

INTEGRATING AHP IN BIG DATA RISK MANAGEMENT FOR FINANCIAL INSTITUTIONS: A SYSTEMATIC APPROACH

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Abstract

The big data revolution has reshaped risk management paradigms in the financial sector while introducing complex, dynamic, and multidimensional risk challenges. This study regularly examines the integration of the Analytic Hierarchy Process (AHP) into big data risk management for financial institutions through a Systematic Literature Review (SLR) using the PRISMA protocol, covering publications from the past decade. Findings indicate that AHP—in both classical and modified forms such as Fuzzy AHP and AHP-DEA—effectively structures hierarchical risk frameworks that integrate quantitative criteria (probability, financial impact) and qualitative aspects (reputation, compliance). Big data integration enriches the weighting process with real-time data from internal sources, markets, and public sentiment, thereby reducing subjective bias and enhancing decision reliability. This approach enables adaptive risk prioritization in response to market and regulatory changes, overcoming the limitations of static AHP models and supporting more holistic, measurable risk mitigation. The results underscore that the AHP–big data framework offers financial institutions a competitive advantage through rapid, evidence-based, objective, and sustainability-oriented decision-making.

Keywords: *AHP, big data, risk management, financial institutions, decision-making*

1. INTRODUCTION

The digital revolution has radically changed the operational and strategic landscape in the financial sector, characterized by an exponential explosion of data in terms of volume, velocity, variety, veracity, and value (5Vs of Big Data). (Testoni et al., 2024) (Testoni et al., 2024). Increased connectivity, the digitization of financial services, the use of mobile devices, the Internet of Things (IoT), and online transactions have created an unprecedented surge in data. According to a report by the International Data Corporation (IDC), the total global data volume is expected to reach over 175 zettabytes by 2025, a dramatic increase from 33 zettabytes in 2018. (Maulida & Uula, 2024) (Maulida & Uula, 2024) In the financial sector, data comes not only from financial transactions, but also from customers' digital footprints, social media, sensors, software logs, and customer interactions across various communication channels. (Syamsuddin & Hwang, 2009) (Syamsuddin & Hwang, 2009) Velocity is a critical dimension, as data must be processed in real time to support instant decision-making, such as in fraud detection or stock trading algorithms. Variety is evident in data types, including structured data (such as transaction data and financial reports) and unstructured data (such as call center audio, customer review text, and customer interaction videos).

Validity, or veracity, is a major challenge, as data quality significantly impacts analytical outcomes, particularly in predictive models and machine learning. Value is key, as competitive advantage and efficiency can only be achieved if institutions are able to extract insights from the data. (Millatina et al., 2022) In other words, big data in the financial sector implies not only “big” in size, but also “big” in the complexity of its management, which involves fast, secure, and intelligent data communication systems. (Sudipa, Kharisma, et al., 2023). Financial institutions such as banks, insurance companies, and investment institutions are increasingly proactive in adopting big data technology to strengthen their strategic functions, starting from risk management. (Budiman et al., 2020), decision-making, and product innovation. Major banks have developed real-time analytics systems to understand customer behavior based on transaction patterns, location, usage time, and digital interactions to create personalized offers. In the insurance industry, big data technology is being used to conduct lifestyle-based risk profiling derived from wearable device data, resulting in more accurate premium determination. (Jamaludin et al., 2022) Meanwhile, investment companies

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are using big data algorithms to automatically manage portfolios based on market sentiment derived from social media, news, and real-time microeconomic data. Furthermore, fraud detection has undergone a major transformation, with financial institutions now using machine learning and pattern recognition to detect transaction anomalies and suspicious behavior within seconds, replacing conventional, reactive and inefficient systems. Operationally, big data helps optimize efficiency by automating back-office processes, increasing service speed, and reducing costs through predictive maintenance of IT systems. This adoption also drives the development of new products based on dynamic market needs, where data is used to identify gaps in people's unmet financial needs. Overall, big data technology is a strategic asset that is shifting the paradigm of financial communications and services from a reactive approach to a predictive and adaptive one. (Sudipa, Ariantini, et al., 2023).

Big data opens up enormous strategic opportunities for financial institutions to build sustainable competitive advantage amidst increasingly intense industry competition. By implementing advanced analytics based on big data, financial institutions can make data-driven decisions that are much more accurate and faster, reducing reliance on intuition or traditional managerial practices. Personalization at scale becomes possible, where services can be tailored to individual customer preferences in real time, significantly increasing customer loyalty and satisfaction. For example, digital banking platforms can suggest savings or investment products based on a user's historical behavior and financial aspirations. (Machdi et al., 2023). Furthermore, predictions of credit and liquidity risks can be made more precisely, enabling institutions to take preventative action against potential losses. Another advantage is the ability to detect market opportunities earlier through sentiment analytics, allowing for more timely launches of new products and services. (Fajri, 2023) The integration of big data with artificial intelligence also enhances customer service automation through intelligent chatbots capable of handling hundreds of requests simultaneously, increasing efficiency without sacrificing service quality. In corporate communications, big data supports public perception mapping, reputation crisis mitigation, and more proactive stakeholder management. Therefore, big data is not only a technological asset but also a strategic pillar in guiding the business and communications direction of modern financial organizations.

While big data offers numerous strategic benefits, its implementation in financial institutions also carries a number of specific risks that are complex and multidimensional. One major risk is privacy and data privacy breaches, where financial institutions become easy targets for cyberattacks due to the large volumes of sensitive data they store. This risk is exacerbated by reliance on third-party providers, such as cloud providers and analytics vendors, which increases system vulnerabilities. The second risk is data quality risk, which arises when the data used in analytics is inaccurate, outdated, or biased, which can lead to incorrect and misleading decisions. Third, regulatory and compliance risk, where the use of big data is subject to strict regulations such as the GDPR, Indonesia's Data Protection and Transactions Law, and various OJK regulations. Violations of these regulations can result not only in financial penalties but also in severe reputational damage. The fourth risk is ethical risk, where overly intrusive use of big data can cross ethical boundaries in monitoring customer behavior. The fifth risk is technological and systemic risk, which relates to algorithm failures, overfitting in machine learning models, or infrastructure disruptions that lead to incorrect automated decisions. One concrete example of this risk occurred in the Equifax case (USA, 2017), where the personal data of 147 million people was leaked due to negligence in big data system management, resulting in financial losses and a loss of public trust. In Indonesia, the cases of e-commerce and illegal online lending data leaks in 2021–2023 illustrate that weak data protection and governance systems can pose massive risks that not only impact consumers but also undermine the credibility of national financial institutions. Therefore, big data risk management needs to be fully integrated into the governance of financial institutions, not only as the responsibility of the IT division, but as part of the corporate strategy and proactive risk communication. (Hubeis, 2022).

Failure to manage big data risks in financial institutions has serious multidimensional consequences, ranging from significant financial implications to long-term impacts on the institution's sustainability. Financially, losses can occur in the form of data breaches, analytics-based fraud, or predictive system failures that lead to incorrect investment or lending decisions, ultimately impacting the institution's balance sheet. Furthermore, reputational damage resulting from security incidents or data misuse is systemic and difficult to repair, as public trust is crucial in the financial industry. When an institution's credibility is compromised, customers tend to withdraw their funds, reduce engagement, or even switch to competitors. Furthermore, failure to manage data ethically and in accordance with regulations can invite legal sanctions from supervisory authorities such as the Financial Services Authority (OJK), Bank Indonesia, or even international bodies, which can include not only administrative fines but also operational restrictions. At critical junctures, the loss of customer trust is the most devastating consequence, as it touches on the emotional and relational aspects that have been built over years, and this loss often cannot be compensated for with technological or financial solutions alone. Therefore, big data risk management is not only a technical issue, but also concerns the institutional sustainability and social legitimacy of financial institutions in the

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eyes of the public. (Halim et al., 2025). Traditional risk management frameworks, historically designed to address structured data and relatively stable business environments, are now irrelevant when faced with the highly dynamic, unstructured, and multidimensional challenges of big data. While traditional risk frameworks such as COSO or ISO 31000 provide a conceptual foundation for risk identification, analysis, and mitigation, their underlying assumptions are system stability, linear causal relationships, and relatively high predictability—characteristics that are at odds with the realities of big data. Big data encompasses not only large volumes of information, but also data that is fast-moving (velocity), diverse (variety), uncertain (veracity), and has contextual and changing value. These characteristics make traditional frameworks too slow, rigid, and incapable of early detection of risk patterns hidden in semi-structured or unstructured data such as text, images, and video. Furthermore, the complexity of relationships between variables in the big data ecosystem is often non-linear and adaptive, demanding a risk management approach that can accommodate real-time dynamics, respond flexibly, and integrate with advanced analytics technologies. Therefore, a methodological and epistemological reorientation is needed in big data risk management that is not only based on deterministic logic, but also accommodates the uncertainty, complexity, and emergent nature of continuously evolving digital systems. (Gibrana, 2020).

Analytic Hierarchy Process (AHP) is a multi-criteria decision-making (MCDM) method developed by Thomas L. Saaty in 1980, designed to simplify the complexity of the decision-making process by decomposing problems into a hierarchy. This approach allows decision-makers to break down large, complex problems into smaller, structured elements, such as objectives, criteria, sub-criteria, and alternatives, which are then analyzed using pairwise comparisons. The advantage of AHP lies in its ability to accommodate subjective judgments of decision-makers through a calibrated numerical preference scale, while maintaining a level of logical consistency in those judgments. AHP not only integrates quantitative and qualitative data harmoniously but also provides a consistency testing mechanism (consistency ratio) to validate subjective rationality in decision-making. This uniqueness makes AHP a powerful tool in dealing with ambiguous, complex problems that require multidimensional considerations—including in the context of big data risk management in financial institutions, where decisions depend not only on statistical data but also on the intuition, experience, and qualitative judgments of stakeholders.

AHP is highly relevant and suitable for application in the context of big data risk management due to its unique ability to bridge the gap between technical complexity and strategic subjectivity in the decision-making process. In the big data ecosystem, risks stem not only from technological aspects such as cybersecurity or data integrity, but also from organizational factors, legal compliance, and complexly interconnected social expectations. AHP provides a systematic approach that captures this complexity through a flexible hierarchical structure, where various risk dimensions—both quantitative, such as probability and impact, and qualitative, such as reputation and stakeholder trust—can be analyzed holistically. Furthermore, AHP enables the integration of multiple sources of knowledge, including expert intuition, historical data, and organizational values, all of which are crucial in the high uncertainty inherent in big data. In practice, AHP can be used to identify and prioritize key risks faced by financial institutions in using big data, assign importance to each risk criterion, and systematically and transparently evaluate the effectiveness of various mitigation strategies. Thus, AHP is not only an analytical tool, but also a deliberative mechanism that supports adaptive, collaborative risk governance based on a deep understanding of context. This makes AHP a very strategic approach and compatible with the needs of big data risk management in the volatile digital economy era.

The results of previous research by (Bi et al., 2025) shows that the integration of AHP (Analytic Hierarchy Process) into Big Data risk management in financial institutions begins with building a risk hierarchy consisting of the main objective (Big Data risk management), assessment criteria (e.g., security risks, data quality, fraud detection speed), and alternative mitigation strategies (such as implementing real-time analytics, implementing encryption, or strengthening data literacy). The AHP method allows communication-based decision-makers to conduct pairwise comparisons between elements, thereby calculating the relative weight of each criterion and ensuring consistency of measurement logic (ratio consistency) in assessing the complex hierarchy of Big Data risks. In addition, the results of research that has been conducted by Ningsih et al (2024) The AHP process is integrated into the Big Data risk management framework through the following stages: risk criteria formulation, internal and external data collection, weighting assessment through pairwise comparisons between criteria, and synthesis of risk prioritization results. Scientific communication plays a role at each stage: from the criteria formulation phase (involving risk domain experts and data engineers) to the feedback phase of modeling results to policymakers. This ensures that the AHP criteria weighting is not only based on statistical logic, but also takes into account the business narrative and strategic significance of the risk. Apart from the two studies above, research has also been conducted by Du et al (2025) which concludes that the integration of Big Data in financial risk assessment enables early detection of potential customer defaults through various data sources. By integrating AHP, banks can establish critical weights for various types of

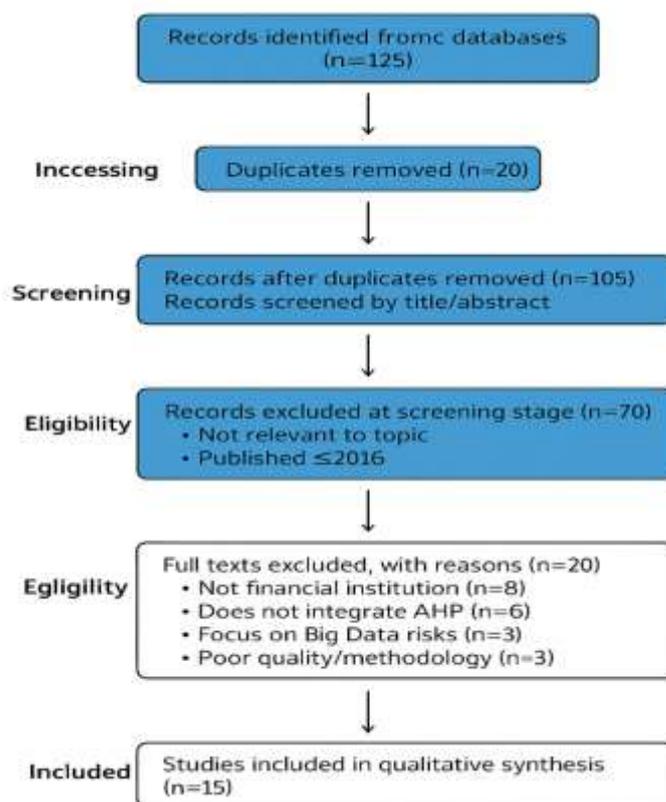
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risks (default, fraud, market, operational) and select appropriate mitigation strategies based on the priority of these weights, improving the accuracy of resource allocation for mitigation. related, with a more in-depth discussion. Although the literature on risk management, big data, and the application of the Analytical Hierarchy Process (AHP) method has grown significantly in recent years, there is a significant gap in previous research, particularly regarding the integration of the AHP method in the context of big data risk management in the financial sector. Many previous studies still discuss these aspects separately and have not comprehensively integrated the three within a single conceptual framework or systematic application. Based on the above explanation, the researcher is interested in conducting research on "AHP integration in big data risk management in financial institutions: A systematic approach". The problem formulation in this research is (1) How to integrate the Analytic Hierarchy Process (AHP) method with a big data approach to systematically identify, evaluate, and prioritize risks in financial institutions? (2) How can the application of a systematic framework based on AHP and big data improve the accuracy, objectivity, and effectiveness of decision-making in risk management of financial institutions compared to conventional approaches?

2. METHODS

This study uses a Systematic Literature Review (SLR) research design to examine the integration of the Analytical Hierarchy Process (AHP) method in big data risk management in financial institutions. The data sources used come from scientific articles published in local and international journals over the past ten years. The data collection technique was carried out through a systematic filtering process using the PRISMA protocol, with search keywords adjusted based on the topic focus such as "AHP", "risk management", "big data", and "financial institutions". The analyzed dataset includes publications that meet predetermined inclusion and exclusion criteria, including topic relevance, the AHP method used, and contributions to big data-based risk management. The data analysis technique was carried out qualitatively with a thematic approach to identify research trends, literature gaps, and the potential for AHP integration in big data-based strategic decision making in the financial sector. The following is a prism image showing the number of journals used in the research after screening:



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3. RESULTS AND DISCUSSION

The following are several journals containing findings from research related to the research topic.

No.	Title & Author	Research purposes	Research methods	Key Findings	Theoretical & Practical Implications
1	(Testoni et al., 2024)- AHP for 3PL Prioritization in Banking	Develop procedures to evaluate and prioritize the performance of third-party logistics (3PL) providers in banking services based on SCOR metrics.	Analytic Hierarchy Process (AHP); a multi-criteria approach based on SCOR (agility, responsiveness, reliability).	AHP successfully prioritized key performance indicators for 3PLs. The model demonstrated reliability in evaluating financial logistics performance.	Contribution to the literature regarding the application of AHP for third-party performance evaluation in the financial sector, expanding the practice of quantitative decision-based supply chain management.
2	(Maulida & Uula, 2024)- Bibliometric Review of AHP in Banking	Analyzing global research developments related to AHP in the banking sector through a bibliometric approach.	Bibliometric study with keyword mapping; 207 Scopus articles.	Six main clusters were identified, including strategy, efficiency, and evaluation of the banking sector.	Provides direction for future research related to AHP and banking, proposes a research agenda based on thematic intellectual maps.
3	(Risonarta & Kamila, 2022)- AHP for Supply Chain Risk Analysis	Examining the application of AHP in supply chain risk analysis and management amidst global uncertainty.	Literature study with the development of a new AHP structure for risk impact ordering.	AHP has proven to be flexible, allowing for multi-criteria and subjective risk assessment for supply chain resilience.	Provides a new conceptual structure for integrating AHP in resilience-based risk management systems.
4	(Cerchiello & Giudici, 2016)- Big Data for Financial Risk	Developing a systemic risk model that combines financial and social media data (financial tweets).	Big data-based Bayesian model (market & social media).	The combination of market data and tweets results in more accurate modeling of interdependencies between financial institutions.	Offers a new systemic approach to big data-based financial risk management that can be integrated within the AHP framework.
5	(Hong & Qu, 2024)- AHP-DEA for Cross-Banking Risk	Assessing interbank operational risk using the integrative AHP and DEA models.	AHP-DEA (replacing pairwise AHP with DEA for criteria weights).	The AHP-DEA method is simple yet effective for cross-bank operational risk assessment, overcoming the limitations of traditional AHP.	Relevant for the development of an integrated risk evaluation system across banking institutions.
6	(Liu & Wang, 2020)- AHP for Big Data Audit Risk	Building a big data-based audit risk evaluation system for	AHP + expert rating approach (audit risk evaluation).	AHP is able to assess and quantify audit risk weights in big data environments	Provides methodological guidance for auditors in

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		complex operational conditions.		fairly and objectively.	identifying new audit risks in the big data era.
7	(Styoutomo & Ruldeviyani, 2023)- Fuzzy AHP for Information Security	Develop a strategy to increase information security awareness at XYZ financial institution.	Fuzzy AHP + HAIS-Q + ISO/IEC 27001:2013 + FGD.	Many employees don't understand the basics of information security. The awareness score is only 78.8% (moderate).	Providing information security education strategy modeling based on Fuzzy AHP in public financial institutions.
8	(Jung et al., 2022)- Big Data for Portfolio Risk	Developing a big data-based dynamic risk portfolio model to address missing information.	Big data models for portfolio risk measurement.	Big data can improve the accuracy of measuring the risk of small portfolios that are difficult to analyze with traditional approaches.	Introducing a new paradigm in risk modeling that can be collaborated with the AHP method for managerial decision making.
9	(Du et al., 2025)- Big Data Financial Risk Survey	Developing a systematic survey of corporate financial risk analysis approaches from a big data perspective.	Literature survey of 250+ articles (1968–2023).	Classified by risk type, evaluation metrics, and the latest AI/Big Data trends.	This study serves as a primary reference for researchers to develop a comprehensive big data-based risk analysis system.
10	(Peng et al., 2022)- Big Data Risk Prediction for Banks	Developing a bank financial risk prediction model with big data and machine learning techniques.	Lasso + linear regression + IG + BoW + ensemble model.	The model is able to predict bank risks efficiently and accurately in a short time.	Potential to be integrated with AHP in order to make systematic and data-driven risk mitigation decisions.
11	(Ristanović et al., 2021)- AHP for Operational Risk	Develop a decision-making system in selecting operational risk management methods.	Classic AHP for comparing criteria and alternatives.	External factors become dominant especially during financial crises or pandemics.	Demonstrates the effectiveness of AHP in structuring operational risk decision making in banking.
12	(Najem et al., 2025)- AI and Big Data in E-Finance	Conducting a comprehensive survey of the use of AI, big data, text mining, and cloud in digital financial services.	Bibliometric analysis (Google Scholar & Scopus 2013–2025).	E-finance has been proven to improve efficiency, risk prediction, and fraud detection.	Reinforcing the importance of technology integration in risk mitigation and modern financial decision making.
13	(Zhang et al., 2021)- CORPORATE FINANCIAL RISK	This study explores the impact of big data on corporate financial risk assessment by	This study applies fuzzy set theory and the Fuzzy Analytic Hierarchy Process (F-AHP) with fuzzy	The empirical analysis results show that the use of big data indicators improves the accuracy of the	Implementing appropriate risk management strategies can increase financial institutions'

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	<p>ASSESSMENT AND ROLE OF BIG DATA; NEW PERSPECTIVE USING FUZZY ANALYTIC HIERARCHY PROCESS</p>	<p>integrating big data-based public opinion indicators into traditional risk assessment indices to improve the accuracy and effectiveness of evaluation.</p>	<p>triangular and trapezoidal numbers to calculate weights using a pairwise comparison matrix. This approach integrates big data-based public opinion indicators into traditional financial risk assessment models, using the logarithmic least squares method to obtain fuzzy weights and scores, and mentions Chang's method as a simpler alternative.</p>	<p>assessment compared to conventional models, by addressing the limitations of the initial model. The non-fuzzy matrix used displays the standardized weights and ratios between criteria (D1–D5), which reveal the hierarchy of the relative importance of each criterion, where a ratio value >1.00 indicates an above-average contribution.</p>	<p>resilience and responsiveness to new risks, including by leveraging technologies like AI and machine learning to mitigate potential threats. Operational risks, while often not directly impacting financial indicators, can cause significant losses indirectly due to internal and external factors. The "three lines of defense" approach provides an effective framework for managing these risks, with an emphasis on controlling external factors, managing human resources, and improving system processes.</p>
<p>14</p>	<p>(Li, 2025)- Application of Big Data in Bank Loan Risk Early Warning and Prediction</p>	<p>This research aims to explore the application of big data in bank loan risk management, specifically in early warning and risk prediction systems. The goal is to demonstrate how big data can improve the way financial organizations operate and mitigate risk, as well as improve efficiency and decision-making in addressing potential risks such as loan</p>	<p>The methods used are literature analysis and case studies, in which the author discusses the advantages and disadvantages of big data by comparing various relevant scenarios and examples.</p>	<p>This study found that big data has improved bank loan risk management by enabling the development of predictive models, risk detection systems, and comprehensive risk monitoring. This significantly improves efficiency and decision-making, enabling banks to identify potential risks such as loan defaults or unpaid applications early and take preventative action. Big data also supports</p>	<p>The theoretical implication is that big data shifts the risk management paradigm from reactive to proactive, emphasizing the importance of a robust data governance framework and ethical data use. Practically, banks are encouraging investment in addressable infrastructure (such as cloud computing), adopting advanced analytics, and developing ethical</p>

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		defaults or early loan applications.		personalization of financial products and operational efficiency. However, these big data applications are not without challenges, including privacy and regulatory issues, technical scalability challenges due to the large volume, velocity, and variety of data, and the potential for algorithmic bias in machine learning models.	guidelines to ensure the responsible and effective use of big data in risk mitigation and customer service improvement.
15	(Ristanovic, 2023)- Application of Multi-Criteria Assessment in Banking Risk Management	This study aims to develop a comprehensive decision-making system in selecting operational risk management methods in banking, by utilizing the Analytical Hierarchical Process (AHP) to identify and evaluate relevant criteria and alternatives systematically and objectively.	This study uses the Analytical Hierarchical Process (AHP) method as the main framework for multi-criteria analysis. AHP is applied in three main steps: the formation of a hierarchical structure of the problem, pairwise comparisons between elements (criteria and alternatives), and priority synthesis to determine the optimal solution in operational risk management.	The results of this study definitively demonstrate that external factors are the most significant criteria in banking operational risk management, especially during periods of financial crisis. Therefore, the most effective solution is to adopt international standards and develop the bank's own internal tools to proactively identify, mitigate, and eliminate operational risks. This approach confirms that the AHP (Analytic Hierarchy Process) model is a valid tool for multi-criteria decision-making in the context of operational risk management.	Theoretically, this study strengthens the validity of the AHP model as a powerful framework for multi-criteria decision making in operational risk management, particularly in identifying the dominance of "External Factors" during the financial crisis. . Practically, this theme states that banking institutions must prioritize adapting to international standards and developing sophisticated internal tools to proactively manage operational risks, beyond simply using regulatory frameworks, to improve competitiveness and performance.

Discussion

Integration of the Analytic Hierarchy Process (AHP) method with a big data approach to identify, evaluate, and prioritize risks in financial institutions

The integration of the Analytic Hierarchy Process (AHP) method with a big data approach provides a systematic framework for more objectively identifying and prioritizing risks in financial institutions. Based on findings (Liu & Wang, 2020; Zhang et al., 2021), AHP is able to structure financial risk criteria, both operational and strategic, into a clear hierarchical model. Meanwhile, big data enriches the model by incorporating variables sourced from market data, internal institutional data, and non-traditional indicators such as public opinion and social media sentiment. The combination of the two enables risk identification not only from a historical perspective but also from current trends detected in real time. From a risk evaluation perspective, big data provides quantitative and qualitative information that can be processed by the AHP model to generate more accurate criteria weights. Research (Cerchiello & Giudici, 2016; Peng et al., 2022) shows that integrating market data with unstructured data, such as text from social media, can reveal patterns of interdependence between financial institutions that are not visible in traditional risk evaluation methods. With AHP, these patterns can then be converted into measurable risk priorities, helping decision-makers effectively determine mitigation focus.

Furthermore, big data supports the AHP modeling stage by improving the quality of input for pairwise comparisons. For example, in Zhang et al.'s (2021) study using Fuzzy AHP, big data indicators helped minimize subjective bias in expert judgment. This is particularly relevant in the financial sector, where human bias can significantly impact investment decisions and risk mitigation. By leveraging big data, the criteria weighting process becomes more evidence-based, ultimately improving the reliability of risk prioritization results. The use of big data in AHP integration also enables adaptive risk management to rapidly changing market dynamics. Studies (Jung et al., 2022; Li, 2025) show that systems combining AHP and big data can periodically update risk weights according to changes in economic, political, or technological variables. This approach overcomes the limitations of static AHP models, which generally only reflect conditions at the time of the assessment, enabling them to adapt to the volatility of the global business environment. Overall, the integration of AHP and big data forms an approach that not only comprehensively identifies and evaluates risks but also prioritizes them based on their significance and urgency for mitigation. Supported by massive data and structured AHP algorithms, financial institutions can manage risks more proactively, anticipate potential crises before they escalate, and ensure long-term performance sustainability.

The application of a systematic framework based on AHP and big data can improve the accuracy, objectivity, and effectiveness of decision-making in financial institution risk management compared to conventional approaches.

A systematic framework based on AHP and big data has been proven to improve decision-making accuracy in risk management, as demonstrated by research (Hong & Qu, 2024; Peng et al., 2022). In the context of financial institutions, accuracy is highly dependent on data quality and clarity of risk measurement methods. Big data provides a broad and diverse information base, while AHP facilitates the process of organizing and weighting this data into measurable decision parameters. This combination reduces the potential for prediction errors that often occur with conventional approaches that rely solely on historical data or managerial intuition. Decision objectivity is also enhanced through the implementation of this framework because the criteria weighting process in the AHP can be balanced with quantitative indicators from big data. Studies (Liu & Wang, 2020; Zhang et al., 2021) show that by integrating market data, operational indicators, and public sentiment, subjective bias in expert judgment can be minimized. This process results in more transparent decisions, where each risk priority has a verifiable measurement basis, unlike conventional approaches that tend to rely on opinions or assumptions.

The effectiveness of decision-making is also influenced by the system's ability to respond quickly to changing conditions. Research (Li, 2025; Najem et al., 2025) highlights that big data enables real-time updates of risk parameters, while AHP provides a mechanism for rapidly adjusting priority weights. This allows financial institutions to respond to market fluctuations or regulatory changes without waiting for the annual assessment cycle, a common drawback of traditional methods. Conventional approaches to risk management are often siloed, with each work unit assessing risks based on its own internal criteria without an integrative framework. In contrast, applying AHP with big data allows for the consolidation of all information sources into a single, structured evaluation model. Studies (Ristanović, 2023; Risonarta & Kamila, 2022) confirm that the hierarchical structure of AHP facilitates cross-functional data integration, resulting in holistic and non-overlapping mitigation strategies. Thus, implementing a systematic framework based on AHP and big data provides a significant competitive advantage for financial institutions. This model not only enhances the accuracy and objectivity of decisions but also increases effectiveness

through speed of response and inter-unit coordination. This makes AHP-big data a relevant approach in an era of high volatility, where the timeliness and quality of information are critical factors in successful risk management.

4. CONCLUSION

Based on the research results, the integration of the Analytic Hierarchy Process (AHP) method with a big data approach in financial institution risk management has been proven to provide a systematic, adaptive, and evidence-based framework for identifying, evaluating, and prioritizing risks objectively and accurately. AHP plays a role in structuring financial risk criteria, both operational and strategic, into a clear hierarchical model, while big data enriches this process by incorporating variables from market data, internal data, and non-traditional indicators such as public sentiment, resulting in more reliable criteria weighting and reducing subjective bias. Furthermore, big data's ability to process information in real time allows for updated risk weights based on market, political, and technological dynamics, thus overcoming the limitations of a static AHP model. This integration also facilitates the consolidation of cross-functional data in a single structured evaluation model, resulting in a holistic and efficient risk mitigation strategy. Thus, the application of the AHP-big data framework provides a significant competitive advantage for financial institutions, as it not only improves the accuracy, objectivity, and effectiveness of decision-making but also strengthens the ability to anticipate potential crises and supports long-term performance sustainability.

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