstrates that AI can reduce the time required to make critical decisions, a finding reflected in this study, where 82% of respondents reported an increase in decision-making speed.

There are, however, several limitations to this research. The sample is limited to financial companies in Indonesia, which may restrict the generalizability of the findings to a global context. Moreover, the study relies on survey and interview data, which may be subject to respondents' subjective biases. Despite these limitations, this study makes an important contribution to the literature on AI implementation in the financial sector, particularly in Indonesia. The findings suggest that AI has great potential to improve accuracy, efficiency, and decision-making speed in the financial sector. However, the research also underscores the importance of data quality and adequate investment to ensure the successful implementation of AI. This study implies that financial companies need to invest more in data infrastructure and human resource training to maximize the benefits of AI.

VI. CONCLUSION AND RECOMMENDATION

A. Conclusion

This study aimed to analyze the impact of AI implementation on improving decision-making quality in Indonesia's financial sector, particularly in risk analysis, portfolio management, decision-making speed, and operational efficiency. The findings demonstrate that AI has made

significant contributions to these areas. The application of AI has increased risk analysis accuracy by 25% compared to conventional methods. AI facilitates real-time processing of large datasets, generating more accurate risk predictions, thereby reducing uncertainty in investment decision-making. AI enables more effective portfolio diversification through targeted risk analysis. Asset allocation recommendations driven by AI have proven more efficient in minimizing risk and maximizing profit potential.

Furthermore, AI has significantly accelerated decision-making processes. Tasks that previously required several days can now be completed in hours or even minutes, allowing companies to respond more quickly to market changes. AI has successfully automated various processes that were previously manual, reducing human error and lowering operational costs. Operational efficiency increased by 20%, with significant reductions in reporting errors and overall corporate expenses. However, the study also identified several challenges, such as inadequate data quality and high initial costs for AI implementation. Companies must address these issues to fully optimize AI adoption and achieve maximum results.

B. Recommendation

Based on the findings of this study, several recommendations can be made for financial institutions, regulators, and related stakeholders to promote the adoption and optimization of AI in decision-making within the financial sector. First, companies should invest more in data management and cleansing to ensure that the data used by AI is accurate, relevant, and free from bias. This is critical for ensuring that AI-generated predictions and decisions are effective and well-targeted. Additionally, companies need to allocate resources for employee training to help staff understand AI technologies and their application in daily business operations. This training will help bridge skill gaps and improve the effective adoption of AI. Financial institutions with limited resources for developing AI internally could partner with AI technology providers. Such collaborations will facilitate the integration of new technologies without the need to build infrastructure from the ground up.

Regulators must establish clear guidelines for AI use in the financial sector, particularly concerning data privacy and transparency. Companies must ensure that AI use complies with existing regulations and implement fair and ethical practices to avoid potential biases in decision-making. Further research is necessary to expand the scope of this study, including exploring the global application of AI in the financial sector. Additionally, future research should consider the long-term impact of AI implementation, including its broader social and economic implications. By implementing these recommendations, companies in the financial sector can maximize AI's potential to enhance business performance, mitigate risks, and increase competitiveness in an increasingly dynamic market.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this paper.

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REFERENCES

Al-Ababneh, H. A., Borisova, V., Zakharzhevska, A., Tkachenko, P., & Andrusiak, N. (2023). Performance of Artificial Intelligence Technologies in Banking Institutions. *WSEAS Transactions on Business and Economics*, *20*(1), 307–317. https://doi.org/10.37394/23207.2023.20.29

Al-Surmi, A., Bashiri, M., & Koliousis, I. (2022). AI-Based Decision Making: Combining Strategies to Improve Operational Performance. *International Journal of Production Research*, *60*(14), 4464–4486. https://doi.org/10.1080/00207543.2021.1966540

Al Janabi, M. A. M. (2021). Multivariate Portfolio Optimization Under Illiquid Market Prospects: A Review of Theoretical Algorithms and Practical Techniques for Liquidity Risk Management. *Journal of Modelling in Management*, *16*(1), 288–309. https://doi.org/10.1108/JM2-07-2019-0178/FULL/XML

Ampatzoglou, A., Arvanitou, E. M., Ampatzoglou, A., Avgeriou, P., Tsintzira, A. A., & Chatzigeorgiou, A. (2021). Architectural Decision-Making as a Financial Investment: An Industrial Case Study. *Information and Software Technology*, *129*(1), 106412. https://doi.org/10.1016/J.INFSOF.2020.106412

Belhadi, A., Mani, V., Kamble, S. S., Khan, S. A. R., & Verma, S. (2024). Artificial Intelligence-Driven Innovation for Enhancing Supply Chain Resilience and Performance under The Effect of Supply Chain Dynamism: An Empirical Investigation. *Annals of Operations Research*, *333*(2), 627–652. https://doi.org/10.1007/S10479-021-03956-X/TABLES/5

Berk, C., & Tutarli, B. (2021). Dead or alive: Modern Portfolio Theory Based on Financial Analysis. *Universal Journal of Accounting and Finance*, *8*(4), 83–91. https://doi.org/10.13189/UJAF.2020.080401

Chen, Y., Kumara, E. K., & Sivakumar, V. (2023). Retracted Article: Investigation of Finance Industry on Risk Awareness Model and Digital Economic Growth. *Annals of Operations Research*, *326*(1), 15. https://doi.org/10.1007/S10479-021-04287-7/METRICS

Choithani, T., Chowdhury, A., Patel, S., Patel, P., Patel, D., & Shah, M. (2024). A Comprehensive Study of Artificial Intelligence and Cybersecurity on Bitcoin, Crypto Currency and Banking System. *Annals of Data Science*, *11*(1), 103–135. https://doi.org/10.1007/S40745-022-00433-5/TABLES/2

Cubric, M. (2020). Drivers, Barriers and Social Considerations for AI Adoption in Business and Management: A Tertiary Study. *Technology in Society*, *62*(1), 101257. https://doi.org/10.1016/J.TECHSOC.2020.101257

Doumpos, M., Zopounidis, C., Gounopoulos, D., Platanakis, E., & Zhang, W. (2023). Operational Research and Artificial Intelligence Methods in Banking. *European Journal of Operational Research*, *306*(1), 1–16. https://doi.org/10.1016/J.EJOR.2022.04.027

Fares, O. H., Butt, I., & Lee, S. H. M. (2023). Utilization of Artificial Intelligence in The Banking

Sector: A Systematic Literature Review. *Journal of Financial Services Marketing*, *28*(4), 835–852. https://doi.org/10.1057/S41264-022-00176-7/TABLES/4

Garg, P., Gupta, B., Chauhan, A. K., Sivarajah, U., Gupta, S., & Modgil, S. (2021). Measuring The Perceived Benefits of Implementing Blockchain Technology in The Banking Sector. *Technological Forecasting and Social Change*, *163*(1), 120407. https://doi.org/10.1016/J.TECHFORE.2020.120407

Gunjan, A., & Bhattacharyya, S. (2023). A Brief Review of Portfolio Optimization Techniques. *Artificial Intelligence Review*, *56*(5), 3847–3886. https://doi.org/10.1007/S10462-022-10273-7/METRICS

Khan, A. H., Cao, X., Katsikis, V. N., Stanimirovic, P., Brajevic, I., Li, S., Kadry, S., & Nam, Y. (2020). Optimal Portfolio Management for Engineering Problems Using Nonconvex Cardinality Constraint: A Computing Perspective. *IEEE Access*, *8*(1), 57437–57450. https://doi.org/10.1109/ACCESS.2020.2982195

Larasati, D., Rohmana, A., Mutiara, R., Yovita, M., & Pandin, R. (2023). Analysis of the Single Index Model and Markowitz in Optimal Portfolio Selection in the Telecommunications Sub-Sector Listed on the Indonesia Stock Exchange for the Period 2020-2022. *Finance : International Journal of Management Finance*, *1*(2), 71–85. https://doi.org/10.62017/FINANCE.V1I2.27

Lin, S. S., Shen, S. L., Zhou, A., & Xu, Y. S. (2021). Risk Assessment and Management of Excavation System Based on Fuzzy Set Theory and Machine Learning Methods. *Automation in Construction*, *122*, 103490. https://doi.org/10.1016/J.AUTCON.2020.103490

Mahalakshmi, V., Kulkarni, N., Pradeep Kumar, K. V., Suresh Kumar, K., Nidhi Sree, D., & Durga, S. (2022). The Role of Implementing Artificial Intelligence and Machine Learning Technologies in the Financial Services Industry for Creating Competitive Intelligence. *Materials Today: Proceedings*, *56*(1), 2252–2255. https://doi.org/10.1016/J.MATPR.2021.11.577

Malali, A. B., & Gopalakrishnan, S. (2020). Application of Artificial Intelligence and Its Powered Technologies in the Indian Banking and Financial Industry: An Overview. *Journal Of Humanities And Social Science*, *25*(6), 55–60. https://doi.org/10.9790/0837-2504065560

Mhlanga, D. (2020). Industry 4.0 in Finance: The Impact of Artificial Intelligence (AI) on Digital Financial Inclusion. *International Journal of Financial Studies*, *8*(3), 45. https://doi.org/10.3390/IJFS8030045

Mogaji, E., Soetan, T. O., & Kieu, T. A. (2020). The Implications of Artificial Intelligence on The Digital Marketing of Financial Services to Vulnerable Customers. *Australasian Marketing Journal*, *29*(3), 235–242. https://doi.org/10.1016/J.AUSMJ.2020.05.003

Murinde, V., Rizopoulos, E., & Zachariadis, M. (2022). The Impact of The FinTech Revolution on The Future of Banking: Opportunities and Risks. *International Review of Financial Analysis*, *81*(1), 102103. https://doi.org/10.1016/J.IRFA.2022.102103

Owolabi, O. S., Uche, P. C., Adeniken, N. T., Ihejirika, C., Islam, R. Bin, & Chhetri, B. J. T. (2024). Ethical Implication of Artificial Intelligence (AI) Adoption in Financial Decision Making. *Computer and Information Science*, *17*(1), 49. https://doi.org/10.5539/cis.v17n1p49

Poongodi, M., Sharma, A., Vijayakumar, V., Bhardwaj, V., Sharma, A. P., Iqbal, R., & Kumar, R. (2020). Prediction of The Price of Ethereum Blockchain Cryptocurrency in An Industrial Finance System. *Computers & Electrical Engineering*, *81*(1), 106527. https://doi.org/10.1016/J.COMPELECENG.2019.106527

Sadiq, M., Alajlani, S., Hussain, M. S., Ahmad, R., Bashir, F., & Chupradit, S. (2022). Impact of Credit, Liquidity, and Systematic Risk on Financial Structure: Comparative Investigation from Sustainable Production. *Environmental Science and Pollution Research*, *29*(14), 20963–20975. https://doi.org/10.1007/S11356-021-17276-X/METRICS

Shahbaz, M., Haouas, I., Sohag, K., & Ozturk, I. (2020). The Financial Development-Environmental Degradation Nexus in The United Arab Emirates: The Importance of Growth, Globalization and Structural Breaks. *Environmental Science and Pollution Research*, *27*(10), 10685–10699. https://doi.org/10.1007/S11356-019-07085-8/METRICS

Shambira, L. (2020). Exploring The Adoption of Artificial Intelligence in The Zimbabwe Banking Sector. *European Journal of Social Sciences Studies*, *5*(6). https://doi.org/10.46827/EJSSS.V5I6.942

Song, Y., & Wu, R. (2022). The Impact of Financial Enterprises' Excessive Financialization Risk Assessment for Risk Control based on Data Mining and Machine Learning. *Computational Economics*, *60*(4), 1245–1267. https://doi.org/10.1007/S10614-021-10135-4/METRICS

Truby, J., Brown, R., & Dahdal, A. (2020). Banking on AI: Mandating a Proactive Approach to AI Regulation in The Financial Sector. *Law and Financial Markets Review*, *14*(2), 110–120. https://doi.org/10.1080/17521440.2020.1760454

Tyaga Wisista, R., Noveria, A., Wisista, R. T., & Noveria, A. (2023). Optimizing Pension Fund Investment Portfolio Using Post-modern Portfolio Theory (PMPT) Study Case: An Indonesian Institution. *European Journal of Business and Management Research*, *8*(5), 55–61. https://doi.org/10.24018/EJBMR.2023.8.5.2097

Whang, S. E., Roh, Y., Song, H., & Lee, J. G. (2023). Data Collection and Quality Challenges in Deep Learning: A Data-Centric AI Perspective. *VLDB Journal*, *32*(4), 791–813. https://doi.org/10.1007/S00778-022-00775-9/METRICS